Sustainable & Eco-friendly textiles: A comprehensive analysis of consumer behavior, dye sustainability, upcycling, and circular fashion in India

Ananya Shukla

Assistant Professor, Department of BFA, SD College of Management Studies, Muzaffarnagar, Uttar Pradesh, India

Corresponding Author: Ananya Shukla

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Abstract

The textile sector is one of the highest polluters around the world, accounting for nearly 10% of the carbon emissions worldwide and more than 92 million tonnes of textile waste each year. The transition to sustainability is not just an environmental imperative but also an economic opportunity in India, where textile practices are intertwined with cultural and economic fabric. This paper explores four interlinked aspects of sustainable textiles in India: awareness of the consumers about sustainable fashion, environmental impacts of natural and synthetic dyes, upcycling as a waste reduction strategy and overview of the role of circular fashion in increasing sustainability in textiles. Survey data was gathered from 320 respondents in both urban and semi-urban areas of India, and secondary data gathered from industry reports, government publications and academic literature. The results show that there is growing awareness of sustainable fashion, especially among younger consumers, but not enough consumers have actually adopted the label as it is difficult to access, costly and they do not have enough information. Natural dyes have environmental benefits, but are limited in scale and commercial availability. Upcycling offers possibilities in waste reduction and micro entrepreneurism, while circular fashion offers great potential for systemic industry change in the long term. The study finally presents the recommendations for policy makers, industry stakeholders and consumers to ensure sustainable textile ecosystem in India.

Keywords: Sustainable textile, Circular fashion, Natural dyes, Upcycling, Eco-friendly fashion, India

1. Introduction

There is hardly a single industry with such a huge social, cultural, and economic impact as textiles- and few industries with an equal massive environmental footprint. Fashion and textile industry in the world generates greater carbon emission than international aviation and maritime shipping together [13]. This tension is especially acute in India. The nation is the second-largest textile exporter in the world and the sector contributes approximately 2.3% to the national GDP and employs more than 45 million individuals directly [1]. However Indian rivers such as the Noyyal and Bandi still remain world leaders in chemical contamination, much of which is due to dyeing and finishing effluents of textile clusters in Tamil Nadu and Rajasthan [2].

Ironically, one of the richest traditions of sustainable textile practices in the world is also found in India-handloom weaving, vegetable dyeing, natural fibre growing, and upcycling through crafts. The 21 st century is not about creating a new form of sustainability but about expanding and modernising what has always been there [11]. The paper will discuss that challenge using four analytical lenses, namely consumer behaviour and market adoption; dye chemistry and environmental impact; upcycling as a circular intervention; and the structural potential of circular fashion models.

The fast fashion system around the globe has radically shortened the lifespan of garments and intensified throughput volumes, generating accumulating environmental and social costs [14]. The general aim of this study is to present a comprehensive but still grounded analysis of the position of India in the shift to sustainable textiles, and what specific obstacles and facilitators exist within these four dimensions. It is hoped that the results will be of value to fashion brands, policymakers, sustainability practitioners, and academic researchers in general.

2. Materials and Methods

The research design adopted in this study is a mixed-methods research design which involves the combination of survey-based numbers with a review of secondary information. A total of 320 participants from five cities in India Delhi, Mumbai, Jaipur, Bengaluru and Lucknow were asked to complete a questionnaire during October-December 2025. We selected these individuals based on age groups, such as 18 to 25 years old, 26 to 35 years old, 36 to 50 years old and those who are above 50 years. We also took into consideration their gender and the amount of money they earn every month. We questioned how people know about some brands when they are willing to pay more to have clothes that are made in a way that

is good to the environment in case they know about natural dyes and clothes created out of old things and what they think about circular fashion. We also looked at already existing information, such as the text about the waste of the textile factories in the Annual Report 2022-23 of the Ministry of Textiles, and the text about how the textile factories make their waste less damaging in the Central Pollution Control Board and information in the Ellen MacArthur Foundation about making fashion more circular. We have read articles in such journals as the Journal of Cleaner Production, Resources, Conservation and Recycling and Nature Reviews Earth and Environment. Using the data on the studies, which examined the life cycle of these dyes between 2015 and 2024, we compared the effects of the natural and synthetic dyes on the environment. To examine the figures of our survey, we used a computer program called SPSS v26. We employed statistics, special tests to determine whether things are associated and scores, on a special scale known as the Likert scale. Thematic analysis, which was invented by Braun and Clarke [10], is the special way of analyzing that we use on the information that is not numbers such as the answers to open-ended questions and what we read in books and articles.

