Stockholm Environment Institute

Gaps, challenges and drivers for environmentally sustainable textile and garment manufacturing in India

SEI working paper
May 2023

Jaee Nikam

Stockholm Environment Institute
Linnégatan 87D 115 23 Stockholm, Sweden
Tel: +46 8 30 80 44 www.sei.org

Author contact: Jaee Nikam
jaee.nikam@sei.org
Editor: Naomi.Lubick
Layout: Richard Clay
Graphics: Mia Shu
Cover photo: © Jaee Nikam / SEI

DOI: https://doi.org/10.51414/sei2023.033

Stockholm Environment Institute is an international non-profit research and policy organization that tackles environment and development challenges.
We connect science and decision-making to develop solutions for a sustainable future for all. Our approach is highly collaborative: stakeholder involvement is at the heart of our efforts to build capacity, strengthen institutions, and equip partners for the long term.
Our work spans climate, water, air, and land-use issues, and integrates evidence and perspectives on governance, the economy, gender and human health.
Across our eight centres in Europe, Asia, Africa and the Americas, we engage with policy processes, development action and business practice throughout the world.

Contents

Summary

India has a diverse and complex textile and garment industry. With about 45 million workers, the ready-made garment sector is one of the largest employment providers in the country. India is one of the few countries that has operations across all sections of the textile manufacturing value chain.

This paper provides an overview of the country's manufacturing value chain of textiles and garments, and the status of sustainable manufacturing throughout these so-called upstream processes, from raw material procurement to ready-made garment production. After outlining the regulatory structure that influences the upstream textile and garments value chain in India, this paper also aims to provide an understanding of the challenges and drivers faced by textile manufacturers in India, along with providing policy suggestions and highlighting the opportunities for sustainable transitions.

The textile manufacturing value chain is complex, with a need to transition towards sustainable manufacturing in all stages of the manufacturing value chain. The different stages include fibre production, spinning, weaving and knitting, dyeing and finishing, and ready-made garment production. Cotton is the most widely produced textile fibre in India, and most of the fabrics are created by a loom by interlocking yarns through either weaving or knitting yarns. The industry actors include local handicraft workers providing raw materials to local manufacturers, to giant conglomerates working directly with overseas partners to create final products.

The Indian regulatory system has 18 trade, 23 textile and 8 sustainable manufacturing laws at the state and national level. Current policies shape all stages of the textile supply chain: for example, integrated manufacturing in one place, such as construction of textile parks, to aid resource efficiency and sustainable transitions for small and medium-sized manufacturing units and aid growth in production, incentives to upgrade machinery used for resource efficiency, and funds for skills development. Another example is policies integrating the weaving sector with raw materials production, such as aiding transitioning cotton and other fabric-crop farmers to organic production, increasing the production of human-made fibres, passing appropriate policies to address weak bargaining power in India as a developing country, setting industry guidelines for sustainable manufacturing, providing incentives for using alternate sustainable materials, implementing regulations for waste reduction, implementing wastewater effluent standards, promoting transparency and traceability, prioritizing renewable energy sources, and ensuring accountability and transparency in policymaking and implementation.

The key challenges faced by the industry and for policymaking overall focus on the actors: multiple stakeholders have varied priorities, and there is a lack of trust among stakeholders and high levels of competition between them. The key drivers for transitioning to sustainable manufacturing will require higher collaboration among stakeholders, better regulatory structures that support transitions and sustainable products, better internal processes like tracking systems and adequate implementation of standards and certifications. India's textile manufacturing sector faces other challenges to achieving sustainability, such as lack of up-to-date technologies, transportation obstacles and infrastructural obstacles. However, the rise in sustainable policies and growing awareness and demand for sustainably manufactured products among customers in recent years highlight the changing narrative and increasing desire for sustainable manufacturing in India.

1. Introduction

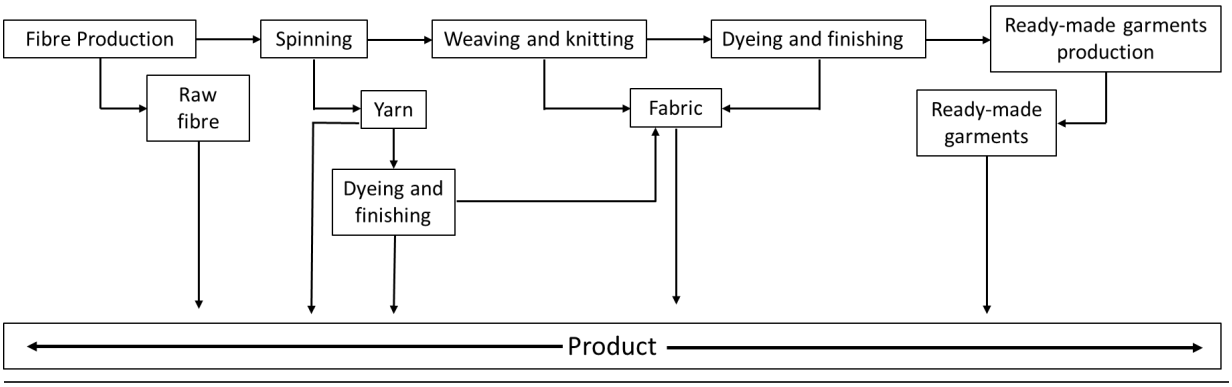
Textile manufacturing in India has historical and cultural significance. Cotton has been at the core of Indian textiles since ancient times. Studies date the Indian exports of fabrics back to almost 4000 years ago. Techniques like embroidery, which is done to strengthen fabric, have been an important tradition in many communities in India for decades and even millennia (Fibre2Fashion, 2008).

The Industrial Revolution reached India in 1854, when Bombay opened its first steam-powered cotton mill for textile manufacturing in Asia. This marks the beginning of textile and garment manufacturing in India at both the national and international scale. The expansion of these modernized cotton mills occurred in the 1870s and 1880s, building the foundation of the modern textile industry in the early nineteenth century.

The Indian textile industry is both diverse and complex. Textile manufacturing in India currently accounts for about 2% of India's GDP and 7% of industry output in India (ClearIAS, 2022c). In 2019, India ranked as the second largest producer of textiles and garments after China, with 6.9% of global share (BizVibe, 2021; Statista, 2022a). Given the scale of the sector, the Indian textile and garment industry plays a pivotal role in the Indian economy, and it is a major foreign exchange earner and employer of about 45 million people in 2022 (Jhunjhunwala, 2022b).

The garment manufacturing supply chain is one of the most diverse supply chains in India. This includes the types of raw materials used, technologies deployed, and the variety of products produced (Chandra, 2006). An overview of the textile manufacturing value chain is outlined in Figure 1. For this paper, "textiles", "ready-made garments" and "textiles and apparel" are used interchangeably and are all defined as any cloth or goods produced by weaving, knitting or felting. Manufacturers are defined as producers of textiles (clothing or other related products) that either sell or export these goods.

Figure 1. Textile manufacturing value chain



Source: Textile Value Chain (2012)

1.1 Textile value chain in India

India is one of the few countries in the world to have all the components of the textile manufacturing value chain described in Figure 1, from fibre production to ready-made garments. This is important, as textile manufacturing in India does not completely depend on import of certain raw materials, as its neighbouring countries do (Verma, 2002). The different stages of textile manufacturing include fibre production, spinning, weaving and knitting, dyeing and finishing, and ready-made garment production.

Fibre production Textile fibres are the raw materials used to create yarn used for production of a garment. There are three types of textile fibres: natural, synthetic and artificial fibres (Audaces, 2022). The total production of textile fibre in India in 2021 was 2.4 million metric tons (tons). This was a considerable increase from 1.6 million tons in 2019, and part of a progressive increase in fibre production in India domestically (Statista, 2022a). Cotton is the most widely produced textile fibre.

Spinning Spinning is a technique used to convert fibres into yarn, which involves twisting fibres together. Today some of the most commonly used techniques include ring, rotor, air-jet, composite, wrap, friction and twisted spinning (Texcoms Textile Solutions, 2019). As of 2022, according to one independent market researcher, India has about 3400 textile mills with a capacity of more than 50 million spindles and more than 800 000 rotors total, making the spinning sector in India the second largest in the world (Anil, 2019).

Weaving and knitting Most of the fabrics are created by a loom by interlocking yarns through either weaving and knitting yarn (Khubab et al., 2016). In India, weaving is done with handlooms, mostly located in rural areas, and power looms, usually done by composite mills that handle spinning and processing operations.

Over the years, due to rise in demand for high volumes of standardized products, the production gradually has shifted to power looms. In 2022, about 58% of cloth production is done using power looms (Ministry of Textiles, 2022). As of April 2022, India has about 385 600 power looms (India Brand Equity Foundation, 2022a).

In India, knitting of yarns has become more successful than weaving in export channels (Chandra, 2006). As of 2019, India currently has about 50 000 circular knitting machines established and in operation. Knitting is mostly concentrated in knitting clusters present in Tirupur, Ludhiana, Kolkata, Surat and Bengaluru (Industrial Extension Bureau, 2019).

Dyeing and finishing Dyeing and finishing are the final steps of production of any garment. The type of dyeing and finishing technique used depends on the requirement of the type of fabric needed for the production of the final garment. Finishing is done either mechanically, chemically or through textile printing. The last step of finishing involves inspecting defects that have occurred during the above processes (Dabedan, 2016). Most of the finishing processes in India are done independently or as a part of a compost mill that uses automated large bath or continuous processing at the rate of about 20 000 m of cloth per day.

Ready-made garment production This involves cutting, shaping and stitching the garments to create the final ready-made garment. About 45 million people are employed by India's ready-made garment industry, which makes it the largest employment provider for all the sectors. As of 2016, India has eight major manufacturing clusters for ready-made garment production: Gujarat, Maharashtra, the National Capital Region (NCR), Uttar Pradesh, West Bengal, Tamil Nadu, Madhya Pradesh and Rajasthan (India Brand Equity Foundation, 2022b). Cotton garments currently lead in market share, at 65% (Kalhan, 2008).

The past couple of decades saw the emergence of large-scale retailers domestically. In 2012, local fashion retail brands made up 95% of total sales in department stores, and 70% in "hypermarkets", or large stores that sell a wide range of goods (Pani & Sharma, 2012).

"Agents" typically secure and consolidate orders for producers. For the garments that are exported, this is done by export houses or commissioning offices of large global apparel retailers (Roy, 2009). There are an estimated 65 000 garment manufacturing units in the organized sector, out of which about 88% are using woven cloth and the remaining, knits. These units are spread out all over the country. However, clusters emerged in cities like the NCR, Mumbai, Bangalore, Coimbatore and Ludhiana (Chandra, 2006; Khan et al., 2009).

2. Research methodology

This study was largely desk-based. Individual interviews of several Indian manufacturers helped to validate and supplement the initial desk review findings.

2.1 Desk review for supply chain

The search engine used for finding relevant literature was Google and Google Scholar. The search strings used, and the number of search results acquired and shortlisted, are detailed in Table 1.

Table 1. Search terms and results

Search Terms	Number of documents identified by an internet search	Number of relevant shortlisted documents
Barriers, drivers or challenges for green transition in garment manufacturing in India	10 600	9
Barriers, drivers or challenges for green transition in garment supply chain in India	10 400	6
Circular design in garment manufacturing	36 700	9
Circular supply chain for Indian garments import and export	22 700	4
Circular transition in the Indian garment manufacturing supply chain	20 300	16
garment sector trends in India	55 800	10
status of the garment supply chain in India	60 900	12
Current status of textile supply chain India	118 000	3
Total		69

The large resulting sample set was checked for relevance, based on abstracts and the first 100 documents from search results. Relevant documents were shortlisted and read thoroughly to extract relevant details in a codebook. The purpose of the codebook was to provide bibliographic information, garment/textile supply chain status, sustainable manufacturing status, challenges, and drivers to transition to sustainable manufacturing in a tabular format for easy data analysis. The details of the codebook are mentioned in Table 2.

Table 2. Details of the codebook for challenges and drivers

Bibliographic information:

Author	Title	Year	Journal	Method	Key focus area	Research gaps

Supply chain related:

Focus area	Status/ trends	Import/ export trends	Success stories	Key stakeholders	Policy suggestions

Sustainable transitions related:

Sustainable manufacturing status	Challenges to sustainable manufacturing transitions	Drivers to sustainable transitions	Opportunities for transitions

Additionally, specific searches were conducted using the Google search engine, on an as-needed basis, throughout the production of the report, to find missing relevant information. These searches were carried out to identify recent relevant information missing from the initial searches with the search strings described above, including import/export statistics, examples of success stories, and other categories. The ancillary information was acquired mostly through documents such as government publications or websites, and from news sources, such as newspapers, online newsletters by and for industry, and other sources.

2.2 Desk review for policies

The search engine used for searching for India's textile policies was Google. The policy documents were primarily identified through websites of relevant ministries in the government, such as the Ministry of Commerce, Ministry of Textiles, Ministry of Industry, Ministry of Finance and Ministry of Environment, Forest and Climate Change.

The key search words used were "textile policies in India", "garment regulations India", "circular manufacturing policies" and "trade regulations garment manufacturing India". The identified policy documents were read in depth and relevant information was added to the codebook for policies. The details for this codebook are as follows:

- date of implementation
- level (national/regional)
- sector
- relevant to sustainable manufacturing
- relevant to textiles
- relevant to trade
- implementing body
- enforcement measures
- policy recommendations.

