Traditional Wisdom to Artificial Intelligence: Strategies for Sustainable Fashion and Textile Practices in India

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Abstract

The United Nations' agenda for Sustainable Development Goals (SDGs) seeks to protect the planet and reduce environmental impact. In recent times, sustainable practices in fashion and textiles have attracted considerable global attention due to their huge contribution to the waste generation system. Indian fashion and textile systems are extensive due to the abundance of locally available resources, diverse decentralized textile productions, handloom textile artisan skills, established manufacturing infrastructure, and enormous opportunities stemming from their emerging domestic market and young professionals. This research aims to identify and analyze the principal strategies explored by Indian enterprises in the domain of sustainable fashion and textiles in order to advance in this sector. The study seeks to understand the possibilities for Indian fashion and textile organizations of different sizes and formats to adapt sustainability.

The study involved a comprehensive study of 80 Indian business establishments that are implementing sustainable fashion and textile practices successfully. The sample included design houses, NGOs, online retailers, small-scale entrepreneurs, and leading Indian conglomerates like the Raymond's Group, Tata Group, Reliance, Birla Group, etc. The research entailed a close examination of sustainable strategies employed by fashion and textile companies as well as the possibilities explored by them. The research findings suggest that Indian enterprises are employing various strategies, from traditional wisdom to artificial intelligence, to support sustainability. Traditional craft practices, eco-friendly materials and processing, and green entrepreneurship are the most popular strategies used in the Indian scenario. Craft-culture preservation, handloom, and ethical practices for social impact are other successful strategies employed by a considerable percentage of enterprises. Large enterprises are using AI-supported technologies for optimization and efficient actions at various stages, whereas small and micro enterprises are relying

on green ethical practices and social impact. Energy efficiency, reduced carbon footprint, and circular economy have a small presence and require further action and training for real action. The study confirms the possibilities of new players to adapt to varied strategies in order to contribute to a sustainable future.

Keywords: Sustainable strategy, Indian fashion and textile organizations, traditional textile crafts, artificial intelligence for supply chain, sustainable material production

Introduction

The transition towards sustainable fashion is not just a temporary trend but a necessary step for the industry's future sustainability and progress. Niinimäki (2010) states that the focus is on the significance of eco-clothing in influencing consumer identity and ideology. The shift is supported by the research of Connolly and Prothero (2008), who argue that green consumption behaviors are gaining popularity as consumers become more aware of the environmental and social impacts of their purchasing decisions. Wahl (2016) explores sustainable solutions, emphasizing economic, social, institutional, and environmental interdependence within human society and the non-human environment. The industry's response to sustainability initiatives indicates a positive and encouraging direction. Arora (2023) highlights the increasing popularity of the sustainable apparel market in India, driven by rising consumer demand for eco-friendly fashion. It is essential to highlight that the ethical fashion market is experiencing significant growth worldwide, with predictions from industry experts indicating that this trend will persist in the coming years. "A New Textile Economy" by the Ellen MacArthur Foundation (2017) is in line with circular economy principles that focus on restoring and regenerating resources, ultimately benefiting companies, communities, and the ecosystem.

Recent research studies continue to shed light on the latest developments in sustainable fashion. A study conducted by Ciarli et al. (2021) covers the emerging trajectories and challenges of digital technologies for sustainable fashion. The study specifically explores the utilization of blockchain technology to enhance traceability and transparency in supply chains. A study by Tawiah et al. (2025) elaborates on the relationship between consumer behavior and sustainable fashion. They highlight the importance of raising consumer awareness and providing education to stimulate the demand for sustainable products. The studies highlight the complex challenges facing the fashion industry and emphasize the importance of ongoing research and innovation to address sustainability.

Furthermore, recent studies have surfaced, offering novel insights into sustainability within the fashion industry. A report published by Fashion Revolution (2023) emphasizes the increasing significance of transparency and traceability in the fashion supply chain. It urges brands to provide more details about their sourcing and manufacturing practices. The emphasis on transparency is widely recognized as essential for fostering consumer trust and encouraging ethical behavior throughout the industry.

The fashion supply chain can significantly benefit from the promising solutions provided by recent advancements in blockchain technology (Khanfar et al., 2021). Through thorough research and analysis, it is evident that blockchain technology has the potential to revolutionize the production process. By providing an unchangeable record of every stage, from sourcing raw materials to delivering the final product, blockchain ensures that all practices adhere to sustainability standards.

Many educators and research scholars are playing a crucial role in inspiring and guiding young designers to embrace sustainable practices. There is a growing recognition and appreciation for empathetic fashion, which indicates a change in design culture towards addressing social issues and enhancing the well-being of individuals (Armtrong and Niinimäki, 2014). Experts are exploring various concepts like zero-waste pattern cutting, natural dyeing and printing, hand stitching, recycling, upcycling, and handloom products as effective methods to enhance the sustainability of the fashion industry.

Academic settings are also delving into exploring the intersection between sustainability and technology. Universities and research institutions are actively incorporating sustainability into their curricula, fostering a culture of innovation among students to address the environmental challenges faced by the industry. A study conducted by Corbett, Dennehy and Carter (2023) sheds light on the significance of design education in driving sustainable practices. The study emphasizes the need to cultivate a new breed of designers who prioritize environmental and social responsibility.

The growing global sustainable market and India's emerging domestic and export market

Recent global market reports indicate that the ethical and sustainable fashion sector is undergoing significant expansion, driven by increased consumer awareness and policy shifts in favor of environmental responsibility. In 2023, the global ethical fashion market was valued at USD 9.81 billion and is anticipated to attain around USD 19.85 billion by 2030, exhibiting a compound annual growth rate (CAGR) of 10.2 percent (Statista, 2024; Business Research Company, 2024). This growth is propelled

by increased customer demand for sustainable, ethically manufactured clothing, more stringent environmental restrictions, and advancements in circular fashion methodologies. In India, the domestic clothing market was valued at USD 115.7 billion in 2024 and is anticipated to reach USD 171.6 billion by 2034, exhibiting a CAGR of almost 4 percent (Nandi, 2025). This ranks India among the foremost global fashion markets, with the potential to surpass the UK and Germany in scale. India's textile and apparel export sector is strong, with projections indicating exports could exceed USD 65 billion by 2026, bolstered by worldwide demand for sustainable textiles and government programs like PM-MITRA parks and PLI schemes for textiles (Invest India, 2024).