3. Results

3.1 Consumer awareness and adoption of sustainable fashion in India

Out of 320 individuals who participated in the survey 74.7% of them have heard about sustainable fashion. It is only through the aid of 31.2% that it can be defined correctly without any help. This difference between knowing the word and knowing it indicates that sustainable fashion is much discussed, on social media. People don't really get what it means. As respondents were questioned about their clothing purchase, only 18.4% of the respondents said they had selected a brand because it was sustainable. Most people said they cared about price (61.3%) design (52.1%) brand reputation (34.7%) and comfort (29.6%). Interestingly 43% of the people ranked impact as the last. This indicates that despite the fact that people claim they are concerned about sustainability but they still consider aspects when purchasing clothes. The factors that influence sustainable purchasing behavior are age and income. Individuals between the ages of 18-25 who have a household income exceeding INR 60,000 are more likely to purchase sustainable clothes (41.6%). They also are more inclined to subscribe to sustainability-focused content creators and utilize second-hand clothing exchanges or rentals. The less likely to adopt sustainable purchasing behavior are on the hand people older than 36 with a lower income (less than INR 30,000). Lack of familiarity with brands and lack of access to retail outlets are considered by them to be the biggest obstacles. A chi-square test was conducted and there was a significant relationship between education level and sustainable purchasing behavior. This implies that awareness campaigns in schools and colleges can help. Majority (68.4%) of the people are in agreement that fashion brands ought to be environmentally responsible. However 22.5% are willing to pay more than 15% above market price for a certified sustainable garment. The disconnect between declaring that sustainability is important and being willing to pay a price is a well-known problem, in sustainability economics.

3.2 Comparison between natural dyes and synthetic dyes: Environmental impact analysis

The dyeing industry in India works with around 3.8 billion metres of fabric each year. synthetic dyes accounting for roughly 85% of all dyes used. These synthetic dyes are used about 85% of the time. The synthetic dyes are mostly azo dyes, synthetic dyes, reactive dyes and vat dyes. These dyes are made from petroleum products. People like these dyes because they are bright, reliable and can be made in quantities. These dyes are very bad for the environment.

It is said that the dyeing process of textiles causes 17 to 20 percent of industrial water pollution in the world. This is because the synthetic dye molecules do not break down easily in water. They are a threat to the environment.

The dyeing industry in India uses dyes like azo dyes, synthetic dyes, reactive dyes and vat dyes.

When we make one kilogram of dye it produces a lot of bad things. It makes between 10 and 15 kg of CO2 equivalent. It also needs 150 litres of water. The water that is left over after the dyeing process has a lot of chemicals in it. This is much more than what's allowed.

Some of the dyes like azo dyes break down into bad things that can cause cancer. These bad things can harm the health of workers and people who live near the dyeing factories.

There are also dyes that come from plants, minerals and insects. These natural dyes are better for the environment. They come in colours like indigo, red, yellow and black. The good thing about dyes is that they break down easily and do not leave behind bad things. Studies have shown that the water left over after using dyes has much less bad chemicals in it.

However natural dyes also have some problems. To fix the dye to the fabric we need to use salts like alum, iron or copper. If we are not careful these metallic salts can get into the water. Cause harm. Also growing plants for dyes can take away land and water that could be used for food.

Another problem is that natural dyes are not easy to make in quantities. In India we can only grow an amount of natural dye plants. This is not enough to replace the dyes.