2.3 Stakeholder interviews

Interviews with relevant textile and garment manufacturers in India were carried out to supplement and validate the desk review and policy mapping. Five interviewees were identified through SEI's existing networks and past collaborations. All of these interviewees identified as textile or garment manufacturers and as working with exporting products to the international markets. Due to travel restrictions during the COVID-19 pandemic, these interviews were conducted online. Each interview consisted of semi-structured questions and lasted around one hour.

Prior to the interview, a project information sheet with the project information, consent form, and an introductory questionnaire consisting of questions about the interviewee's company's general information was provided to the interviewees. The questionnaire consisted of questions regarding the status of the textile and garment supply chain, relevant policies, sustainable manufacturing status in textile manufacturing, the drivers and challenges to transition, and success stories. The relevant information from the questionnaire was added in the codebook detailed above for further analysis. These interviews are used throughout the report to support the data or statistics found in the literature review.

3. Market scenario of the textile and apparel sector

The textile firms in India are either in organized or unorganized forms. The organized sector is usually made up of businesses that are registered with the government. According to a study by Kulshreshtha (2011), the Indian National Accounts Statistics (NAS) defines the unorganized segment of the economy as "all operating units whose activities are not regulated under any Statutory Act or legal provision and/or those which do not maintain any regular accounts."

3.1 Organized sector

This sector involves firms with established supply chains. Technology is highly integrated in this sector. "The spectrum of technology is wide spread right from handmade to semi-mechanical, mechanical and highly sophisticated information based technology and microprocessor based technology" (Devaraja 2011). Additionally, the growth of organized retailing is gradually eliminating the wholesalers and intermediaries from market (Kalhan, 2008).

There are three tiers of firms manufacturing textiles and ready-made garments:

1. Very large-scale firms: These include firms like Raymond, Arvind and others, which produce everything from yarn to finished products and own their own or licensed foreign brands.

2. Medium and large-scale firms: These firms mostly supply to Indian and foreign brands like Reebok, Adidas, Columbia, Walmart and others. They have the capacity to produce large amounts of product through 24-hour production and multiple-shift operations.

3. Small-scale firms: These firms either subcontract for large firms or manufacture for the local unbranded garment market. Examples of these include Gokuldas group and Texport (Kalhan, 2008).

3.2 Unorganized sector

These firms consist of small-scale operators using handlooms, producers of handicrafts, and sericulture operated through traditional tools and methods (Fibre2Fashion, 2015, p. 2). The unorganized sector generally suffers from fragmentation and technology obsolescence, leading to inadequate ability to produce high-quality fabric (Competition Commission of India, 2023). As of 2018, the unorganized clothing sector contributed around 80% of the country's total garment production, employing about six million workers (Majumdar & Sinha, 2018).

The general trend of US and EU brands is to design their garments at a company's headquarters and then partner with Indian firms to source them through their central merchandizing office. Indian firms, also known as contract manufacturers, produce clothes for these brands according to their specifications as well as function on their own supply chain. The list of international well-

known brands that Indian firms supply is rather extensive and includes well-known brands like Arrow, Wrangler, Louis Phillipe, Zodiac, Lee, Weekender, Lacoste, Nike and Tommy Hilfiger. The contract manufacturers mostly provide labour, tailoring expertise, packaging and ready-for-retail services (Kalhan, 2008; interviewees 1 and 2).

The Indian textile industry has been steadily growing since the last decade at a rate higher than the previous decades. This is mostly due to liberalization of trade and economic policies in the 1990s. The change of fiscal duty structure in textile industry has also influenced this rapid rise rate of growth and overall structure of the industry. In the previous decades, fiscal duty structures focused on downstream segments of the industry in the decentralized sector and decimation of organized sector (Devaraja 2011).

Changes in purchasing trends among local customers also have influenced the industry. Prior to 2000, the trend was to purchase two or three new pieces of apparel annually and only on occasions like festivals and functions. Indian consumers had limited access to Western brands and their access often was limited to relatives residing abroad (Rathinamoorthy, 2019).

In 2005, the World Trade Organization abolished the quota system on clothing exports, which enabled the entry of more Western brands and retailers to India. In parallel, the rise of the average per capita income for average Indians led to higher consumption rates. The increased per capita income and increased access to Western brands, in retail outlets and online, in addition to a rise in fashion consciousness and societal image, led to high demand for a variety of clothing. This in turn led to a rise in growth of the industry (Rathinamoorthy, 2019).

The COVID-19 pandemic impacted the manufacturing industry in India much as it did globally. An updated optimum inventory is key for successful processing of orders in the garment industry. Due to lockdowns and a sudden slowdown in transportation in many parts of the world, garment manufacturing in India was affected, leading to inventories being piled up and causing many small-scale manufacturing businesses to shut down (Interviewee 1 and 2).

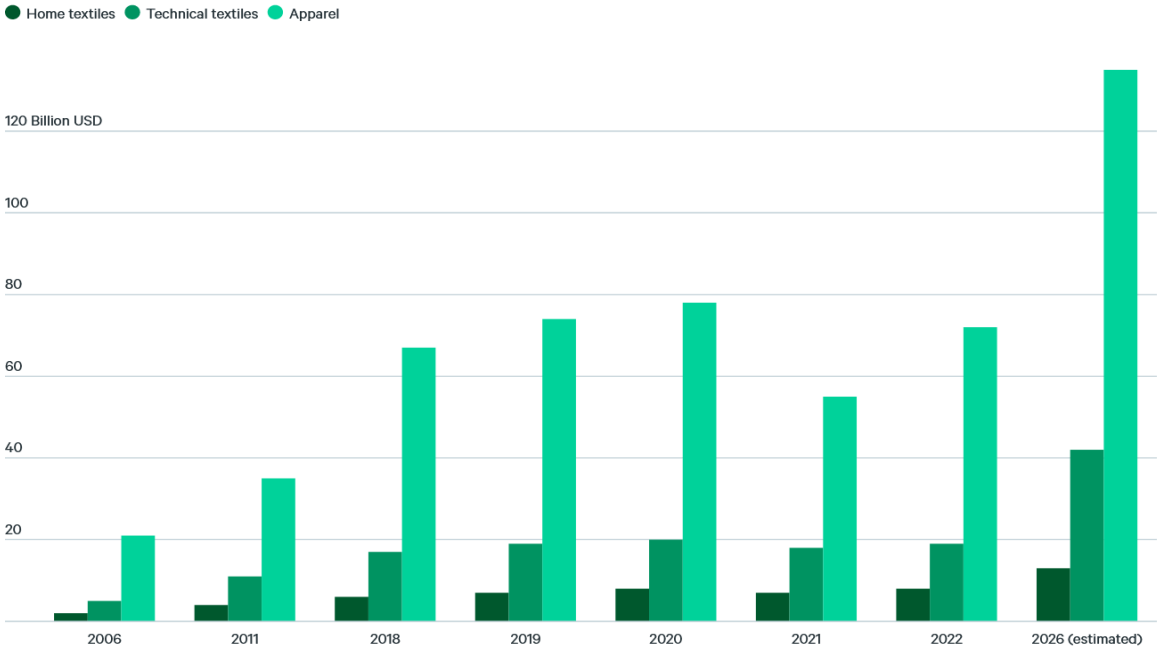
Even with the impact of the pandemic, India has still shown a constant progressive upward trend in the growth of the textile manufacturing sector (Interviewee 2 and 4). There is also an increasing trend observed with bigger companies partnering with each other in order to compete with neighbouring markets like China (Interviewee 2). A study done by the Statista Research Department (2022) estimated that "the market value of apparel across India in the financial year 2021 was the highest at 55 billion U.S. dollars and this value was estimated to reach over 135 billion U.S. dollars by 2026" (Statista, 2022b). Figure 2 shows the growing trend of the market value of the sector in India, with 2021 being the year in which the industry was impacted by the COVID-19 pandemic.

3.3 Import and export trends

India's ready-made garment exports recently increased significantly as a share of the country's total exports (see Figure 3 for types and proportion of materials exported). As of 2019, India ranked in the top fifth in the list of textile exporters globally, with an average turnover of USD 37.11 billion. India had about 4% share in the global textile and apparel trade in 2019 (Fibre2Fashion, 2019; India Brand Equity Foundation, 2022b).

Historically, India has imported very little throughout the textile manufacturing value chain, however, imports are steadily increasing in the recent years as result of duty-free import of readymade garments under the South Asian Free Trade Agreement (SAFTA) in 2006 which resulted in increased imports of readymade garments made from Bangladesh which use Chinese yarns and fabrics. The import of textiles valued at approximately USD 5.2 billion in November 2022. Most of the imports come from other Asian countries, such as China, Vietnam and Bangladesh, with 41% of all imports being from China (Pandey, 2023; World Integrated Trade Solution, 2023).

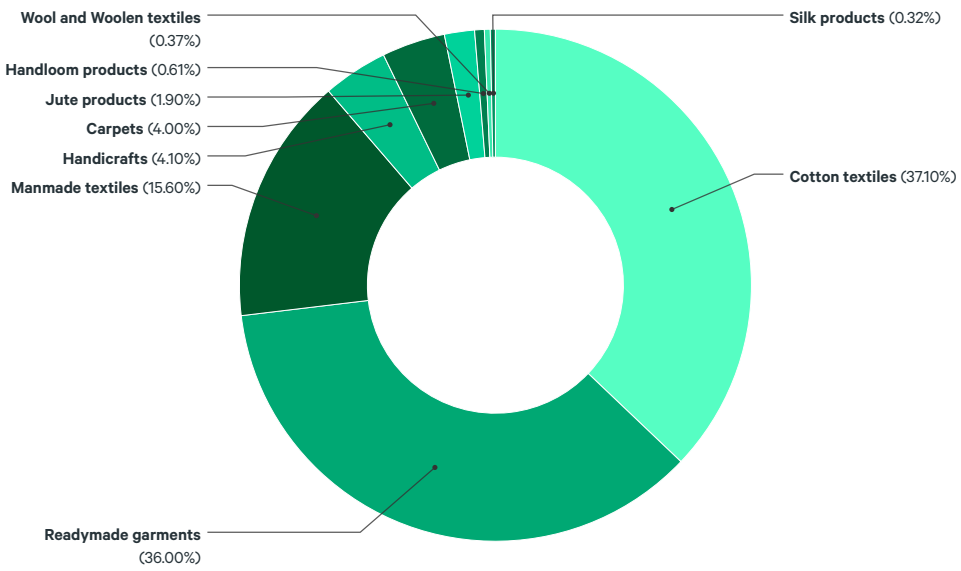
Figure 2. Market value of textile and apparel in India



Source: (Statista, 2022b)

As of 2022, India recorded textiles and apparel exports at USD 44.4 billion, including handicrafts, which was a 41% increase from 2021 and 26% increase from 2020. In FY 2019–20, the US and EU countries accounted for a major share of India's textile and apparel exports, at 27% and 18% respectively (Dubey, 2022). The other countries that India exports to are Bangladesh and the UK, at 6% and 12% respectively (Ministry of Commerce and Industry, 2020). These numbers are aligned with the data provided by the interviewees 1, 2, 3 and 5, whose major export markets were the US and EU, followed by the UK, Australia and countries in South America (Interviewee 1, 2, 3 and 5).

Figure 3. Type of textiles exported and their percentages as of 2022



Source: (India Brand Equity Foundation, 2022a)

4. Social and environmental impacts

The textile and garment manufacturing value chain is resource intensive and releases massive waste and toxic substances in the environment, making it one of the most polluting manufacturing value chains, in India and elsewhere. The textile industry also promotes mass and fast consumption, so the accumulation of post-use waste that is disposed of with other wastes in landfills is also a big problem (Maity et al., 2020). One estimate is nearly 1 kg of textile waste a year per person – far less than in the EU or US, for example, but substantial in a country of nearly 1 billion people (Aggarwal, 2021). Additionally, textile manufacturing processes and water used during manufacturing lead to about half a million tons of microfibre pollution, most of it dumped in rivers and oceans (Davda, 2021).

The harmful environmental impacts of the manufacturing value chain start from the raw materials used like cotton, which is very resource intensive to produce and also has a high demand for pesticides and insecticides which easily pollute the water sources in the area. Studies report that production of one cotton shirt requires up to 2700 litres of water (Drew & Yehounme, 2017). Other materials like polyester are non-biodegradable and contribute to the problem of the accumulation of microplastics (Hari & Mitra, 2022).

4.1 Production waste

These include land and water pollution due to pesticides used in the raw material harvesting (Thangavel & Duraisamy, 2014), used and leftover dyes and chemicals used during production and solids and gas emissions during the finishing processes. In many areas, these chemicals and pollutants are directly released into the environment without any treatment (Maity et al., 2020). The textile and apparel industry use over 8000 chemicals throughout the manufacturing value chain. Statistics show that almost 20% of the total water pollutions is due to textile dyeing and treatment (Hari & Mitra, 2022).

Waste left over after the post-production processes: This includes pieces of cloth, yarn, leather and other raw materials that are discarded after production.

Additionally, spinning and fabric production processes are very energy intensive with a “total of 34% of all energy being used to spinning, 23% for weaving and 38% for chemical processing. The textile industry in India currently has the lowest efficiency in energy utilization as compared to other energy consuming industries” (Goyal & Nayak, 2020).

4.2 Post-consumer waste

This includes clothes that are no longer desirable for the user due to fashion trends, intended functional purpose. In India, these garments are usually recycled by reselling or using it for cleaning purposes. However, given the trends of fast fashion, has led to consumers in India buying a lot more clothes than required and using them for a shorter amount of time. Studies suggest, almost 85% of all the clothes used, end up in the landfills (Hari & Mitra, 2022).