India plays a pivotal role in sustainable raw material production, contributing around 23–25 percent of world cotton output (Cotton Corporation of India, 2024). India is the second-largest producer of silk and a significant manufacturer of synthetic and recycled fibers (Ministry of Textiles, 2025). Innovative ecological materials like hemp, organic cotton, kala cotton, and recycled polyester are increasingly being embraced by startups and prominent textile manufacturers.

The Indian fashion and textile industry

India's fashion and textile industry holds immense promise, thanks to its pool of talented young professionals. There are numerous individuals and groups dedicated to promoting sustainability in different ways. India's fashion industry is making great strides in adopting sustainable practices through various innovative approaches. 11.11 Ka-Sha, Doodlage, Raw Mango, Bodice, Rustic Hue, and others are active in designing and selling apparel made with fair and ethical methods, such as giving factory workers safe working conditions, collaborating with handloom weavers and artisans to produce handcrafted goods, sourcing recycled or organic raw materials, and upcycling waste from post-production and post-consumer sources. Gautam Gupta specializes in creating hand-spun fabrics using unique and unconventional materials such as bananas, bamboo, and coffee beans (Khandual and Pradhan, 2018). On the other hand, "Pero Recycle" and "Pero Upcycle" labels are dedicated to promoting environmental conservation (Nanda, 2019). According to Lal (2020), brands such as Akira Ming and Yarn Glory have a total inclination to manufacturing organic clothing.

The eco-friendly clothing market in India is experiencing steady growth, as manufacturers are actively implementing practices to reduce their environmental footprint (Lal and Rahman, 2013). Raymond Group and Reliance Industries have

recently joined forces to introduce Ecovera, an eco-friendly fabric line. The Aditya Birla Group's Grasim has introduced Liva, a branded cellulose fiber. Sunil Sethi, the chairman of the Fashion Design Council of India, emphasizes India's rich heritage in sustainable practices, indicating that the country possessed inherent sustainability long before the rise of fast fashion disrupted traditional methods. He argues that, despite the perception that India is a latecomer to sustainability, the country has been implementing these practices long before the rise of fast fashion, as cited by Adhikary (2021).

A key model for India's sustainability drive is the integration of the handloom and craft sector into global fair-trade supply chains. This addresses the social, environmental, and economic pillars of sustainability, ensuring artisan livelihoods while promoting eco-friendly production. Organizations like SEWA, Okhai, Ethicus, and Antaran (Tata Trusts) are actively involved in connecting traditional handloom practices with modern ethical consumption trends (SEWA, n.d.; Okhai, n.d.; Ethicus, n.d.; Tata Trusts, n.d.). India's fashion-tech ecosystem is also evolving. Companies like Welspun (Indian Textile Journal, 2021) and ReshaMandi (Nainar, 2021) are using AI and blockchain for supply chain transparency. Virtual try-on technologies and AI-based demand forecasting reduce overproduction (Roy, 2024). Circular fashion models and upcycling initiatives by brands like Doodlage (Aggarwal, Singh and Krishna, 2024; Jain, 2020) and Paiwand Studio (Huggard and Choudhary, 2025) are promoting zero-waste strategies. India's young, digitally savvy consumers, combined with government policy support, are evolving sustainable fashion and textile possibilities and placing the country at the forefront of the global sustainable fashion movement.

This research was initiated to examine sustainable fashion and textile organizations in India and identify their key principal strategies for sustainability. The expected findings of this research will progress further for the creation of guidelines for sustainable fashion education.

Research Methodology

Research design

The study employed a qualitative research design, utilizing in-depth content analysis to systematically explore and interpret how fashion and textile organizations communicate their sustainability strategies and practices. The research focused on analyzing textual and visual content from the official websites, aiming to understand the representation of sustainability principles across different companies. The study

incorporated approaches to identify patterns, codes, and themes within the data. The research framework is grounded in thematic analysis underpinned by sustainability. Websites of fashion brands served as the primary data source, offering an accessible platform to assess how sustainability is framed in various contexts, leading to a comprehensive framework that organizations use to present their sustainability efforts, thus imparting valuable insights for consumers and the fashion industry. The research emphasized the messaging strategies, visual content, and transparency of claims related to ethical production, environmental impact, and corporate social responsibility.

The researcher opted for a deductive approach in framing initial codes based on existing literature on sustainability while inductively identifying new themes that emerged from the data. This study utilized a single-method research choice focusing exclusively on qualitative content analysis to explore the representation of sustainability. The choice was made to ensure an in-depth examination of textual and visual content without being constrained by quantitative metrics.

Time horizon

The research followed a cross-sectional time horizon, with data collected in a single period from April to September 2024. This time-frame allowed the researcher to capture the state of sustainability communications as they appear on websites during that period, without considering changes over time.

Sampling strategy

The study used purposive sampling, targeting websites of fashion and textile organizations that explicitly claim to follow sustainable practices. The research context is global but focused on companies that have a strong online presence and are transparent about their sustainability efforts. This sample includes brands based in various geographical locations in India, serving diverse markets but with a common goal of promoting eco-friendly practices. The study aims to capture the broad spectrum of sustainability approaches, from niche eco-friendly startups to large-scale businesses.

The criteria for selecting websites included the following:

- The organization must publicly promote sustainability as a core value.

- It must offer product lines or services that aim to reduce environmental or social harm.
- Organizations of different sizes and formats (e.g., small-to-medium, large enterprises and large online retailers, and NGOs) were included to ensure diversity.

The researchers acknowledge that the content available on these websites is curated by the brands themselves, potentially resulting in bias towards self-promotion. Reflexivity in the analysis process ensures that the researchers remain aware of this limitation, avoiding assumptions based solely on the brand's portrayal of its practices. This is counteracted by cross-referencing claims with certifications and industry standards wherever available.

A total of 78 organizations were considered, encompassing a range of companies from MSMEs to large enterprises of fashion and textile, manufacturers, design houses, NGOs, and large multinationals, as mentioned in Table 1. This sample size is considered sufficient to capture the variety of sustainability strategies across different business formats and sizes.