With these problems people are becoming more interested in natural dyes. Some groups in India are being helped by the government to learn about dyes. They are also getting help to sell their dyes to other countries.

To make natural dyes better we need to come up with ways of doing things. We can use enzymes to help fix the dye to the fabric. We can also reuse the water to make the process more environmentally friendly and cheaper.

3.3 Upcycling in fashion: Waste reduction in the textile industry

According to the estimates, Indian textile industry produces approximately 7.6 million tonnes of fabric waste every year,

out of which less than 10% is officially recycled or repurposed [8]. Most of them are disposed of in landfills or burnt, leading to soil pollution and greenhouse gas emissions. The practice of upcycling, known as creative reuse, is a response to this issue that is both tangible and can be deployed in the short term [12].

In contrast to recycling which usually implies mechanical or chemical degradation of the materials leading to the production of lower-quality products, upcycling does not decrease the material value of the textiles but adds creative and economical value [12]. In the Indian context, the upcycling process has strong cultural roots: the tradition of the so-called kantha in West Bengal, where the women stitched layers of worn-out saris into quilts and garments, is in fact an ancient upcycling process. Likewise, the patchwork quilts of Gujarat and the "phulkari" embroidery of Punjab are centuries-old methods of using textile waste to create art [11].

A new breed of fashion entrepreneurs are formalising and scaling these practices today. According to our secondary research, upcycling or zero-waste design is considered a fundamental part of the business model of more than 240 registered fashion start-ups in India now [9]. These include small artisan groups that manufacture limited-edition accessories in factories using the pre-consumer waste produced, to medium scale businesses that enter into contracts with garment plants to process their pre-consumer waste into new collections.

The data on the surveys conducted under this study indicates that 44.6% of the surveyed people have already purchased at least one of the products made out of upcycled materials within the last 12 months, but the most commonly mentioned category was home textiles (cushion covers, tote bags), and not apparel. Perception of upcycled clothing as a category was significantly less (29.1%), which implies that the marketing of upcycled fashion as a specific and desirable product category is not developed. When given a definition and examples, however, 67.4% of the respondents said that they would be willing to try upcycled clothing, though, with the caveat that quality and aesthetics must be comparable with conventionally produced alternatives. The barrier of institutions is still prominent.

The majority of upcycling projects in India are of micro or small scale, with no access to consistent waste streams, professional finishing equipment, or retail distribution networks [12]. The logistics are also a problem because of the informality of much of the fabric waste collection. One of the major policy suggestions that can emerge as a result of this analysis is the creation of textile waste aggregation centres - centres that collect, sort and make available to upcycling businesses pre- and post-consumer fabric waste that meet verifiable waste-to-product conversion goals [8].

3.4 Role of circular fashion in reducing textile waste

Circular fashion is the most systematic solution to the sustainability crisis in the textile industry. The principles of the circular economy including design out waste, keep products and materials in use and regenerate natural systems all underlie circular fashion in a challenge to the very logic of the linear take-make-dispose model that has been governing the industry since industrialisation [3]. In practice, it encompasses a range of strategies: to be durable, dismantle, and recycle; to implement take-back and repair programmes; to enable clothing rental and resale markets; and to use recycled fibres as the primary raw material [3]. The case of the industry of circular fashion in India, is complex. On the one hand, the country long-time practice textile repair and resale, the informal second-hand clothes market (also referred to as the so-called chor bazaar or raddiwala systems) has existed in the Indian cities since time immemorial. On the other hand, the rapid growth of fast fashion consumption with the appearance of e-commerce platforms and the introduction of internationally low-cost brands has increased the throughput of garments bending the average lifespan of the product and exiling waste streams [13].