Most of the negative social impacts of the textile manufacturing value chain are observed in the fibre production and garment production stages of the value chain. Raw materials like cotton and jute are very pesticide-intensive crops. These pesticides often wash off of agricultural land into local water bodies, leading to impacts on human and environmental health, for people using the water and animals and plants in the local ecosystem. Breathed in or otherwise ingested, pesticides can cause both short-term health impacts, like nausea and dizziness, to long-term impacts, such as neurological damage and developmental toxicity (Starks et al., 2012). Additionally, pressure of harvesting the most amount of crop per season has led to farmers being financially dependent on synthetic pesticides.

In the garment production stage, harmful health impacts of handling toxic dyes during the dyeing process without protective equipment compounded with long working hours, poor working conditions and low minimum wages, are other social impacts of this industry. Though labour laws have become better over years, child labour is still a problem in many areas (Thangavel & Duraisamy, 2014).

5. Status of sustainable manufacturing of textile and garments in India

Sustainable manufacturing is defined as "Promoting resource and energy efficiency, sustainable infrastructure, and providing access to basic services, green and decent jobs and a better quality of life for all. Its implementation will help achieve overall development plans, reduce future economic, environmental and social costs, strengthen economic competitiveness and reduce poverty" (United Nations, n.d.). Since 2010, the Indian textile industry has been witnessing a rapid structural progression in order to meet the needs of the stringent global buyers (Pathak, 2020). The same point was reiterated by Interviewee 1 and 2. In recent years, buyer demands have influences Indian companies to raise that production and product standards and improve the image along with overall growth. As mentioned in the introduction, Indian textile industry is one of the largest ones in the world, thus leading to a large footprint in terms of impact on economy as well as the environment (Pathak, 2020).

Additionally, as of 2017, and with the advent of "fast fashion", the average number of times a garment is worn has decreased by 36% as compared to 15 years ago (Laville, 2017). Garments reach their end-of-life more quickly than previously, thus leading to large amounts of textile wastes. Adding just an extra nine months of active use would reduce the carbon, waste and water footprints by 20–30% and cut resource costs by 20% for garments (Aggarwal, 2021). This highlights the need for consumers to revert to the "slow fashion" lifestyle of using clothes for a longer time, thus creating a demand for manufacturers to produce clothes with longer lifespans and using sustainable manufacturing to ensure efficient use of resources and reduction of waste from textile manufacturing. The transition to sustainable manufacturing in a linear-dominated value chain will require critical shifts in how the international textile sector functions and consumer behaviours. Though the international industry has already begun engaging with sustainable manufacturing practices in multiple ways, the complete impact of sustainable manufacturing among all stakeholders of the manufacturing value chain is yet to be achieved. The current status for the sustainable manufacturing for the textile manufacturing value chain in India is detailed below (Schröder, 2020; Interviewee 2).

5.1 Current status of sustainable manufacturing for textiles

India is on a trajectory of rapid economic development, with rapid growth in Gross Domestic Product from nearly USD 2295 billion in 2016 to more than USD 3176 billion in 2021 (World Bank, n.d.). India's economic strategy has included expanding the nation's manufacturing base and conducting pro-business reforms under the Make in India programme to transform the nation into a major global production hub (MakeinIndia, n.d.). As seen in the policy mapping, a large part of textile sector–specific policy development has occurred in the past decade. The policy mapping also shows the prominence of policies focusing on sustainable manufacturing in recent years. This shows the interest of the government in aiding transitions to sustainable manufacturing practices along with the growth in production.

One of the pushes towards sustainable manufacturing processes is due to a combination of pressures on manufacturers to increase production to meet demand from growing global middle class markets and, at the same time, reduce the environmental impacts of linear consumption. This has led some small and medium-sized manufacturers to pursue several aspects of

sustainable business models, like reusing and recovering material resources from existing stocks to save production expenses, or make the current processes more efficient to produce maximum amount of products in less time (Circle Economy, 2019). Some of the manufacturers are already green certified and/or recycling/upcycling of their waste, investing in eco-wash machines, reducing water consumption and waste segregation (Interviewee 1, 2 and 4). Though India has recently taking steps towards sustainable manufacturing, from the sustainability standpoint, the Indian textile industry is a highly criticized sector due to issues along the value chain as well as consumption of large amounts of water and energy and uses various toxic chemicals with a potential to degrade the environment. However, the large-scale adoption of this policy is still limited due to high operating and capital costs (Evonik, 2022; Jhunjhunwala, 2022a; Sonak, 2021). Currently, many prominent players in India are concentrating more on input management as a preferred strategy to sustainable manufacturing than tailpipe management. Some of the sustainable manufacturing value chain activities already implemented include:

- regenerative organic farming for cotton and generating a sustainable ecosystem from farm to fabric
- plastic recycling through use of recycled LDPE instead of virgin polyester
- manufacturer use of eco-friendly textiles to process waste material into fibre
- governmental schemes, such as the Mega Investment Textiles Parks (MITRA) and Production Linked Incentive (PLI) Scheme, with an aim to achieve the UN Sustainable Development Goal 9: "Build resilient infrastructure, promote sustainable industrialization, and foster innovation", thus enabling easier and financially affordable installing and functioning of sustainable manufacturing practices in clusters instead of relying on individual manufacturers (ClearIAS, 2022b).

Also included are national and international level efforts: Project SU.RE (for "Sustainable Resolution"), launched in 2019, aims to create long-term environmental, social and corporate governance goals in India (Jain, 2021), and, in the international realm, in 2022, India's Ministry of Textile industry, the Indian Cotton Corporation and UNEP signed an agreement committing to promote sustainability and circularity within its textile sector (Guinebault, 2022; Hari & Mitra, 2022).

5.2 Challenges to sustainable transition for garment manufacturers

The Indian textile and garment manufacturing value chain is complex with multiple players involved. The manufacturing value chain is still very fragmented, with multiple competing stakeholders involved, leading to difficulty for garment manufacturers to efficiently transition to sustainable manufacturing practices. Given the complexity of the supply chain, the challenges related to the structure of supply chain were the most frequently mentioned challenges in the identified literature and as mentioned by the interviewees.

These supply chain challenges also were identified as one of the most common faced by manufacturers when it comes to the transition to sustainable manufacturing (as detailed in Figure 4). The current supply chain is fragmented, with a majority of the fabric produced in decentralized looms, leading to challenges in sustainable transitions due to lack of quality investments and scale adoption. The supply chain also faces a lack of manufacturer competencies, lack of information, transparency, and cultural and language differences. This leads to a lack of an information exchange system, rational training, "skillfulness" and knowledge within businesses, as well as poor distribution of data between vendors. Sustainable manufacturing requires transparency and information sharing between stakeholders.

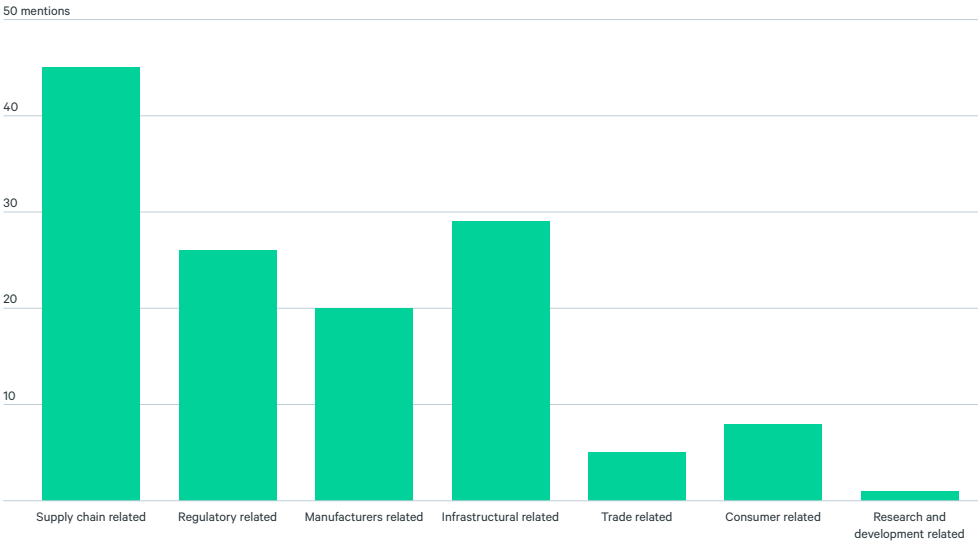
In India, the manufacturers rarely form long-term collaborative relationships. They also face challenges like heavy competition with other manufacturers. With multiple manufacturers emerging at a constant rate with competitive prices, it is difficult for one manufacturer to

transition to more sustainable practices, since transitioning requires cost investment and a constant supply of buyers. Moreover, even though some buyers in the garment industry have multi-year relations with some of their manufacturers, they tend not to provide their long-term manufacturers with stable orders (Interviewee 1). That is, within a multi-year relationship, some months a buyer might place an order for 100 000 units, the next month it might order 50 000 units, and some months it may place no orders at all.

In the current context of hyper-competition and overcapacity among manufacturers competing to sell to well-known brands, price negotiations are very intense. The brands at times switch manufacturers on specific orders for a fraction of a cent difference per unit. This uncertainty leads to lack of manufacturers' will and financial capacity to transition (Bhanot et al., 2017; Giri & Rai, 2013; Roy, 2009; Verma, 2002; Interviewee 5).

In addition to these key challenges, listed above and detailed in Table 3, infrastructure-related challenges followed by regulatory-related challenges were the other major challenges identified in the literature and by interviewees. Infrastructural challenges include lack of in-country technological development leading to inefficient and old machines being used that use up more resources and emit more pollutants than newer ones. Other infrastructural hindrances include acute shortages in power supply, lack of efficient transportation and financial issues like high cost of disposal of hazardous waste or eco-friendly packaging and high implementation cost for green technologies (Begum et al., 2017; Bhanot et al., 2017; Chandra, 2006; Chhimwal et al., 2021; Giri & Rai, 2013; Govindan et al., 2014; Kazancoglu et al., 2020; Khan et al., 2009; Majumdar & Sinha, 2018; Mathiyazhagan et al., 2019; Negrete & Lopez, 2020; Rathinamoorthy, 2019; Roy, 2009). Regulatory challenges include current regulations being biased towards linear manufacturing, lack of adequate implementation and accountability in implementing policies and label harmonizing issues (Ansari & Kant, 2017; Bhanot et al., 2017; Chhimwal et al., 2021; Gardas et al., 2018; Govindan et al., 2014; Majumdar et al., 2021; Majumdar & Sinha, 2018; Mathiyazhagan et al., 2019).

Figure 4. The most common challenges to transition



Source: Author's data

Table 3. Challenges to sustainable transition for garment manufacturers in India

Details	Reference
Supply chain	
Fragmented supply chain: Currently only 5% of the fabric is produced in organized mills and about 57% is produced in decentralized power looms. Most of the manufacturing units are small, catering to small sized demand for fashion garments.	(Verma, 2002; Giri & Rai 2013; Gardas et al., 2018; Interviewee 1)
Heavy competition with other manufacturers.	(Roy, 2009; Bhanot et al., 2017; Giri & Rai 2013; Verma, 2002; Interviewee 1)
Preference for virgin material over recycled material.	(Giri & Rai 2013)
Financial difficulties in implementing codes and lack of buyer support: For implementing codes like SA8000, it includes paying higher waters and investments in facilities. Investing in such involves manufacturers to increase product prices to balance the costs. However, buyers' buying practices remain the same and a general avoidance for financial help. In order to maximize profits, the managers usually decide between the cost needs to implement the cost versus unethical forms of production. This is not just monetarily but also capacities to handle complex and time-consuming tasks. It is easier to produce unethically since the auditing and traditional compliance processes are not strict and generally auditors do compliance checks of the entire batch based on a sample product.	(Maity et al., 2020; Roy, 2009; Seuring & Muller, 2008; Ansari & Kant, 2017; Stigzelius & Mark-Herbert, 2009; Roy, 2009; Interviewee 1 and 4)
Poor traceability throughout the supply chain: Poor traceability of material source, content and quality due to informality and the decentralized version of the sector.	(Pani & Sharma, 2012; Singh, 2013; Giri & Rai 2013)
Lack of trust between supply chain partners.	(Ansari & Kant, 2017; Rathinamoorthy, 2019; Kazancoglu et al. 2020; Chhimwal et al., 2021; Giri & Rai, 2013; Negrete & Lopez, 2020; Bhanot et al., 2017; Chhimwal et al., 2021)
Issues with clothing designs and recycling: Some clothes are not designed to be recycled. In cases where fabric/goods are recycled and refurbished, the complication in design and unavailability of parts (like zippers, buttons) limits the variety of commodities that can be developed with existing resources. Also, "it is a complex problem to disintegrate the polyester cotton blends individually, while this combination is the major player in the market. From that process, technological challenges in sorting the recycled products into products for high-quality raw material and converting them into a high-quality product are to be established and standardized in a nationalized manner"(Rathinamoorthy, 2019). Product development from waste is a huge challenge without control or accurate prediction of the composition of the waste streams available.	(Rathinamoorthy, 2019; Kazancoglu et al., 2020; Chhimwal et al., 2021; Singh & Ordonez, 2016; Verma, 2002; Jia et al., 2020; Begum et al., 2017; Majumdar & Sinha, 2018) (Chandra, 2006; Jia et al., 2020; Singh & Ordonez, 2016)
Linear manufacturing heavy supply chain with a predominance of fast fashion: This leads to difficulty for manufacturers producing one product in the supply chain to transition since the rest of the stakeholders function in linear manufacturing practices.	(Giri & Rai 2013) (Khan et al., 2009; Begum et al., 2017; Govindan et al., 2014; Dreismann et al., 2020)
Functional separation of environmental and social sustainability: The internal separation of functional topics was a prominent barrier for a holistic supply chain approach. The specialization of initiatives on either environmental or social topics, an attention shift away from social challenges and the static character of standards was pointed out. The shift of attention was mostly related to forms of greenwashing, the scalability of solutions and benefits obtained from the focus.	(Dreismann et al., 2020)
Size limitations of small and medium-sized manufacturers: Capacities to handle complex and time-consuming tasks, such as code implementation, monitoring, certification or communication to all its manufacturers are limited. This pertains to staff constraints, financial limitations and the limitation it poses for the participation in different memberships.	(Dreismann et al., 2020; Chandra, 2006)
Regulatory	
Lack of effective implementation of government policies.	(Gardas et al., 2018; Ansari & Kant, 2017; Majumdar et al., 2021; Chhimwal et al., 2021; Mathiyazhagan et al., 2019; Govindan et al., 2014; Majumdar & Sinha, 2018; Bhanot et al., 2017)
Current regulations biased towards linear economy leading to lack of sectorial standardizations, specifications and supporting policies of governments on recycled materials and reuse for products.	(Kazancoglu et al., 2020; Bhanot et al., 2017)
Lack of transparency of regulations due to lack of regulatory leadership in outlining a vision for sustainable manufacturing transition and conflict of interests between product sustainability policy and free trade provisions.	(Koksal et al., 2017; Ansari & Kant, 2017; Rathinamoorthy, 2019)
Presence of corruption within the regulatory structures leading to improper policy implementation.	(Koksal et al., 2017; Rathinamoorthy, 2019; Jia et al., 2020)
Lack of clarity on requirements and uniform implementation of certain codes for sustainable manufacturing. This leads to contradictory audit findings for the company, hence unreliable quality, and audit fatigue from the manufacturer´s side. The plethora of compliance initiatives create parallel structures of compliance initiatives.	(Roy, 2009) (Ansari & Kant, 2017; Dreismann et al., 2020; Begum et al., 2017)