Table 1: Frequency of business formats selected for the study

Business Format	
Social enterprise (NGOs)	13
Fashion business	26
Textile business	5
Retail supply chain platform	12
Luxury fashion brand	6
Traditional craft-based apparel business	15
Export house	1
Total	**78**

The business formats selected for the study include the following:

- Social enterprise (NGOs): Organizations focused on social impact, often supporting artisans and promoting ethical, sustainable practices. A "not-for-profit" organization prioritizes social, environmental, or cultural impact over profit, with revenue reinvested to further these mission-driven goals.

- Fashion business: Engages in the design, production, and sale of apparel and accessories.
- Textile business: Specializes in manufacturing and supplying fabrics and materials for the fashion industry.
- Retail supply chain platform: Connects producers, suppliers, and consumers to streamline the sale of fashion goods.
- Luxury fashion brand: High-end label known for exclusive, premium-quality apparel and unique design.
- Traditional craft-based apparel business: Integrates traditional craftsmanship into fashion, preserving cultural techniques and skills.
- Export house: Large-scale producer and exporter of fashion and textile products to international markets.

The categorization of business size (Table 2) in this study adheres to the definition established by the Ministry of Micro, Small and Medium Enterprises, Government of India (MSME Development Act, 2006), and is supported by recent industry research (Ministry of Micro, Small & Medium Enterprises, 2006). Micro enterprises with investments of not more than INR 1 crore and less than 10 employees specialize in specialist markets like bespoke tailoring or textile crafts, allowing for agility and personalized services. Small enterprises with investments not exceeding INR 10 crore and 10 to 49 employees and they may offer locally or online with limited distribution and low production capability. Medium enterprises with investments of not more than INR 50 crore and 50–249 employees, serving national or regional markets with greater manufacturing facilities, distribution, or brand visibility. Large enterprises surpass these thresholds, with 250 or more employees with large manufacturing facilities, global supply chains, and diverse product lines.

Table 2: Frequency of business size selected for the study

Business Size	
Large	14
Medium	3
Small	25
Micro	36
Total	**78**

Research phases

The research was conducted in the following phases:

Phase 1:

Data collection (April 24 to September 2024): Websites were systematically reviewed, and relevant textual and visual content was extracted.

Data extraction: Textual content was manually extracted from the selected sections of websites, including homepages, sustainability pages, product descriptions, corporate social responsibility reports, and featured stories.

Phase 2:

The extracted content was categorized into spreadsheets and coded for analysis. The coding process was systematic, involving thematic categorization to ensure the reliability of findings across various websites. Data management and coding processes ensure the robustness of the thematic analysis. As the study is based on publicly available website data, there are no direct ethical concerns related to participant confidentiality. However, the researchers remained mindful of the limitations associated with using self-reported content from organizations.

Phase 3:

A thematic content analysis was applied to the coded data to identify recurring patterns and differences in how organizations communicate their sustainability efforts. Data were categorized into specific themes related to sustainability, such as ethical labour, environmental responsibility, product innovation, etc. Table 3 illustrates this process.

Open coding was first applied to extract themes directly from the data. Initial codes are based on existing literature on sustainability in various online platforms of the fashion and textile industry. Initial codes were created to identify recurring terms such as “eco-friendly,” “organic materials,” “fair trade,” “environmental impact,” etc. Essential tactics such as “material sourcing,” “ethical production,” “circular fashion,” and “supply chain transparency” were recognized.

Axial coding was done to relate categories to one another. The codes were grouped into larger categories, such as artisan development, eco-friendly production, and transparency in supply chains. Finally, selective coding was used to consolidate themes that emerged as central to the brands’ sustainability narratives. Selective coding represented the principal theme of core sustainable practices, which included all techniques employed by sustainable fashion enterprises.

Table 3: Coding table

S.No.	Open coding	Axial coding	Selective coding
1.	"Transparent system from farm to finished garments" "AI combined with IoT ensures the quality and traceability" "Global Organic Textile Standard (GOTS)"	Traceability and certification	AI and technology for optimization
2.	"Circular business model" "100 percent zero leftovers" "Circular model of business"	Circular business models	Circular economy
3.	"Closed-loop production system" "Ethical production and wages"	Circular economy	Circular economy
4.	"Quality of life of craftsmen" "Local artisan training" "Supporting rural and local economies" "Cluster Development" "Supporting underprivileged women artisans" "Artisan upliftment for social Impact" "Decentralized craft production"	Artisan development	Decentralized system and artisan upliftment
5.	"Handloom weavers" "Handcrafted" "Handspun" "Upliftment of handloom" "Khadi handloom"	Handloom Handmade Khadi	Handloom and Khadi for sustainability
6.	"Revive old textiles" "Improved efficiency in craft space" "Heirloom and traditional weaves" "Preserving the craft"	Craft preservation Cultural heritage	Craft for cultural preservation
7.	"Natural dyes" "Handprint with natural dyes" "Eco-friendly dyes"	Eco-friendly material and processing Natural dyes Handprint	Eco-friendly material and processing
8.	"Focus on longevity and quality" "Social development" "Sustainable sourcing" "Green ethics reduce environmental impact" "Collaborate" "Product for a social cause" "Focus on inclusivity" "Eco-friendly garments and accessories" "Jewelry with recycling"	Sustainable business models Green entrepreneurship Sustainable products	Green entrepreneurship for sustainability