Among the respondents in the survey, 53.8% had clothing in their wardrobe that they had not worn in a period of more than six months and 38.1% had actually gotten rid of clothing in their wardrobe that they had not worn in a period of more than six months. These tendencies are also linked to the overall trends in the world, which are registered by the Ellen MacArthur Foundation, which estimates that the rates of utilisation of garments have dropped by 36% during the last 15 years [3]. This growing churn is augmenting the press and the business model feasibility of resale, rental and recycling businesses as the more garments are discarded, the larger the resale, rental and recycling business opportunity. A number of Indian brands have started to adopt the principles of a circular fashion. Take-back programmes of used garments have also been introduced by Fabindia, Nicobar, and No Nasties and websites like Relove and ThriftGuru have become online resale vendors. In 2024, the Clothing Manufacturers Association of India (CMAI) introduced a pilot program of the circular fashion initiative, which would involve 15 mid-size brands and would involve targets of recycled fibre content and end-of-life product take-back systems [9]. The policy which will accelerate this transition must be supported. The Government of India textile sector is given the Extended Producer Responsibility (EPR) provisions- a mechanism that would render the producers of the products brought to market legally liable [15]. Assuming that it is implemented successfully, EPR can prompt the significant investment in the infrastructure of collection, sorting, and recycling waste, radically changing the way the industry handles the waste [15].

4. Discussion

The themes above are not mutually exclusive-they form a connected framework. Purchase decisions drive market forces around brands. Brand practices dictate sustainable dye use and production processes. Production capabilities create (or leave) waste streams that upcycling and circularity depends on. Policy structures can enable or restrict progress on each of these fronts [11]. Perhaps the study's starkest finding is the imbalance between consumer consciousness and consumer action. Without structural economic reform, this gap will likely persist in the face of societal disparities such as income inequality,

lack of accessible shopping options outside of urban centers, and predatory pricing models established by fast-fashion that renders sustainable apparel seem unreasonably expensive [4]. Closing this gap requires consumer education, yes, but also an restructuring of the market itself; making sustainable garments price-competitive through economies of scale, streamlined supply chains, and incentives with policy backing [6].

Natural dye versus synthetic dye: One takeaway from this comparison is that care should be taken in making blanket statements about environmental impact. One is not universally better than the other in all situations [5]. Natural dyes have their strongest environmental case when done with safe mordanting, water source recycling, and dye crops that are grown using regenerative farming practices [7]. Ideally, efforts would be made to improve both avenues; developing less toxic synthetic dye chemistry alongside growing natural dye production with agricultural subsidies [11].

Upcycling and circular fashion rely on each other, though they are conceptually distinct, on proper waste management infrastructure [12].The highly informal textile waste management ecosystem of India that is characterised by itinerant rag pickers, small-scale recyclers and unregistered collectors has enormous latent potential but is lacking in the formalisation to scale [8]. Examples of Japan (Resource Circulation Act) and the European Union (Textile Strategy 2030) are also informative examples of how policy can spur formal infrastructure investment and investments without putting the livelihoods of informal workers in the sector at risk.

5. Conclusion

This paper is a grounded and extensive analysis of how India is developing its relationship with sustainable textiles, and how this relationship is developed in consumer psychology, industrial chemistry, grassroots entrepreneurship, and systemic design. India has an exceptional cultural and material tradition in sustainable textile practices - from vegetable dyeing to handloom weaving to craft-based repurposing [11]. However, it is the scale, pace, and format of modern fashion consumption that is actively undermining that legacy and creating new waste, pollution, and inequality [13]. In order to achieve the actual change in the textile industry in India, we should collaborate on numerous levels. It is not only the question of people making better decisions when they are buying clothes, or about the development of new technologies. We require a plan which will bring together what consumers desire, how industries operate, how new businesses can develop and what the government permits. The following are some specific things that can be done: - We should teach people about sustainable fashion in schools and colleges, so they know what it's all about. - We need to build a system to collect and manage all the waste that is produced by textiles across the country. All these things combined can help us truly begin to shift towards a more sustainable textile economy in India. We must consider the way in which the purchasing patterns of people are altered with time when the government intervenes. Another thing to research is how much new dyeing techniques affect the environment and how successful circular fashion can be in India where most artisans produce clothing. The textile industry of India will have no other option but to change as climate change intensifies - the question is, will it be the first to change or will it be forced to do so.

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