Details	Reference
Label harmonizing issues: There is a lack of harmonizing labeling requirements leading to customer confusion due to high number of labeling schemes. Additionally, mislabeling in the attempt to greenwash the product would lead to customer confusion as well.	(Ansari & Kant, 2017; Begum et al., 2017; Interviewee 1)
Misalignment of short- and long-term strategic goals by government and manufacturers.	(Ansari & Kant, 2017)
Lack of common standards in performance evaluation of sustainable manufacturing practices.	(Kazancoglu et al., 2020; Chhimwal et al., 2021)
Lack of scientific frameworks to identify the most profound sustainability impacts.	(Ansari & Kant, 2017)
Manufacturing	
Lack of available information for manufacturers on production waste and on sustainable manufacturing specific policies for government.	(Giri & Rai 2013; Chhimwal et al., 2021; Seuring & Muller, 2008; Ansari & Kant, 2017; Bhanot et al., 2017)
Lack of training and education about sustainability and sustainable economy: Lack of trained workers drastically reduces the transition to sustainable manufacturing. "The apparel industry is facing a shortage of more than 500 000 trained workers. According to the Ministry of Textiles (2006), 450 000 operators, 22 000 jobbers, 11 000 pattern makers, 11 000 technicians/quality controllers and 6000 managers are required" (Khan et al., 2009) p.65.	(Ansari & Kant, 2017; Khan et al., 2009; Majumdar et al., 2021; Govindan et al., 2014; Chandra, 2006; Begum et al., 2017; Stigzelius & Mark-Herbert, 2009)
Lack of training among employees.	(Stigzelius & Mark-Herbert, 2009)
Lack of initiatives from top management or commitment to initiate sustainability efforts. Firms want to establish a sustainable brand image for consumers. There is a general assumption that recycled materials are of lower quality than virgin materials and hence managers are not willing to compromise the quality of the end product by utilizing recycled materials. Therefore, rules established by firms to manufacture only novel products crucially influence not only the handling of refunded commodities, but also the recovery of the hidden secondary value of returned goods.	(Ansari & Kant, 2017; Majumdar et al., 2021; Jia et al., 2020; Chandra, 2006)
Lack of common standards in performance evaluation of sustainable manufacturing practices.	(Kazancoglu et al., 2020; Chhimwal et al., 2021)
Infrastructure	
Uneven growth or lack of technological development: About 50% to 60% of the textile machinery is imported with high excise duty, leading to high cost of purchasing machinery. This leads to disproportionate development in technology in different parts of manufacturing processes like dyeing, compacting and printing leads is a disadvantage for transitions. Indian firms have an average of 119 machines compared with 605 in China. Additionally, Indian firms have much higher proportion of manual machines. For example, 2% of total looms in India are shuttle-less looms as compared to the world average being 16% and competitors like China and Pakistan at 15% and 9%, respectively. There is also a lack of availability of the past data that is needed to innovate new methods. This makes it difficult for small and medium-sized businesses to adapt to the sustainable manufacturing, as they do not know about new ways of doing business and employees do not know how to apply.	Khan et al. 2009; Begum et al., 2017; Roy, 2009; Rathinamoorthy, 2019; Kazancoglu et al., 2020; Chhimwal et al., 2021; Mathiyazhagan et al., 2019; Govindan et al., 2014; Bhanot et al., 2017; Chandra, 2006; Giri & Rai 2013; Negrete & Lopez, 2020; Majumdar & Sinha, 2018)
Infrastructural hindrances like acute shortage in power supply and transportation: Electrical power cuts and high-power costs across the country leads to production process interruption and affect in delivery schedules, thus leading to delays in delivery, especially exports that have strict delivery schedules. The cost of power in India is much higher at nine cents per kilowatt-hour than competing countries like Bangladesh and China at five cents. Additionally, transportation issues that occur from road, railway and sea travel leads to expensive shipping costs.	(Roy, 2009; Khan et al., 2009; Chhimwal et al., 2021; Bhanot et al., 2017; Pani & Sharma, 2012; R. Singh, 2013; Begum et al., 2017; Chandra, 2006; Khan et al., 2009; Giri & Rai 2013)
Financial barriers: There is a high cost of disposal of hazardous waste or eco-friendly packaging. High implementation cost for green technologies leads to a higher payback period and low return on investment. The current green processes and designs are complex. There is lack of clarity regarding the outcomes of green initiatives in terms of market share and volume and profit margin leading to lack in confidence in green initiatives by the organizations.	(Ansari & Kant, 2017; Kazancoglu et al., 2020; Chhimwal et al., 2021; Bhanot et al., 2017; Jia et al., 2020; Majumdar & Sinha, 2018)
Export	
Competition in exports from countries like China and Bangladesh: This leads to stress among Indian manufacturers to keep the value as low as possible in other in attract international buyers. Even though there are big production units in India, smaller production areas like Tirupur bag only 2% of garment exported to USA.	(Roy, 2009; Ansari & Kant, 2017; Bhanot et al., 2017; Interviewee 1)
Inflation in raw material costs compared to competitor countries.	(Begum et al., 2017)
High dependence on US and EU for exports.	(Begum et al., 2017)
Consumer interest and awareness: Despite increasing awareness of the consumers, price, quality and style are still the dominant motivating factors when purchasing. A large number of consumers are not willing to pay a more amount of money for the sustainable item. The existing ready-made business models rely on volume of sales. Hence, the specific sustainable product would result in higher prices. This demotivates the customers from buying.	(Rathinamoorthy, 2019; Seuring & Muller, 2008; Maity et al., 2020; Chhimwal et al., 2021; Mathiyazhagan et al., 2019; Bhanot et al., 2017; Negrete & Lopez, 2020; Koksal et al., 2017; Interviewee 1)
Poor research and development.	(Majumdar et al., 2021)

5.3 Drivers to sustainable transition for garment manufacturers

Along with the challenges mentioned in the previous section, quite a few drivers can help aid the transitions for sustainable manufacturing. The most mentioned driver is increased trust among stakeholders (see Figure 5). The lack of trust and collaborative functioning has also been most commonly identified as a major challenge, as noted in the previous section. This highlights the extreme fragmentation of the textile manufacturing value chain. Another commonly identified driver is increased governmental schemes and policies that encourage sustainable manufacturing. As identified in the policy mapping, policies like the Zero Liquid Discharge Policy, 2014, and the Amended Technology "upgradation" fund scheme for textiles industry, 2016 have recently been implemented. Table 4 details the key drivers faced by textile and garment manufacturers to transition to sustainable manufacturing practices.

Figure 5. Statistics of the most common challenges to transition

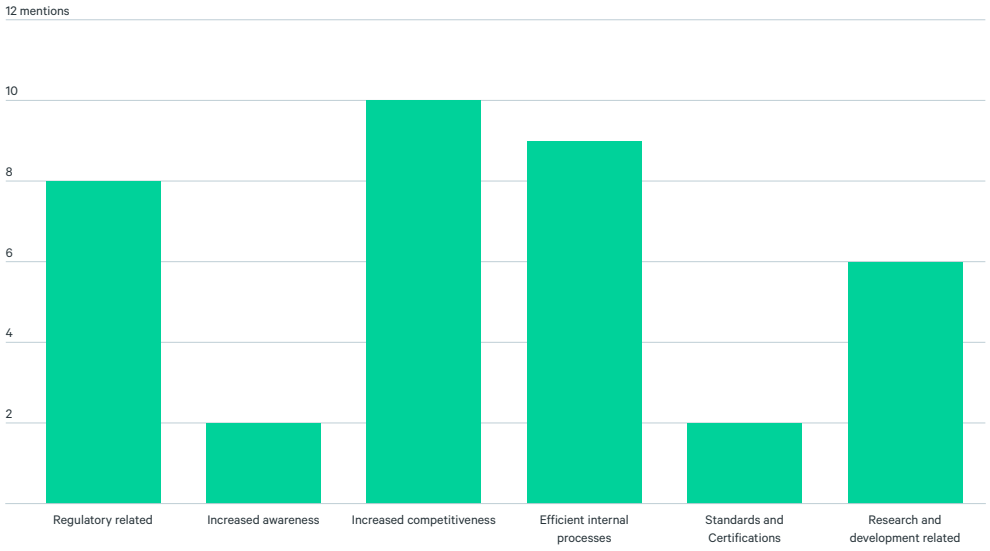


Table 4. Drivers for transition to sustainable manufacturing in textile and apparel manufacturers

Drivers	Reference
Regulatory	
Evaluate, strengthen governmental schemes and policies that enable skill development, technology upgradation etc. Improve government legislations through formulating a dedicated department that ensures inclusion of environmental, social and ethical factors as well as integration of different components of the supply chain to ensure sustainability like procurement of sustainable raw materials, labels for reuse, recycle etc.	(Gardas et al., 2018; Luthra et al., 2015; Jia et al., 2020; Ansari & Kant, 2017; Shete et al., 2020)
Additional incentives and tax exemptions provided by the government for both owners of businesses and workers. Tax exemptions for **goods and service tax (GST)** for sections of garment supply chain that include skill development, maintenance activities and leasing. The government can support manufacturers to undertake those actions to guarantee the sustainability of commodities. In addition, the government regulations require the companies to select manufacturers based on sustainability standards.	(Gardas et al., 2018; Luthra et al., 2015; Bhanot et al., 2017; Jia et al., 2020; Donovan, 2019; Interviewee 1)
Cooperation between the Ministry of Textiles and the state government for effective implementation of the programs and schemes.	(Gardas et al. 2018)
Mandatory treatment of textile and apparel waste is needed for all levels of the industry. Implementation of effective strategies recycling of textile waste and wastewater to save resources and finances required for raw resources and landfilling. Implementation of laws to ban dumping of textile waste in landfills is required to encourage accountability and transparency.	(Gardas et al., 2018; Roy, 2009)
Awareness	
Empowering the small-scale textile sector through awareness generation is needed. This can be done with collaboration with NGOs, institutions and research scholars through knowledge sharing **workshops that educate the sector on sustainable manufacturing practices, waste minimizations and resources recycling.**	(Gardas et al., 2018; Luthra et al., 2015)