9.	"Minimize water usage during the textile manufacturing process" "Production as per sustainability standards" "Optimize material usage and minimize waste" "Transparent and ethical production" "Reducing unnecessary production"	Eco-friendly material and processing Sustainable production approach Ethical manufacturing	Sustainable production approach
10.	"Eco-friendly fibers and fabrics" "Organic cotton, hemp, and linen" "Kala cotton, indigenous cotton" "Eri silk, tasar silk, linen, wool" "Eco Tencel, Econyl" "Recycled polyester" "Natural products" "Sustainable farming" "Sustainable raw material"	Eco-friendly fiber Material innovation	Eco-friendly material and processing
11.	"Reducing the carbon footprint" "Monitor energy consumption: farm to retail" "Reducing unnecessary production" "Energy-efficient technologies in production" "Carbon negative" "Minimize water usage"	Energy-efficient carbon footprint reduction	Energy-efficient carbon footprint reduction
12.	"Livelihood for indigent women", "Work for social welfare" "Fair-trade and ethical wages" "Social development"	Fair wages Livelihood generation	Ethical practices for social impact
13.	"Recycle plastic waste" "Upcycle post-production fabrics" "Reduce fabric waste" "Zero waste methods" "Fabric scraps into new products" "Recycle plastic waste" "Yarn upcycling" "Reduce returns and waste"	Reduce Reuse Recycle Repurpose	Reduce - Reuse - Recycle - Repurpose
14.	"Long-lasting fashion and textiles" "Seasonless and slow fashion"	Slow and seasonless fashion and textiles	Slow and seasonless fashion

15.	"Storytelling to celebrate multi-layered cultures and ever-changing social conversations" "Conscious consumerism" "Educating individuals and organizations" "Promote handmade" "Encouraging customers to make informed choices" "Transparent information for customers" "Eco-conscious choices" "Creating awareness for pollution"	Conscious consumerism Customer education Creating awareness for sustainability	Consumer awareness
16.	"AI-powered" "AI optimizes logistics" "Optimizing material usage" "AI predicts customer demand accurately, reducing overproduction" "Virtual try-ons" "AI-driven systems to optimize inventory" "Prevent overstocking" "Predictive analytics" "AI-driven processes optimize water usage in production" "AI-based manufacturing processes" "Virtual product visualization"	AI for forecasting AI for inventory management AI for production optimization AI for customer demand AI for virtual visualization	AI and technology for optimization
17.	"AI supply chain optimization" "AI to manage organic cotton supplies" "Blockchain tracks, enhances transparency" "Blockchain ensures traceability" "Blockchain tracks from farm to retail"	AI for supply chain optimization Blockchain and transparency	AI and technology for optimization
18.	"AI for natural dye optimization"	AI for material usage	AI and technology for optimization
19.	"AI minimizes water usage" "AI to measure and report on water and energy usage"	AI for water and energy	AI and technology for optimization

Results and Discussion

The data analysis and interpretation, which aligned with the research objectives, utilized thematic analysis to examine the strategies employed by Indian fashion and textile organizations to achieve sustainability. The 13 themes identified illustrate the principal strategies employed by sustainable fashion and textile organizations in India (Figure 1).

Figure 1: Principal sustainable strategies
Source: Nandini Lal

Green entrepreneurship for sustainability

Green entrepreneurship is an overarching theme that encompasses all unique ideas for sustainable practices. It includes various approaches to reduce environmental impact, green ethics, self-employed women, sustainable sourcing, collaboration, products for a social cause, a focus on inclusivity, size inclusivity, eco-friendly outcomes with recycling, etc. For example, The Terra Tribe is a small green enterprise that promotes plant-based, PETA-approved clothing made from sustainable materials. The company fosters an environmentally conscious business model by focusing on vegan, eco-friendly materials

and ethical practices. Suta is another example of an Indian fashion brand that engages in green entrepreneurship by integrating sustainability into every aspect of their business, from material sourcing to packaging.

Sustainable production approach

Natural dyeing processes are gaining popularity as a sustainable alternative to chemical dyes. Brands like Kriti Tula, Ashita Singhal, and Tilla use natural dyes sourced from plants, minerals, and insects. Larger manufacturers like Arvind Limited have successfully adopted eco-friendly methods of textile processing, such as waterless dyeing and recycled water systems. Sustainable practices are also seen in production approaches like zero-waste pattern-making, fabric scrap recycling, and upcycling to reduce waste. Designing strategies to reduce wastage, pollution, and energy consumption is a key component. The brand, Fabindia, follows a sustainable production approach by collaborating with artisans who use organic and natural fibers. Fabindia's production methods focus on minimizing environmental impact, ensuring that their entire process from raw material sourcing to finished products aligns with sustainable principles.

Energy-efficient carbon footprint reduction

Energy efficiency and carbon footprint reduction are crucial for reducing the environmental impact of the fashion and textile industry. Organizations achieve their goals by using energy-efficient technologies and renewable energy sources and optimizing manufacturing processes to reduce emissions. Textile manufacturer Welspun India has implemented AI for energy management in its factories, significantly reducing its carbon footprint. Welspun's energy-efficient practices and focus on low-impact dyes are geared toward minimizing the carbon emissions associated with textile production.

Decentralized system and artisan upliftment

India's decentralized textile craft system is integral to sustainable practices. Many Indian fashion brands, such as Raw Mango and Anokhi, collaborate with local artisans to preserve these traditional crafts while promoting sustainability. Decentralized systems bring production closer to rural and artisan communities, supporting local economies and reducing the environmental impact. The upliftment of artisans entails training and support to sustain their livelihoods. Brand Okhai empowers rural women artisans by providing training, fair wages, and a platform to sell their handcrafted products. This

decentralized model supports artisan communities and enhances their quality of life by promoting sustainable employment.

Handloom and Khadi for sustainability

Handloom and Khadi production methods are inherently sustainable due to their low energy consumption, minimal environmental impact, and reliance on natural fibers. Khadi, which is hand-spun and handwoven, supports a sustainable and slow production process that uses no electricity. The Khadi Cult promotes khadi as a sustainable fabric that requires minimal resources for production.

Craft for cultural preservation

The use of traditional crafts not only promotes sustainability but also preserves cultural heritage. By valuing traditional crafts, companies can keep indigenous knowledge alive, support artisans, and connect consumers with cultural history through fashion and textiles. Qasab, Khamir, and many other NGOs work with the nomadic tribes of Gujarat to create handloom and embroidered products that reflect the region's cultural heritage. This initiative preserves heritage crafts and techniques while promoting sustainable fashion.

Circular economy

The concept of circularity is gaining traction in India, where companies focus on designing products that have longer life cycles and can be recycled, repaired, or repurposed. Circular fashion models discuss the afterlife; brands are creating take-back programs or repair services to prolong the life cycle. The circular economy in fashion promotes a "closed loop" with minimum energy leakage and harmful byproducts. Doodlage is a leading brand in circular fashion, specializing in upcycling industrial waste and post-consumer materials to create unique garments.