Drivers	Reference
In India, small-scale industries have very **little knowledge, and awareness about CSR** programs that aid in sustainable transitions.	(Gardas et al., 2018)
Educating and encouraging consumers to revert to "slow fashion" purchasing practices to encourage manufacturers to transition to circular manufacturing practices and enable environmental regulation.	(Lestari et al., 2021)
Competitiveness:	
Increased collaboration among stakeholders like garment manufacturers and exporters by marketing a brand jointly.	(Gardas et al., 2018; Shete et al., 2020; Interviewee 1 and 2)
A balance in the decision-making power between the manufacturer and buyer of the textile/apparel products.	(Jia et al., 2020; Shete et al., 2020; Interviewee 2)
Improvising efficiency in communication and transportation of raw materials and final products can drastically increase the efficiency of the manufacturing value chain and reduce costs involved in transportation and fuel while reducing greenhouse gas emissions.	(Gardas et al., 2018; Shete et al., 2020)
Increased trust in activities between stakeholders like brands, direct manufacturers through long-term contracts rather than short-term contracts, information disclosure in terms of manufacturing activities.	(Roy, 2009; Dreismann et al., 2020; Bhanot et al., 2017; Shete et al., 2020; Luthra et al., 2015; Ansari & Kant, 2017; Donovan, 2019; Shete et al., 2020; Maity et al., 2020; Interviewee 1)
Development of effective strategies for **reusing or recycling textile and apparel waste** as it has the potential for an excellent cradle-to-cradle solution.	(Gardas et al., 2018)
Development of mega textile parks would make it easier for the sector to install technologies that promote sustainable manufacturing like onsite wastewater treatment plants etc. The presence of mega textile parks will also boost the financial status of the sector.	(Gardas et al., 2018; Shete et al., 2020)
"For ensuring global product standards, the workforce of the textile parks should be provided with **decent accommodation within proximity** of the workplace in order to ensure quality workforce accessibility."	(Gardas et al., 2018; Shete et al., 2020)
"For promoting the use of latest technologies, government should encourage the textile machinery manufacturing in India, and **reduce import of second hand (old) machinery."**	(Gardas et al., 2018)
Internal processes	
Artificial intelligence. IT systems: Application of advanced information technology systems and technologies, such as e-procurement, radio frequency identification (RFID) and supply chain management, helps reduce the cost and improve economic performance, thus enhancing the supply chain efficiency.	(Majumdar et al., 2021; Shete et al., 2020; Ansari & Kant, 2017; Donovan, 2019)
Initiation and commitment from **top management,** workplace management	(Luthra et al., 2015; Bhanot et al., 2017; Shete et al., 2020; Roy, 2009; Ansari & Kant, 2017) (Vanathi & Swamynathan, 2014)
Sustainable practices that provide economic benefits through lowering manufacturing cost	(Bhanot et al., 2017; Ansari & Kant, 2017; Donovan, 2019)
Employee participation and inspiration can be a driving force for sustainable transitions.	(Jia et al., 2020; Donovan, 2019; Maity et al., 2020)
Long-term financial assistance through CSR or other means can aid companies to adopt sustainable practices.	(Jia et al., 2020; Ansari & Kant, 2017; Donovan, 2019; Interviewee 2 and 4)
Tracking systems. To date, no instruments have been developed for manufacturers or recyclers to trace and evaluate the lifespans of commodities sold, and to forecast the quantity and value, of returned merchandise and frequency of collection. Thus, tools for textile traceability need to be enabled in the production and distribution network. Universal product codes, RFID and 2-D barcodes are the most used identifiers.	(Jia et al., 2020)
Eco-design as an internal driver which includes adoption of green practices and green purchasing.	(Diabat et al., 2014; Ansari & Kant, 2017; Donovan, 2019)
Standards and certifications	
Indian enterprises should be encouraged and supported for acquiring relevant **national and global certifications of environmental** standards.	(Gardas et al., 2018; Ansari & Kant, 2017)
Research and Development	
The ministry needs to have sufficient funds for **Research & Development (R&D) activities** and promotion of eco-friendly practices in the textile and apparel supply chain. Research labs, along with universities and government institutes, need to come up with a higher amount of funding to develop sustainable technologies to improve sustainable supply chain management adoption.	(Gardas et al., 2018; Shete et al., 2020)
Increased implementation of innovation is linked with higher sustainability.	(Das, 2021; Bhanot et al., 2017; Shete et al., 2020; Jia et al., 2020; Ansari & Kant, 2017)

6. Relevant policies and policy suggestions

India's policy system has both federal and state laws, including 18 trade-related, 23 textile-related and 8 sustainable manufacturing–related laws. As detailed in the policy mapping in Figures 4 and 5, regulatory issues can be seen as both a challenge and driver for making a transition to sustainable manufacturing.

The key regulatory body responsible for the enforcement of policies for the textile sector is the Ministry of Textiles. These laws either focus on textile manufacturing or have one or multiple clauses that regulate textile manufacturing. A large part of manufactured textiles in India is exported and hence the growth of the industry has heavily been dependent on international trade laws and policies.

The first trade-related law that included a component of textile manufacturing was implemented as early as 1947, with the General Agreements on Tariffs and Trade. The first textile manufacturing–related law was the textile modernization scheme, implemented in 1986–91. The trend of laws specific to textile manufacturing and raw materials has increased in recent years, given the rapid growth of the sector. This highlights the increase in interest of the government to expand this sector, both domestically and internationally, in the last couple decades. Figure 6 shows the mapping of the textile and garment manufacturing–related policies.

As mentioned in Section 4, the textile industry is a high-polluting sector. To address pollution issues, the government started implementing sustainability and circularity manufacturing–related laws, beginning with certain sections of its first national level legislation, the National Environment Policy, in 2006. The legal framework aims to protect and conserve critical ecological systems and resources and to provide equitable access to environmental resources and good environmental quality for all sections of India's society. As seen in the policy mapping, the frequency of adoption and implementation of sustainable manufacturing–related laws have increased since 2014, which shows the interest of the government in encourage such transitions in recent years.

6.1 Policy suggestions

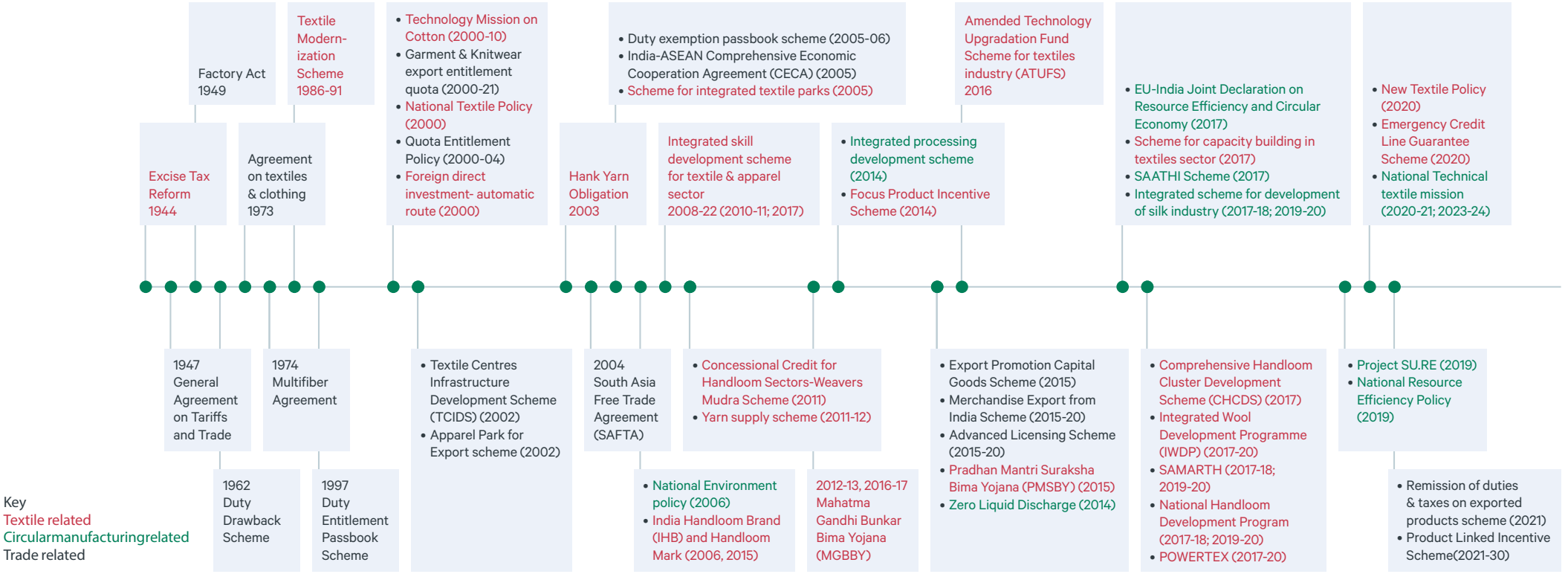
This section highlights the policy suggestions for more sustainable textile manufacturing value chain and better implementation of the current policies, as identified in the literature review and interviews.

Regulatory support is needed to develop all stages of the textile supply chain in a uniform and coordinated manner. Currently, the weaving sector is considered the weakest link and needs to be integrated in order to reduce lead time, cut costs and improve quality (Jain-Chandra & Ananthakrishnan, 2005; Interviewee 4). "The Indian national and regional governments should consider passing a law to transition farmers' moves to organic and sustainable production methods to avoid the lag between the adoption of organic methods and the eventual improvement in yields and income, the availability of grants and training is essential to empower the small-scale level farmers to survive" (Rieple & Singh, 2010, p. 2300; Interviewee 4).

Additionally, policies to enable increased capacity of production of human-made fibres is needed. Though India leads in cotton yarn and fabric production, the yield of synthetic fibres is lower than in many other countries (Jain-Chandra & Ananthakrishnan, 2005; Verma, 2002).

Also, as mentioned in the previous section, overuse of fertilizers while producing raw materials like cotton and jute is prevalent in the country and has detrimental health and environmental impacts. The government has passed policies like the Nutrient Based Subsidy Policy, 2010, which aims to ensure balanced use of fertilizers through subsidies provided, based on the weight of different macronutrients in the fertilizers (ClearIAS, 2022a). However, one study reported that

Figure 6. Map of policy related to textiles, sustainable manufacturing, and trade 1944 to 2021



Source: Author's own

the impact of such policies is still limited and has unintended outcomes, such as high levels of subsidization that prompt many farmers to use increased amounts of chemical fertilizers, increasing productivity but with negative impacts to soil fertility (Salunkhe & Deshmush, 2014).

Manufacturers in developing countries have relatively weak bargaining power with stronger customers in the Western world, which leads to attempts of the customers to impose their own requirements in countries with different needs or priorities. Regulatory bodies need to pass appropriate policies or initiate international negotiations among countries to address this issue (Rieple & Singh, 2010). Emphasis on enabling implementation of quality certification and branding can help build manufacturer-buyer trust in the quality of the product as well as ensure a collaborative transition towards a sustainable value chain (Jain-Chandra & Ananthakrishnan, 2005).

Formulation and implementations of additional policies addressing the following areas would aid in sustainable transitions:

- additional laws for setting industry guidelines for sustainable manufacturing (Hari & Mitra, 2022)
- policies to provide incentives for alternate materials with clear labelling and quality norms as well as provide incentives and tax perks for alternate materials (Hari & Mitra, 2022)
- development of service-related expertise in designing, marketing, retailing, financing and gathering market intelligence on foreign markets and training relevant to the same (Jain-Chandra & Ananthakrishnan, 2005)
- clear guidelines for labelling and use of different types of raw materials and chemicals to be used (Fibre2Fashion, 2022, p. 2)
- a task force to facilitate the formulation and implementation of industry guidelines for eco-design and sustainable manufacturing (Hari & Mitra, 2022).

Policy changes like abolishing “hank yarn obligations”, required a certain amount of raw yarn to be packed in all yarn shipments are needed. There is also a need to provide market assistance schemes for assistance to handlooms, especially for the unorganized handlooms (Verma, 2002).

More regulations need to be implemented for the reduction of waste released from textile manufacturing. This includes banning of hazardous chemicals, uptake of waterless dyeing techniques and banning of landfilling of waste (Hari & Mitra, 2022). Wastewater effluent standards specific to textile and dyeing industries need to be implemented by the Central Pollution Control Board with supervision by the Ministry of Environment, Forest and Climate Change (Central Pollution Control Board, n.d.). Policy that promotes transparency and traceability of products would enable efficient recycling and has a high potential to generate trust among the stakeholders in the value chain, thus encouraging sustainable transitions (Fibre2Fashion, 2022; Rinaldi et al., 2022).

Policies need to prioritize long-term and stable renewable energy source over conventional sources of energy (Hari & Mitra, 2022). Power delinked from State Electricity Boards and better quality of power in terms of strength and reliability in textile parks will lead to lower cost of power (Jain-Chandra & Ananthakrishnan, 2005).

Finally, accountability and transparency in policymaking and implementation are also needed to ensure the adequate impact of policies.

7. Opportunities for a sustainable transition

The Indian market for textiles and apparel is growing rapidly both domestically and internationally. More buyers and manufacturers are demanding and committing to sustainable manufacturing because of globalization, technology shifts, the growing need for environmental responsibility and sustainability, a rise in consumer awareness of the harmful impacts of textile manufacturing and demand for sustainable textiles, in both international and domestic markets.

Buyers have begun to view startups as an inspiration for new technologies and business practices and innovative alternate environmentally sustainable materials and retail models (Gupta & Gupta, 2020; Interviewee 1). Indian textile manufacturing has rapidly been increasing, with a growth rate of above 10% since 2005 (Pani & Sharma, 2012). Being in a highly competitive market, increasing brand image, buyer preference and reduction of cost and resource utilization due to implementation of environmental management practices become important for the industries to sustain (Saha et al., 2021). With governmental scaling up schemes like Technological Upgradation Fund Scheme (TUFS) and Scheme for Integrated Textile Parks (SITP), it is easier for Indian industries to go through technological and infrastructural upgrading and install sustainable manufacturing systems (Khan et al., 2009; Marwah et al., 2014). Some individual brands have already proven that sustainable manufacturing can be successfully implemented. Policies need to be implemented to encourage similar efforts. Some of the brands that have successfully implemented sustainable manufacturing practices include:

- Péro and Doodlage recycles manufacturing waste for surface ornamentation like patchwork. It also has an established upcycling project where it raises awareness among customers to recycle garments.
- Green the Map recycles used tires, Tetra Pak packaging, waste clothes, waste leather and other apparel waste into garments.
- Upasana produces organic garments through traditional weaving and dyeing practices and upcycles their manufacturing waste to make cost-effective products and components.
- Bhusattva uses technology like infusing bamboo, banana, soya bean fibres with khadi, silk and cotton to make it compatible with mainstream fashion (Jain-Chandra & Ananthakrishnan, 2005).

India's gross expenditure on research and development (R&D) has seen a rapid increase in recent years from Rs.394.4 billion (approximately USD 482.6 million) in 2007–08 to Rs.1.1 trillion (approximately USD 13.45 billion) in 2017–18 (Ministry of External Affairs, 2020). This leads to a rise in potential for R&D labs working in relation with marketing, production, development of new eco-friendly substitutes like development of biodegradable and environmentally sustainable enzyme options for traditionally used enzymes for fabric softening process which also reduces water consumption (Kumar et al., 2020; Shete et al., 2020) or development of new techniques for salt-free dyeing of cotton with reactive and direct dyes that reduces excessive water use (Kumar et al., 2020).

With the implementation of mega-investment textile parks schemes, different establishments, especially in southern India, have started organizing into clusters or into bigger, integrated units with all processes under one roof: dyeing, weaving, washing, cutting and stitching. Several clothing units have also taken advantage of the government's TUFS to expand and modernize their units. Having all of the processes under one roof enables ease in investing in waste management systems such as wastewater treatment plants, which would be a very high investment for individually functioning decentralized manufacturing units. Research has shown that collaborative initiatives and activities can aid the transitions of industry towards sustainable manufacturing (Khan et al., 2009; Shete et al., 2020).

A rise in a trend in combining pre- and post-treatment textiles processes, like bleaching and scouring, has been observed by Kumar et al. (2020). This trend leads to successful reduction in water consumption and thus leads to saving energy and reducing complexity, in turn aiding transitions to sustainable manufacturing (Kumar et al., 2020).

Additionally, these mega parks aim to have the entire manufacturing value chain in the same area. Research shows that firms that operate within the composite product category have better means to implement the circular economy business model and perform better in sustainability because the entire production process (from raw materials to finished goods) takes place under one roof; such a production process requires less transportation and results in a smaller carbon footprint during distribution and is easier to compare the logistics of reuse, recovery, recycling and so forth (Saha et al., 2021).

8. Conclusion

The overview provided in this report of the textile manufacturing value chain for garments and textiles in India suggests that it is complex with multiple stakeholders involved. Getting this system to be sustainable from an environmental and human well-being perspective will require policy support, collaborative efforts between the many stakeholders along the entire chain, and a turn to circularity by consumers, regulators and other stakeholders.

The status of sustainable manufacturing suggests that there is a need for drastic change from the current linear heavy manufacturing processes and this change needs to happen in all stages of the manufacturing value chain. Having multiple stakeholders with varied priorities, lack of trust among stakeholders and high competition are some of the few key challenges the sector is facing in order to transition. This also leads to the key identified driver, in research and by interviewees, that higher collaboration among stakeholders would greatly aid the transition. Requirements such as mandatory treatment of textile waste at all levels of the industry will drive the transition to sustainable manufacturing faster. A tangible step forward would be making technological upgrades to machinery and energy sources that are sustainable, which requires subsidies and policies to make these upgrades.

In conclusion, even though the Indian textile manufacturing sector has shown a constant upward trend in growth of the sector, it still faces multiple challenges on the path to sustainability, in terms of heavy competition, lack of up-to-date technologies, transportation obstacles and infrastructural obstacles. The rise in more sustainable policies and rise in awareness among customers in recent years shows India's growing potential and trajectory towards transition to sustainable manufacturing.

ACKNOWLEDGEMENTS

The author of this paper would like to thank Swedish International Development Cooperation Agency (SIDA) for funding this research. The author would also like to thank Diane Archer for helping guide the writing.

References

Aggarwal, A. (2021). Circular economy for textiles as engrained in the traditional Indian life. *Environmental Science: An Indian Journal*, *17*(1). https://www.tsijournals.com/articles/circular-economy-for-textiles-as-engrained-in-the-traditional-indian-life.pdf

Agricultural and Processed Food Products Export Development Authority. (n.d.). *Duty Entitlement Pass Book Scheme (DEPB)*. https://agriexchange.apeda.gov.in/Ready%20Reckoner/DEPB.aspx

Anil., P. M. (2019). *A Study on Labour Productivity with Special Reference to Co-Operative Spinning Mills in Kerala*. Doctoral thesis. University of Calicut. http://scholar.uoc.ac.in/handle/20.500.12818/247

Ansari, Z., & Kant, R. (2017). A state-of-art literature review reflecting 15 years of focus on sustainable supply chain management. *Journal of Cleaner Production*, *142*, 2524–2543.

Apparel Export Promotion Council. (2022). *Textile Centre Infrastructure Development Scheme*. https://www.aepcindia.com/textile-centre-infrastructure-development-scheme

Apparel Resource News Desk. (2021). *Emergency Credit Line Guarantee Scheme extended*. https://in.apparelresources.com/business-news/trade/emergency-credit-line-guarantee-scheme-extended/

Association of Southeast Asian Nations. (2012). *Framework Agreement on Comprehensive Economic Cooperation Between the Republic of India and the Association of Southeast Asian Nations*. ASEAN. https://asean.org/framework-agreement-on-comprehensive-economic-cooperation-between-the-republic-of-india-and-the-association-of-southeast-asian-nations/

Audaces. (2022). *Textile fibers: Everything you need to know about the subject: Audaces manual*. https://audaces.com/en/textile-fibers/#How_are_fabrics_and_textile_structures_formed

Banerjee, S., Chattopadhyay, S., & Lahiri, K. (2016). Export Performance in Textile and Garments with China as a Competitor: An Analysis of India's Situation from the Perspective of Structure-Conduct-Performance Paradigm. In *Internatonal Trade and International Finance*. https://www.springerprofessional.de/en/export-performance-in-textile-and-garments-with-china-as-a-compe/10202842

Begum, Z., Das, S., Kannan, E., Kumar, K. K. S., & Narayanan, G. B. (2017). *A Study of India's Textile Exports and Environmental Regulations*. Springer. https://doi.org/10.1007/978-981-10-6295-7

Bhanot, N., Rao, P. V., & Deshmukh, S. G. (2017). An integrated approach for analysing the enablers and barriers of sustainable manufacturing. *Journal of Cleaner Production*, *142*, 4412–4439. http://dx.doi.org/10.1016/j.jclepro.2016.11.123

BizVibe. (2021). *Global Textile Industry Factsheet 2020: Top 10 Largest Textile Producing Countries and Top 10 Textile Exporters in the World*. https://blog.bizvibe.com/blog/top-10-largest-textile-producing-countries

Central Pollution Control Board. (n.d.). *Charter for Water Recycling & Pollution Prevention in Textile Industries in Ganga River Basin* (p. 153). https://cpcb.nic.in/ngrba/charter_textile.pdf

Chandra, P. (2006). *The Textile and Apparel Industry in India*. Indian Institute of Management.

Chhimwal, M., Agarwal, S., & Kumar, G. (2021). Challenges in the implementation of circular economy in manufacturing industry. *Journal of Modelling in Management*. https://doi.org/10.1108/JM2-07-2020-0194

Circle Economy. (2019). *The Circularity Gap Report 2019* (p. 56). https://assets.website-files.com/5d26d80e8836af2d12ed1269/5dea43f562f8ac3e3113fe51_ad6e59_ba1e4d16c64f44fa94fbd8708eae8e34_compressed.pdf

ClearIAS. (2022a). *Nutrient Based Subsidy Scheme*. https://www.clearias.com/nutrient-based-subsidy-scheme/

ClearIAS. (2022b). *PM Mega Integrated Textile Region and Apparel (PM MITRA)*. https://www.clearias.com/pm-mitra/

ClearIAS. (2022c). *Textile Sector In India*. https://www.clearias.com/textile-sector-in-india/

ClearTax. (2022). *Remission of Duties or Taxes on Export Products Scheme*. https://cleartax.in/s/rodtep-scheme#:~:text=RoDTEP%20stands%20for%20Remission%20of,Merchandise%20Exports%20from%20India%20Scheme'

Competition Commission of India. (2023). *Textile*. https://www.cciindia.org/textile.html

Dabedan. (2016). *Dyeing and Finishing Textiles*. https://www.dabedan.com/en/dyeing-and-finishing-textiles.html

Das, D. (2021). An Empirical Approach to Investigate the Possibility Of Consumer Driven Sustainability Transformation Of Indian Textile And Apparel Industries. *Turkish Journal of Computer and Mathematics Education*, *12*(7), 91–98.

Davda, G. (2021). The Era of Environmental, Social and Governance in Textile Industry. *Fibre2Fashion*. https://www.fibre2fashion.com/industry-article/9214/the-era-of-environmental-social-and-governance-in-textile-industry

Development Commissioner for Handlooms. (n.d.). *Development Commissioner for Handlooms*. http://handlooms.nic.in/

Diabat, A., Kannan, D., & Mathiyazhagan, K. (2014). Analysis of enablers for implementation of sustainable supply chain management: a textile case. *Journal of Cleaner Production*, *83*, 391–403.

Directorate General of Foreign Trade. (2022). *What is Export Promotion Capital Goods (EPCG) Scheme*. https://www.dgft.gov.in/CP/?opt=epcg

Donovan, B. A. (2019). *Secondary Materials in Indian Manufacturing*. IIIEE.

Dreismann, K., Repp, L., & Kirchherr, J. (2020). *Employment quality in supply chains of circular fashion—A comparison of standards and practices of circular fashion enterprises & social sustainability targeting apparel players*. University of Utrecht. https://studenttheses.uu.nl/handle/20.500.12932/35674

Drew, D., & Yehounme, G. (2017). The Apparel Industry's Environmental Impact in 6 Graphics. *World Resources Institute*. https://www.wri.org/insights/apparel-industrys-environmental-impact-6-graphics

D'Souza, E. (2003). *The WTO and the Politics of India's Textile Sector: From Inefficient Redistribution to Industrial Upgradation* (p. 37). Indian Institute of Management. https://web.iima.ac.in/assets/upload/faculty/8611errol.pdf

Dubey, V. (2022). India sees highest-ever textiles and apparel exports in FY22: Govt. *Business Today*. https://www.businesstoday.in/latest/economy/story/india-sees-highest-ever-textiles-and-apparel-exports-in-fy22-govt-335873-2022-05-31

EU-India Summit. (2020). *EU-India Joint Declaration on resource efficiency and circular economy*. EU-India Summit, Brussels. https://www.consilium.europa.eu/media/45027/joint-declaration-with-india-on-resource-efficiency-and-circular-economy.pdf

Evonik. (2022). *Saving water and reducing waste—Evonik opens its first Zero Liquid Discharge plant in India*. https://catalysts.evonik.com/en/saving-water-and-reducing-waste-evonik-opens-its-first-zero-liquid-discharge-plant-in-india-173189.html

Export-Import Bank of India. (2018). *Enhancing exports of Technical Textiles*. (p. 64). https://www.eximbankindia.in/Assets/Dynamic/PDF/Publication-Resources/ResearchPapers/105file.pdf

Fibre2Fashion. (2008). *Artistic heritage in Indian textiles*. https://www.fibre2fashion.com/industry-article/3660/artistic-heritage-in-indian-textiles

Fibre2Fashion. (2015). Unorganised fabric sector hampers Indian apparel export. *Textiles*. https://www.fibre2fashion.com/news/textile-news/unorganised-fabric-sector-hampers-indian-apparel-export-175569-newsdetails.htm

Fibre2Fashion. (2019). *Top 10 Exporting Countries of Textile and Apparel Industry*. https://www.fibre2fashion.com/industry-article/8471/top-10-exporting-countries-of-textile-and-apparel-industry

Fibre2Fashion. (2022). *Indian textile-apparel industry needs orderly circular transition: CRB*. https://www.fibre2fashion.com/news/textile-news/indian-textile-apparel-industry-needs-orderly-circular-transition-crb-280912-newsdetails.htm

Gardas, B. B., Raut, R. D., & Narkhede, B. (2018). Modelling the challenges to sustainability in the textile and apparel (T&A) sector: A Delphi-DEMATEL approach. *Sustainable Production and Consumption*, *15*, 96–108. https://doi.org/10.1016/j.spc.2018.05.001

Giri, S., & Rai, S. S. (2013). Dynamics of Garment Supply Chain. *International Journal of Managing Value and Supply Chains*, *4*(4), 29–42. https://doi.org/10.5121/ijmvsc.2013.4403

Govindan, K., Kaliyan, M., Kannan, D., & Haq, A. N. (2014). Barriers analysis for green supply chain management implementation in Indian industries using analytic hierarchy process. *Int. J. Production Economics*, *147*, 555–568. http://dx.doi.org/10.1016/j.ijpe.2013.08.018

Guinebault, M. (2022). *Indian textile industry commits to UN on promoting circularity*. https://ww.fashionnetwork.com/news/Indian-textile-industry-commits-to-un-on-promoting-circularity,1448159.html

Gupta, P., & Gupta, V. (2020). Digitization of Textile Manufacturing Process: An Exploration. *Supply Chain Pulse*, *11*(1), 24–30.