Eco-friendly material and processing

Indian textile companies are increasingly adopting sustainable materials. Organic cotton, grown without synthetic pesticides or fertilizers, has become particularly popular due to its lower environmental impact compared to conventional cotton. Brands like No Nasties and Ethicus emphasize the use of certified organic cotton and natural fibers in their collections. Eco-friendly materials, sustainable dyes, and environmentally friendly processing methods minimize pollution and environmental impact.

Ethical practices for social impact

Fair wages, livelihood generation, and ethical labor practices in safe conditions are a cornerstone of sustainability in the Indian textile industry. Fairtrade India is a prominent certification that ensures these practices; the ethical approach focuses on fair labor practices, fair wages, safe working conditions, and social welfare for workers. This approach promotes social equity and ethical treatment within the supply chain. SEWA (Self-Employed Women's Association) empowers rural women by providing fair-trade wages, safe working conditions, and training.

4 R's for waste reduction

The 4 R's approach minimizes waste by reducing it, reusing materials, repurposing discarded items, and recycling whenever possible. These 4 R's are part of indigenous traditional practices (Singh and Rani, 2021). The brand "I Was a Sari" repurposes old saris into new fashion items, turning waste into valuable products. 11.11/eleven (n.d.) focuses on creating garments with zero-waste patterns, while Upasana implements social initiatives that repurpose fabric waste into useful products. The 4 R's and waste reduction efforts also encompass the recycling of post-consumer textiles. Companies like Goonj collect old clothes and textiles, transforming them into products such as bags, mats, and garments for underserved communities.

Consumer awareness

Many Indian brands are focusing on consumer education to promote sustainable fashion choices. Tula and Satva, for instance, educate customers about the benefits of organic cotton and sustainable living through their marketing campaigns. Consumer awareness involves educating customers about sustainable practices and empowering them to make informed, eco-conscious choices. By raising awareness, companies encourage responsible consumption. The brand "No Nasties" uses transparent labeling and educational content to inform consumers about the environmental and social impacts of their choices. This approach promotes conscious consumerism and responsible purchasing.

AI and technology for optimization

Transparency and traceability are key aspects of sustainable supply chain management in India. Companies like Good Earth and Fabindia have implemented blockchain

technology and IoT (Internet of Things) to ensure that their supply chains are transparent, enabling consumers to track the origin and production journey of the garments. Sustainable sourcing practices, including working with certified suppliers of organic or fair-trade fabrics, help ensure that the supply chain is ethically and environmentally responsible. AI and advanced technologies optimize production and inventory, reducing resource usage and minimizing waste. As collated in Table 4 and Figure 2, various Indian companies are using AI and technology to boost sustainability through optimization and waste reduction. AI aids in demand forecasting, minimizes overproduction, and enhances logistics. Technologies facilitate transparency and traceability, thereby ensuring responsibility and trust. Virtual visualization, prototyping, and try-ons are saving ample time and resources and making the process more efficient.

Table 4: The use of technology to boost sustainability

Technology	**Company Name**	**Sustainability Impact**
AI for demand forecasting (predictive analytics)	Raymond Ltd.	Reduced overproduction
AI for water/energy management	Arvind Ltd.	Minimized water and energy use
Blockchain for supply chain	ReshaMandi	Ethical sourcing and traceability
Virtual try-ons	Tata CliQ, Zivame	Reduced returns and lower carbon footprint
AI for waste reduction	Doodlage	Upcycling and fabric waste minimization
On-demand production	InkXE, Aks Clothing	Lower inventory and waste
AI for quality control	Welspun India	Reduction of defects and material saving
AI in sustainable farming	BOHECO	Eco-friendly raw material sourcing
Virtual sampling	ABFRL Ltd.	Less waste in sampling and prototyping
AI in circular fashion	Paiwand Studio	Textile waste, reuse and circular design

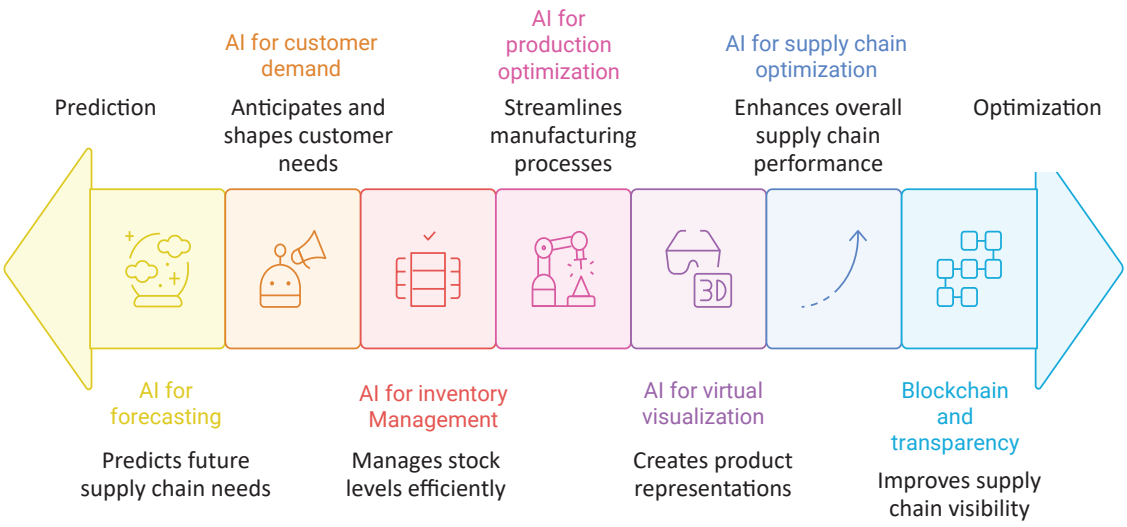

Figure 2: AI's role in supply chain, from prediction to optimization
Source: Nandini Lal

Slow and seasonless fashion

Slow and seasonless fashion counters the fast fashion model by focusing on quality, timeless design, and longevity. Slow fashion encourages consumers to buy fewer, high-quality items that last longer, reducing discarded clothing and promoting resource efficiency. Together, these approaches foster mindful consumption, encouraging consumers to keep items for extended periods. Brand 11.11/Eleven Eleven exemplifies slow and seasonless fashion by promoting emotional attachment to its garments and using traditional Indian textiles and craftsmanship. Designer brand Raw Mango also follows a seasonless model, creating collections that remain relevant year-round. By embracing these principles, brands contribute to a more sustainable fashion industry, emphasizing slow fashion and a lower environmental footprint. New brands for saris, like Suta and Taniera, are promoting timeless handloom products and believing in traditional wisdom.