Hari, D., & Mitra, R. (2022). *Circular Textile and Apparel in India Policy Intervention Priorities and Ideas* (p. 49). https://c4rb.org/wp-content/uploads/2022/04/Circular_Apparel_Status_Paper_140422.pdf

Howtoexportimport. (2022). *Textile Centre Infrastructure Development Scheme for Exporters*. Export Incentives and Benefits. https://howtoexportimport.com/TEXTILE-CENTRE-INFRASTUCTURE-DEVELOPMENT-SCHEME-FO-4123.aspx

IIPNews. (2021). *Integrated Scheme for Development of Silk Industry*. https://indianindustryplus.com/2021/03/20/integrated-scheme-for-development-of-silk-industry/

Impex Consultancy Services. (n.d.). *Advance licence scheme*. http://www.trade-links.net/adv_lic.htm

India Brand Equity Foundation. (2022a). *Powerloom Industry and Exports in India*.

India Brand Equity Foundation. (2022b). *Textile Industry & Market Growth in India*. https://www.ibef.org/industry/textiles

India Filings. (n.d.a). *Apparel Park*. https://www.indiafilings.com/learn/apparel-park-scheme/

India Filings. (n.d.b). *Integrated Wool Development Programme*. https://www.indiafilings.com/learn/integrated-wool-development-programme/

India Filings. (n.d.c). *Integrated Processing Development Scheme (IPDS)*. https://www.indiafilings.com/learn/ipds-scheme/

India Filings. (n.d.d). *Mahatma Gandhi Bunkar Bima Yojana (MGBBY)*. https://www.indiafilings.com/learn/mahatma-gandhi-bunkar-bima-yojana-mgbby/

Indirect Taxes Committee. (n.d.). *GST – Impact on Textiles & Apparels*.

Industrial Extension Bureau. (2019). *Textile Sector—Knitting*. https://indextb.com/files/2020/10/f1810052-8821-48b1-ae00-b76993336e65_6.%20Knitting_Textiles_Profile.pdf

Jain, B. (2021). India Goes Green: Textile Industry. *Invest India*. https://www.investindia.gov.in/siru/india-goes-green-textile-industry

Jain-Chandra, S., & Ananthakrishnan, P. (2005). *The Impact on India of Trade Liberalization in the Textiles and Clothing Sector* (IMF Working Paper Working Paper No. 2005/14). International Monetary Fund. https://www.imf.org/en/Publications/WP/Issues/2016/12/31/The-Impact-on-India-of-Trade-Liberalization-in-the-Textiles-and-Clothing-Sector-18594

Jhunjhunwala, R. (2022a). *Textile industry goes green*. Times of India. https://timesofindia.indiatimes.com/blogs/voices/textile-industry-goes-green/

Jhunjhunwala, R. (2022b). Textile industry supporting Indian employment. *The Times of India*. https://timesofindia.indiatimes.com/blogs/voices/textile-industry-supporting-indian-employment/

Jia, F., Yin, S., Chen, L., & Chen, X. (2020). The circular economy in the textile and apparel industry: A systematic literature review. *Journal of Cleaner Production*, *259*. https://doi.org/10.1016/j.jclepro.2020.120728

Journals of India. (2021). *Focus Product Incentive Scheme (FPIS)*. https://journalsofindia.com/focus-product-incentive-scheme-fpis/

Kalhan, A. (2008). Local impact of retailer-driven garment supply chains. *Economic and Political Weekly*, *43*(4), 19–22. https://doi.org/161.200.183.32

Kazancoglu, I., Kazancoglu, Y., Kahraman, A., Yarimoglu, E., & Soni, G. (2020). Investigating barriers to circular supply chain in the textile industry from Stakeholders' perspective. *International Journal of Logistics Research and Applications*. https://doi.org/10.1080/13675567.2020.1846694

Khan, S. R., Dhar, D., Navaid, M., Pradhananga, M., Siddique, F., Singh, A., & Yanthrawaduge, S. (2009). *Export Success and Industrial Linkages* (1st ed.). PALGRAVE MACMILLAN.

Khubab, S., Muhammad, U., Ashraf, W., & Nawab, Y. (2016). Fabric Manufacturing. *Phyidical Sciences Review*. https://www.degruyter.com/document/doi/10.1515/psr-2016-0024/html?lang=en

Koksal, D., Strähle, J., Müller, M., & Freise, M. (2017). Social Sustainable Supply Chain Management in the Textile and Apparel Industry—A Literature Review. *Sustainability*, *9*(100), 32. https://doi.org/10.3390/su9010100

Kumar, J., Singha, K., Pandit, P., Maity, S., & Ray, A. (2020). Challenges for Waste in Fashion and Textile Industry. In *Recycling from Waste in Fashion and Textiles: A Sustainable & Circular Economic Approach* (pp. 19–32). Scrivener Publishing LLC.

Lal, K., & Mohnen, P. A. (2009). *Innovation Policies and International Trade Rules*. Palgrave Macmillan London. https://link.springer.com/book/10.1057/9780230246201

Laville, S. (2017). *Stella McCartney calls for overhaul of 'incredibly wasteful' fashion industry*. https://www.theguardian.com/environment/2017/nov/28/stella-mccartney-calls-for-overhaul-of-incredibly-wasteful-fashion-industry

Lestari, E., Dania, W. A. P., Indriani, C., & Firdausyi, I. (2021). The impact of customer pressure and the environmental regulation on green innovation performance. *IOP Conference Series: Earth and Environmental Science*, *733*. https://doi.org/10.1088/1755-1315/733/1/012048

Luthra, S., Garg, D., & Haleem, A. (2015). An analysis of interactions among critical success factors to implement green supply chain management towards sustainability:An Indian perspective. *Resources Policy*, *46*, 37–50. http://dx.doi.org/10.1016/j.resourpol.2014.12.006

Maity, S., Singha, K., Pandit, P., & Ray, A. (2020). Circular Economy in Fashion and Textile from Waste. In *Recycling from Waste in Fashion and Textiles* (eds P. Pandit, S. Ahmed, K. Singha and S. Shrivastava). https://doi.org/10.1002/9781119620532.ch11

Majaski, C. (2022). General Agreement on Tariffs and Trade (GATT). *Investopedia*. https://www.investopedia.com/terms/g/gatt.asp

Majumdar, A., Garg, H., & Jain, R. (2021). Managing the barriers of Industry 4.0 adoption and implementation in textile and clothing industry: Interpretive structural model and triple helix framework. *Computers in Industry*, *125*. https://doi.org/10.1016/j.compind.2020.103372

Majumdar, A., & Sinha, S. (2018). Modeling the barriers of green supply chain management in small and medium enterprises A case of Indian clothing industry. *Management of Environmental Quality: An International Journal*, *29*(6), 1477–7835. https://doi.org/10.1108/MEQ-12-2017-0176

MakeinIndia. (n.d.). *About us*. https://www.makeinindia.com/about

Marwah, A. K., Thakar, G., & Gupta, R. C. (2014). Determinants of Supply Chain Performance of Indian Manufacturing Organizations. *International Journal of Business Research and Management (IJBRM)*, *5*(1), 14–28.

Mathiyazhagan, K., Sengupta, S., & Mathivathanan, D. (2019). Challenges for implementing green concept in sustainable manufacturing: A systematic review. *OPSEARCH*, *56*, 32–72. https://doi.org/10.1007/s12597-019-00359-2

Ministry of Commerce and Industry. (1993). *Agreement on South Asian Free Trade Area (SAFTA)*. https://commerce.gov.in/wp-content/uploads/2020/05/safta.pdf

Ministry of Commerce and Industry. (2020). *EP-Textiles Coordination Division*. https://commerce.gov.in/about-us/divisions/export-products-division/ep-textile/

Ministry of Environment and Forests (MoEF). (2006). *National Environment Policy 2006*. https://ibkp.dbtindia.gov.in/DBT_Content_Test/CMS/Guidelines/20190411103521431_National%20Environment%20Policy,%202006.pdf

Ministry of Environment and Forests (MoEF). (2019). *Draft National Resource Efficiency Policy 2019*. https://moef.gov.in/wp-content/uploads/2019/07/Draft-National-Resourc.pdf

Ministry of External Affairs. (2020). *India's scientific R&D spending sees 3X growth*. https://indbiz.gov.in/indias-scientific-rd-spending-sees-3x-growth/

Ministry of Finance. (2022). *Pradhan Mantri Suraksha Bima Yojana(PMSBY)*. https://financialservices.gov.in/insurance-divisions/Government-Sponsored-Socially-Oriented-Insurance-Schemes/Pradhan-Mantri-Suraksha-Bima-Yojana(PMSBY)

Ministry of Textiles. (n.d.). *Integrated Skill Development Scheme*. http://isds-textiles.gov.in/site/about

Ministry of Textiles. (1999a). *Garments and Knitwears export entitlement (quota) policy (2000-2004)*. Government of India. https://www.yumpu.com/en/document/read/37569739/textile-export-quota-policy-2000-2004-ministry-of-textiles

Ministry of Textiles. (1999b). *Yarn, Fabrics & Made-up Export Entitlement (Quota) policy for 2000-2004*. Government of India. http://ministryoftextiles.gov.in/sites/default/files/Yar-quota.pdf

Ministry of Textiles. (2003). *Annual Report: Textile Export* (p. 16). http://ministryoftextiles.gov.in/pdf/ar03_c10.pdf

Ministry of Textiles. (2011). *Guidelines for concessional credit weavers mudra scheme*. https://dht.assam.gov.in/sites/default/files/swf_utility_folder/departments/dht_medhassu_in_oid_4/menu/schemes/Guideline%20for%20Concessional%20Credit-%20Weavers%20MUDRA%20Scheme.pdf

Ministry of Textiles. (2016). *Yarn Supply Scheme (YSS)*. https://www.nhdc.org.in/UPLOAD/TopMenuFile/Yarn-Supply-Scheme.pdf

Ministry of Textiles. (2018). *Chapter XIII: Ministry of Textiles* (p. 11). https://cag.gov.in/uploads/download_audit_report/2018/Chapter_13_Ministry_of_Textiles_of_Report_No_11_of_2018_-_Compliance_Audit_Observations_Union_Government_Commercial.pdf

Ministry of Textiles. (2019a). *Comprehensive Handloom Cluster Development Scheme*. https://pib.gov.in/Pressreleaseshare.aspx?PRID=1558446

Ministry of Textiles. (2019b). *Union Textiles Minister launches Project SU.RE on Sustainable Fashion Day at Lakmé Fashion Week*. https://pib.gov.in/PressReleasePage.aspx?PRID=1582685

Ministry of Textiles. (2020). *National Technical Textiles Mission*. https://pib.gov.in/PressReleasePage.aspx?PRID=1656237#:~:text=Jal%20Jivan%20Mission%3B%20Swachch%20Bharat,and%20exports%20activities%20in%20India.

Ministry of Textiles. (2022). *Powerloom sector contributes nearly 58.4% to total cloth production and more than 60% of fabric meant for export in the country*. https://pib.gov.in/newsite/PrintRelease.aspx?relid=234923

Ministry of Textiles. (n.d.). *About Samarth*. https://samarth-textiles.gov.in/about_us

Ministry of Textiles. (2017). *National Handloom Development Programme (NHDP)*. http://www.karnatakadht.org/pdf/Guidelines-NHDP.pdf

Narayanan, K. (2009). The Indian Textiles and Clothing Industry and Innovation Policies. In *Innovation Policies and International Trade Rules* (pp. 97–140). Palgrave Macmillan, London. https://link.springer.com/chapter/10.1057/9780230246201_4

National Handloom Development Corporation Ltd. (2022). *India Handloom Brand*. https://www.nhdc.org.in/internal.aspx?menuid=2&CatID=64

Nayyar, M., Chawla, A., & Pagaria, A. (2020). Textile & Apparel Industry: The Change Agent of India. *Textile and Apparel*. https://www.investindia.gov.in/siru/textile-apparel-industry-change-agent-india

Negrete, J. D. C., & Lopez, V. N. (2020). A Sustainability Overview of the Supply Chain Management in Textile Industry. *International Journal of Trade, Economics and Finance*, *11*(5). https://doi.org/0.18178/ijtef.2020.11.5.673

Pandey, R. (2023). Why India's critical textile sector, employing 4.5 crore people, is facing challenges. *MacroSutra*. https://theprint.in/macrosutra/why-indias-critical-textile-sector-employing-4-5-crore-people-is-facing-challenges/1299489/

Pani, A., & Sharma, M. (2012). Emerging Trends in Fashion Marketing: A Case Study of Apparel Retailing in India. *International Journal of Business and Management Tomorrow*, *2*(10).

Paper Tyari. (2022). *Objectives of National Environment Policy (NEP), 2006*. https://www.papertyari.com/general-awareness/economics/objectives-national-environment-policy-nep-2006/

Pathak, P. N. (2020). A study on emerging trends in textile industry in India. *Journal of Research in Business and Management* 8(1):50-54 G08015054.pdf (questjournals.org)

Prabhakar, S. (2018). Managing the Transition through Multilevel Governance. In *Industry 4.0: Empowering ASEAN for the Circular Economy* (pp. 325–360). https://www.eria.org/uploads/media/16.ERIA-Books-2018_Circular_Economy_Chapter_12.pdf

Prince, A. (2008). *Energy conservation in textile industries & savings* [Fibre2Fashion news]. https://www.fibre2fashion.com/industry-article/3377/energy-conservation-in-textile-industries-savings

Ramaswamy, K. V., & Gereffi, G. (2000). India's apparel exports: The challenge of global markets. *The Developing Economies*, *38*(2), 186–210.