Analysis

Many organizations are using multiple strategies to implement sustainability. Brands like Upasana and Tula are leading organizations using most of these strategies. Among large enterprises, "sustainable production approach" and "eco-friendly material and processing" are the most preferred strategies. Within small to medium organizations, where 80 percent were fashion brands, "craft for cultural preservation" is the most popular one. To determine the most popular strategy among different sizes and formats of business, frequency analysis methods were used.

Frequency analysis for preferred strategies in sustainability practices

To identify the most prevalent sustainability strategies adopted by Indian fashion and textile organizations, a frequency analysis was conducted on the data extracted from official websites. This analysis revealed that numerous sustainable fashion and textile organizations are implementing sustainable practices at various operational stages. Strategies with the highest frequency of occurrence were deemed the most favored ones, reflecting their widespread adoption across the industry. Figure 3 denotes the overall analysis, including all the sizes and formats of businesses, and shows that "eco-friendly materials and processes," "sustainable production approach," and "green entrepreneurship" are the three most preferred strategies.

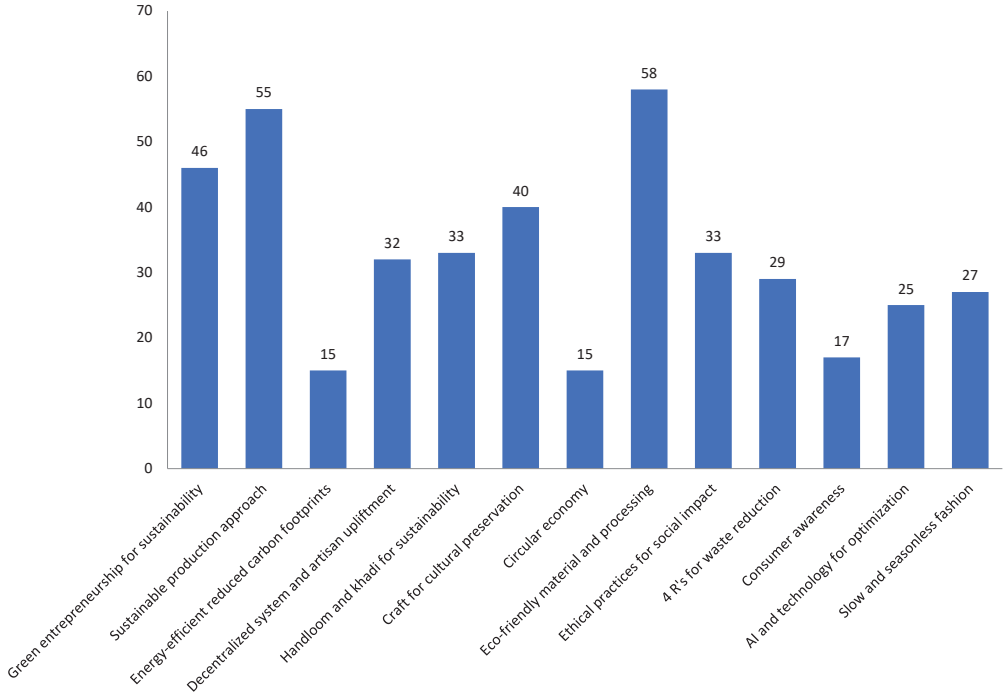

Figure 3: Frequency analysis for preferred sustainable strategies

Furthermore, a comparative frequency analysis of these strategies categorized by business size (Figure 4) and format (Figure 5) provides deeper insights to understand the potential of diverse sustainable strategies and their feasibility in the Indian context. It's important to understand how this strategy works with various businesses.

In large enterprises, the most favored strategy is "AI and technology for resource optimization," followed by "sustainable production approaches" and "eco-friendly materials and processes," which are also popular. In medium businesses, "sustainable production approach," "decentralized system for artisan upliftment," and "waste

reduction through 4 R's are popular. Small-sized businesses utilize eco-friendly materials to promote sustainability. Many micro-enterprises are emerging with the overall theme of "green entrepreneurship."

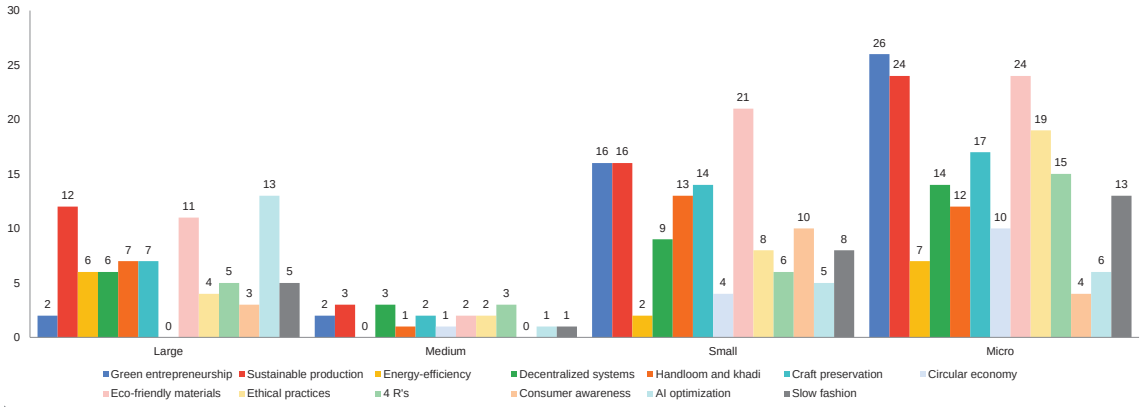

Figure 4: Comparative frequency analysis of sustainable strategies employed by different sizes of enterprises

While comparing different business formats (Figure 5), social enterprises are employing ethical practices for social impact. Sustainable production processes are followed by all businesses. Primarily, textile businesses are emphasizing energy efficiency and reducing their carbon footprint, while other types of businesses are not prioritizing these measures. Social enterprises, retail supply chain platforms, and traditional craft-based apparel businesses are able to implement decentralized systems and artisan upliftment.

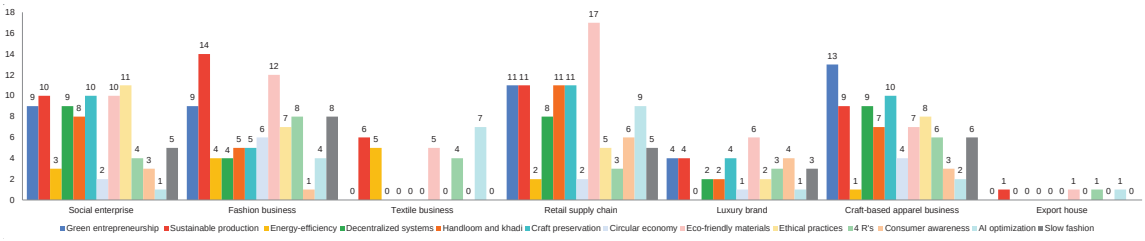

Figure 5: Comparative frequency analysis of sustainable strategies employed by different format of enterprises

Conclusion

Environmental concern, cultural preservation, and social impact are popular elements in Indian sustainable fashion and textile practices. This research shows a multi-dimensional resolution driven by green entrepreneurship, ethical production models, AI innovation, and the revival of handloom and khadi. The thirteen themes show a

rising ecosystem that emphasizes sustainability, artisan empowerment, and consumer awareness. On one hand, grassroots social organizations like SEWA empower rural women, and on the other, high-tech firms like Welspun and Arvind Limited optimize production with AI. Each of these contributes to sustainability for the Indian businesses.

It is important to revive traditional crafts and decentralized production methods to establish supply chain resilience, maintain cultural identity, and assure equal economic participation, not to romanticize but as a strategic path. The rise of conscious fashion brands and eco-labels indicates a shift in consumer behavior and hence gradual systemic transformation. The Indian fashion and textile industry can benefit by integrating traditional wisdom, AI technology, and inclusive growth strategies for sustainable businesses. However, enabling an environment through supportive policies, well-prepared academia, and consistent consumer awareness is mandatory for this shift to succeed.

The current analysis suggests that different sizes and formats of businesses are adopting different approaches to increase and accelerate the sustainable fashion and textile sector's growth and transformation. Favorable policies, tax incentives, subsidies, green certification, etc., can further support the industries. And these can be more strategically defined based on the size and format of the business. Varied approaches are required to introduce artisan clusters, cooperatives, and local manufacturing hubs into national textile missions to promote decentralized models. Artisans and craftsmen should be trained for sustainable design and supported with appropriate new-age technology to facilitate the development of a better product and the marketing of the same. Further channels and systems should be established for energy-efficient and circular economy facilities to manage textile waste locally. These strategies would require government support and trained professionals.

Knowledge of eco-friendly material, sustainable production methods, life cycle analysis, circularity, energy- and water-efficient processes, and ethical ways of production must be introduced in the curricula for fashion and textile design education. Young professionals should be trained to adapt tech-driven optimization and increase AI, blockchain, and IoT usage for transparent supply chains, predictive production, and waste reduction. Green startups should be encouraged through funding for green entrepreneurship that uses upcycling, plant-based textiles, waste reduction, and circularity. By executing and attaining these objectives, India may realize its sustainability aspirations and establish itself as a global leader in ethical, inclusive, and environmentally sustainable fashion systems.

References

11.11/eleven eleven, n.d. *About us*. [online] Available at: <https://11-11.in/pages/about-us> [Accessed 19 September 2025].

Adhikary, S., 2021. Break for sustainable fashion in India on the horizon as pollution, wastage concerns rise. *The New Indian Express.* [online] Available at: <https://www.newindianexpress.com/magazine/2021/jan/03/break-for-sustainable-fashion-in-india-on-the-horizon-as-pollution-wastage-concerns-rise-2243759.html> [Accessed 16 September 2021].

Aggarwal, R., Singh, H. and Krishna, V., 2024. Doodlage: contributing to circular economy in fashion. *The CASE Journal*, [e-journal] *20*(3), pp.747-766. https://doi.org/10.1108/TCJ-05-2023-0117.

Armtrong, C. and Niinimäki, K., 2014. *Empathic fashion product-service systems for sustainable development*. In Proceedings of the Global Fashion Conference, 19-21 November, pp.19-21.

Arora, N., 2023. Shifting consumers' mindset towards the growth of sustainable fashion practices in India. *International Journal of Sustainable Fashion & Textiles*, [e-journal] 2(1), pp.9-27. https://doi.org/10.1386/sft_00018_1.

Business Research Company, 2024. Ethical *fashion global market report 2024*. [online] Available at: <https://www.thebusinessresearchcompany.com/report/ethical-food-global-market-report> [Accessed 28 August 2025].

Ciarli, T., Kenney, M., Massini, S. and Piscitello, L., 2021. Digital technologies, innovation, and skills: Emerging trajectories and challenges. *Research Policy*, *50*(7), p.104289. https://doi.org/10.1016/j.respol.2021.104289.

Connolly, J. and Prothero, A., 2008. Green consumption: Life-politics, risk and contradictions. *Journal of Consumer Culture,* [e-journal] 8(1), pp.117–145. https://doi.org/10.1177/1469540507086422.

Corbett, J., Dennehy, D. and Carter, L., 2023. Introduction to the special section: digital innovation for social development and environmental action. *Communications of the Association for Information Systems*, 53(1), pp.22-41.

Cotton Corporation of India, 2024. *Annual report 2023-24*. [pdf] Available at: <https://cotcorp.websteptech.co.uk/storage/Annualreports/Annualreports_687e0599ca0a9.pdf> [Accessed: 19 September 2025].

Ellen MacArthur Foundation, 2017. *A new textiles economy: redesigning fashion's future*. [online] Ellen MacArthur Foundation. Available at: <https://www.ellenmacarthurfoundation.org/a-new-textiles-economy> [Accessed 29 August 2025].

Ethicus, n.d. *About us*. [online] Available at: <https://www.ethicus.in/pages/about-us> [Accessed 17 September 2025].

Fashion Revolution, 2023. *Fashion transparency index 2023: how transparent are 250 of the world's largest fashion brands?* [online] Fashion Revolution. Available at: <https://www.fashionrevolution.org/fashion-transparency-index/> [Accessed 19 September 2025].

Huggard, E. and Choudhary, P., 2025. Decolonizing fashion brand sustainability narratives, In: Huggard, E., (ed.) *Creating Responsible and inclusive fashion brand narratives: theory and practice*. 1st ed. London: Routledge.

Indian Textile Journal, 2021. Welspun India launches wel-trak 2.0 blockchain, *Indian Textile Journal*, [online] Available at: <https://indiantextilejournal.com/welspun-india-launches-wel-trak-2-0-blockchain-4/> [Accessed 19 September 2024].

Invest India, 2024. *Textiles and apparel*. [online] Invest India. Available at: <https://www.investindia.gov.in/sector/textiles-apparel> [Accessed 17 September 2025].

Jain, S., 2020. Doodlage: reinventing fashion via sustainable design. In *Sustainability in the Textile and Apparel Industries: Sustainable Textiles, Clothing Design and Repurposing,* Cham: Springer International Publishing, pp. 241-261.

Khandual, A. and Pradhan, S., 2018. Fashion brands and consumers approach towards sustainable fashion. In: Muthu, S. (eds) *Fast fashion, fashion brands and sustainable consumption. Textile* Science and Clothing Technology. Springer, Singapore. (pp. 37-54).

Khanfar, A.A.A., Iranmanesh, M., Ghobakhloo, M., Senali, M.G. and Fathi, M., 2021. Applications of blockchain technology in sustainable manufacturing and supply chain management: a systematic review. *Sustainability*, [e-journal] 13(14), p.7870. https://doi.org/10.3390/su13147870.

Lal, N., 2020. India embraces sustainable fashion. [online] *Nikkei Asia*. Available at: <https://asia.nikkei.com/Life-Arts/Life/India-embraces-sustainable-fashion> [Accessed 18 June 2021].

Lal, R. and Rahman, Z.T., 2013. An analytical study of building green fashion and lifestyle brand with satisfaction based segmentation. *Anusandhanika*, 5(1), pp.6-15.

Liva, 2025. *Liva by birla cellulose: Liva's sustainable fibres embrace style with sustainability*. [online] Available at: <https://www.livabybirlacellulose.com/> [Accessed 19 September 2025].

Ministry of Micro, Small & Medium Enterprises, 2006. *The Micro, Small and Medium Enterprises Development Act, 2006. No. 27 of 2006*. (India). [pdf] Available at: https://www.indiacode.nic.in/handle/123456789/2013/3/A2006-27.pdf [Accessed 28 October 2025].

Ministry of Textiles, 2025. *The magic of Indian silk: from sericulture to masterpiece*. Press Information Bureau (Research Unit), 11 April. Available at: <https://static.pib.gov.in/WriteReadData/specificdocs/documents/2025/apr/doc2025411538801.pdf> (Accessed 28 September 2025).

Nainar, N., 2021. How technology weaves a stronger silk supply chain, *The Hindu*, [online] 22 June. Available at: <https://www.thehindu.com/sci-tech/agriculture/silk-agritech-startup-reshamandi-streamlines-production-from-farm-to-store/article34908586.ece> [Accessed 19 September 2025].

Nanda, T.S., 2019. From opulence to sustainability, Indian fashion gets redesigned. *The Wire Science*, [online]. Available at: <https://science.thewire.in/culture/from-opulence-to-sustainability-indian-fashion-gets-redesigned/> [Accessed 10 October 2025].

Nandi, P., 2025. *India apparel market size, share forecast 2034 – India market forecast till 2034.* Market Research Future, [online] Available at: <https://www.marketresearchfuture.com/reports/india-apparel-market-21788> [Accessed 29 August 2025].

Niinimäki, K., 2010. Eco-clothing, consumer identity, and ideology. *Sustainable Development,* [e-journal] 18(3), pp.150-162. https://doi.org/10.1002/sd.455.

Okhai, n.d. *About us*. [online] Available at: <https://okhai.org/pages/about-us?srsltid=AfmBOorKVHrXQojxFdy6YvRGaKeKQQydRHYh2gFEk9fNlBzKmSiO6iNa> [Accessed 17 September 2025].

Roy, A., 2024. Fashion innovation driven by AI: transforming design, manufacturing, and customer experience. *Applied IT & Engineering*, *2*(1), pp.1-8.

SEWA, n.d. *Self employed women's association*. [online] Available at: <https://www.sewa.org/> [Accessed 17 September 2025].

Singh, S. and Rani, J., 2021. Traditional Indian textile techniques used to upcycle and recycle textile waste. *Textile & Leather Review,*[e-journal] 4, pp.336-353. https://doi.org/10.31881/TLR.2021.29.

Statista, 2024. Ethical fashion market size worldwide 2023–2030. [online] Available at: <https://www.statista.com/outlook/emo/fashion/worldwide> [Accessed 29 August 2025]

Tata Trusts, (n.d.) *Antaran: Transforming crafts*. [online] Available at: <https://www.tatatrusts.org/topics/antaran> [Accessed 17 September 2025].

Tawiah, B., Cho, E., Ofori, E.A., Suh, M. and Fei, B., 2025. Sustainable fashion transition towards net-zero future: A review of digital and material innovations, policies and regulatory framework. *Sustainable Futures*, [e-journal] 10, p.101162. https://doi.org/10.1016/j.sftr.2025.101162.

United Nations, 2015. Transforming our world: the 2030 agenda for sustainable development. [online] Available at: <https://sdgs.un.org/2030agenda> [Accessed 19 September 2025].

Wahl, D.C., 2016. *Designing regenerative cultures*. Axminster: Triarchy Press

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