Rathinamoorthy, R. (2019). *Circular Fashion*. https://doi.org/10.1016/B978-0-08-102630-4.00002-9

Raveendran, R. (2022). *Listed Textile Company in India*. https://indiancompanies.in/list-of-textile-companies-in-india/

Ravichandar, K. P., Ganesan, P., Hariharan, S., & Thirumoorthy, M. (2007). *Management policies in Indian textiles*. Fibre2Fashion. https://www.fibre2fashion.com/industry-article/2533/management-policies-in-indian-textiles

Regional Office of the Textile Commissioner. (2003). *Brief note on Implementation of Hank Yarn Obligation Scheme*. https://www.karnatakadht.org/pdf/Brief-note-on-Implementation-of-Hank-Yarn-Obligation-Scheme.pdf

Rieple, A., & Singh, R. (2010). A value chain analysis of the organic cotton industry: The case of UK retailers and Indian suppliers. *Ecological Economics*, *69*, 2300. https://doi.org/10.1016/j.ecolecon.2010.06.025

Rinaldi, F. R., Bernardino, C. D., Cram-Martos, V., & Pisani, M. T. (2022). Traceability and transparency: Enhancing sustainability and circularity in garment and footwear. *Sustainability: Science, Practice and Policy*, *18*(1). https://doi.org/10.1080/15487733.2022.2028454

Roy, S. (2009). *GARMENTS INDUSTRY IN INDIA Lessons from Two Clusters* (Working Paper ISID WORKING PAPER 2009/01; p. 50). Institute for Studies in Industrial Development.

Saha, K., Dey, P. K., & Papagiannaki, E. (2021). Implementing circular economy in the textile and clothing industry. *Business Strategy and the Environment*, *30*, 1497–1530. https://doi.org/10.1002/bse.2670

Salunkhe, H. A., & Deshmush, B. B. (2014). Impact of subsidy on agriculture sector in India – an analytical study. *International Journal of Agricultural Science and Research*, *4*(2), 9–16.

Schröder, P. (2020). Promoting a just transition to an inclusive circular economy. *Energy, Environment and Resources Programme*.

Seuring, S., & Muller, M. (2008). From a literature review to a conceptual framework for sustainable supply chain management. *Journal of Cleaner Production*, *16*, 1699–1710. https://doi.org/10.1016/j.jclepro.2008.04.020

Shete, P., Ansari, Z., & Kant, R. (2020). A Pythagorean fuzzy AHP approach and its application to evaluate the enablers of sustainable supply chain innovation. *Sustainable Production and Consumption*, *23*, 77–93. https://doi.org/10.1016/j.spc.2020.05.001

Shrivastava, S. (2020). Policies in Handloom Industry in India: Short Review. *International Journal of Textile Science*, *9*(1), 17–20. https://doi.org/10.5923/j.textile.20200901.03

Singh, J., & Ordonez, I. (2016). Resource recovery from post-consumer waste: Important lessons for the upcoming circular economy. *Journal of Cleaner Production*, *134*, 342–353. http://dx.doi.org/10.1016/j.jclepro.2015.12.020

Singh, R. (2013). Doing Organized Garment Retailing Business in India: A Critical Analysis. *American Journal of Industrial and Business Management*, *3*, 472–479. http://dx.doi.org/10.4236/ajibm.2013.35054

SMSEnvocare. (2016). *Zero Liquid Discharge in Textile Industry*. SMSRnvorcare. http://smsenvocare.co.in/wp-content/uploads/2019/09/ZLD-IN-TEXTILE-INDUSTRY.pdf

Sonak, I. (2021). Zeroing in on discharge. *DownToEarth*. https://www.downtoearth.org.in/blog/waste/zeroing-in-on-discharge-76089

Starks, S., Gerr, F., Kamel, F., Lynch, C., Alavanja, M., Sandler, D., & Hoppin, J. (2012). High pesticide exposure events and central nervous system function among pesticide applicators in the Agricultural Health Study. *International Archieve for Occupational Environmental Health*, *85*(5), 505–515. https://doi.org/10.1007/s00420-011-0694-8

StartupIndia. (2022). *Comprehensive Handloom Cluster Development Scheme (CHCDS)*. https://www.startupindia.gov.in/content/sih/en/government-schemes/mega_cluster_scheme.html

Statista. (2022a). *Leading cotton producing countries worldwide in 2021/2022*. https://www.statista.com/statistics/263055/cotton-production-worldwide-by-top-countries/

Statista. (2022b). *Market value of textile and apparel in India*. https://www.statista.com/statistics/1119683/india-market-value-of-apparel-by-type/

Stigzelius, I., & Mark-Herbert, C. (2009). Tailoring corporate responsibility to suppliers: Managing SA8000 in Indian garment manufacturing. *Scandinavian Journal of Management*, *25*, 46—56. https://doi.org/10.1016/j.scaman.2008.04.003

Sutlej. (2020). *Various initiatives and steps taken by the Government of India to enhance textile Industry*. https://www.sutlejtextiles.com/blogs/blog-post.php?id=D31

Texcoms Textile Solutions. (2019). *Textile Spinning: Textile Technology knowledge series Volume II* (p. 297). https://www.texcoms.com/wp-content/uploads/2019/06/Textile-Spinning.pdf

Textile Value Chain. (2012). *India's presence in textile value chain*. https://textilevaluechain.in/in-depth-analysis/articles/textile-articles/indias-presence-in-textile-value-chain/

Textile Value Chain. (2020). *Policies that led to the growth of Textile and Garment industry in India*. https://textilevaluechain.in/news-insights/policies-that-led-to-the-growth-of-textile-and-garment-industry-in-india/

Thaker, H. C. (2020). *Duty Drawback under Customs Act, 1962*. https://taxguru.in/income-tax/duty-drawback-customs-act-1962.html

Thangavel, K., & Duraisamy, G. (2014). Environmental Analysis of Textile Value Chain: An Overview. In *Roadmap to Sustainable Textiles and Clothing, Textile Science and Clothing Technology* (pp. 153–188). Springer Science+Business Media Singapore. https://doi.org/10.1007/978-981-287-110-7_6

The Cotton Corporation of India. (2018). *Technology Mission on Cotton (TMC)*. https://cotcorp.org.in/TechnologyMissiononCotton.aspx?AspxAutoDetectCookieSupport=1

The Textile Magazine. (2020). Ministry of Textiles formulating New Textiles Policy 2020. *Industry News*. indiantextilemagazine.in/ministry-of-textiles-formulating-new-textiles-policy-2020/

TradingEconomics. (2022). *India GDP*. https://tradingeconomics.com/india/gdp

United Nations. (n.d.). *Responsible Production and Consumption*. https://www.un.org/en/academic-impact/page/responsible-production-and-consumption#:~:text=Sustainable%20consumption%20and%20production%20is,quality%20of%20life%20for%20all.

United Nations Conference on Trade and Development, Government of India, & Department for International Development. (n.d.). *Duty Entitlement Passbook (DEPB) Scheme*. http://www.fisme.org.in/export_schemes/DOCS/B-1/DUTY%20ENTITLEMENT%20PASSBOOK%20SCHEME(DEPS).pdf

United States International Trade Commission. (2001). *India's Textile and Apparel Industry*. https://www.usitc.gov/publications/332/PUB3401.pdf

Vanathi, R., & Swamynathan, R. (2014). Competitive advantage through supply chain collaboration – an empirical study of the Indian textile industry. *Fibres and Textiles in Eastern Europe*, *22*(4), 8–13.

Verma, S. (2002). *Export Competitiveness of Indian textile and garment industry* (p. 52). Indian Council for Research on International Economic Relations.

World Bank. (n.d.). Gross capital formation (current US$) – India. World Bank national accounts data, and OECD National Accounts data files. https://data.worldbank.org/indicator/NE.GDI.TOTL.CD?locations=IN

World Integrated Trade Solution. (2023). *India Textiles and Clothing Imports by Country in US$ Thousand 2020*. https://wits.worldbank.org/CountryProfile/en/Country/IND/Year/2020/TradeFlow/Import/Partner/by-country/Product/50-63_TextCloth/Show/Partner%20Name;MPRT-TRD-VL;MPRT-PRDCT-SHR;AHS-WGHTD-AVRG;MFN-WGHTD-AVRG;/Sort/MPRT-TRD-VL/Chart/top10

World Trade Organization. (1986). *The General Agreement on Tariffs and Trade*. https://www.wto.org/english/docs_e/legal_e/gatt47.pdf

Annex - Policies

Name of policy or law	Dates of implementation	Level (national, provincial and municipal)	Contents	Implementing body	Reference
Amended Technology Upgradation Fund Scheme for textiles industry (ATUFS)	2016	National	The old machinery and technologies used in the textile industry can affect productivity and safety. ATUFS is designed to provide stimulus to entrepreneurs and business owners for upgrading technologies. A fund of USD 2.7 billion has been allocated for ATUFS scheme which was launched in January 2016. The funds were to be spent over the span of the next seven years. ATUFS facilities are expected to receive an investment of USD 15 billion and create 3 million jobs in the country. A one-time capital subsidy will be offered to business owners from technical textiles, garments, and weaving sectors. The central government will provide 15% subsidy to the garment, apparel and technical textile sectors. Other sub-sectors will receive 10% subsidy for upgradation.	Ministry of Textiles	(Textile Value Chain, 2020)_
Scheme for Integrated Textile Parks (SITP)	2005	National	The SITP has been planned to provide support for the creation of updated infrastructure facilities for setting up of textile units. The government of India has granted up to 40% of the project cost subject to a ceiling of USD 48.7 million. However, the government has granted up to 90% of the project cost for the first two projects (each) in the states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura, Sikkim, Himachal Pradesh, Uttarakhand and Jammu & Kashmir; with ceiling limit of approximately USD 4.8 million for each textile park.	Ministry of Textiles	(Textile Value Chain, 2020)_
National Textile policy 2000	2000	National	Key areas of focus include: The increasing contribution of the private sector by setting environment-friendly and technologically advanced textile units and complexes. To increase productivity, enhance marketing and distribution, upgrade technology, and increase R&D in the handloom sector. To produce cloth of good quality at acceptable prices that can meet the growing needs of the market. Constantly contributing to the provision of sustainable employment and the nation's economic growth. Compete with confidence to achieve a larger share of the global market.	Government of India	(Textile Value Chain, 2020)_
Foreign Direct Investment	NA	National	India allows 100% foreign direct investment through the “automatic route”. The automatic route states that non-resident investor or Indian company does not require approval from the government of India for the investment. This increased Indian investment from USD 55.56 billion in 2015–16 to USD 74 billion in 2019–20.	NA	(Textile Value Chain, 2020)
SAATHI Scheme	2017	Regional (Key clusters such as Ichalkaranji, Surat and Erode, have been chosen for the implementation of the scheme)	Under this initiative, Small and Medium Power loom units are provided with energy efficient power looms, motors and rapier kits at no advance costs by Energy Efficiency Services Limited (EESL), which is a Public Sector Undertaking under the Ministry of Power. The initiative is based on the accumulation, bulk acquirement and financing model. Under this initiative, the owner of the unit does not have to assign any advance capital cost to procure this equipment or administrate additional expenses for repayment. Use of this efficient equipment results in energy savings that in turn, leads to cost savings to the owner of the unit. This helps the owner repay the equipment cost to EESL in instalments over a period of 4 to 5 years.	Ministry of Textile and Union Ministry of Power	(Textile Value Chain, 2020)_

Name of policy or law	Dates of implementation	Level (national, provincial and municipal)	Contents	Implementing body	Reference
Merchandise Exports from India Scheme	2015–20	National	The goal of this scheme is to make India's export products more competitive in the global markets. As part of this scheme, the government has provided 5% incentives for exports of a certain category of goods like handloom, coir, carpets, and shawls to counterbalance infrastructural efficiencies and associated costs involved and to supply exporters with a level field.	Minister of Commerce and Industry	(Export-Import Bank of India, 2018; Textile Value Chain, 2020)
Scheme for Capacity Building in Textiles Sector (SCBTS)	2017	National	The key focus of this scheme is to provide a demand-driven and placement-oriented skilling programme for 10 lakh youth to create jobs in the organized textile sector and to promote skilling and skill upgradation in the traditional sectors. Training includes advanced technology-oriented features like Aadhaar Based Biometric Attendance System (AEBAS), CCTV recording, dedicated call centre, mobile app-based Management Information System and online monitoring.	Cabinet Committee on Economic Affairs (CCEA)	(Textile Value Chain, 2020)
Multifibre Agreement (MFA)	1974–2004	Multilateral	The MFA sought to achieve the expansion of trade, the reduction of barriers to trade and the progressive liberalization of world trade in textile products, while at the same time ensuring the orderly and equitable development of this trade and avoidance of disruptive effects in individual markets and on individual lines of production in both importing and exporting countries.	World Trade Organization	(Ravichandar et al., 2007)
National Technical Textile Mission	2020–21 to 2023–24	National	This mission will bring an overall improvement in cost economy, water and soil conservation, better agricultural productivity, and higher income to farmers per acre of land holding in addition to promotion of manufacturing and exports activities in India. This mission has four components (research, innovation and development, promotion and market development, and export promotion). The use of geo-textiles in highways, railways and ports will result in robust infrastructure, reduced maintenance cost and higher life cycle of the infrastructure assets. This mission also aims to promote innovation among young engineering / technology/science standards and graduates; along with creation of innovation and incubation centres and promotion of start-up ventures. It will also develop suitable equipment for environmentally sustainable disposal of used technical textiles, with emphasis on safe disposal of medical and hygiene wastes.	Ministry of Textiles	(Ministry of Textiles, 2020; Sutlej, 2020)
GST	2022	national	The new proposed law regarding indirect taxes states that all human-made and natural fibres will be treated equally for taxes. This is envisioned to indirectly encourage product diversification in the industry as manufacturers will consider blending synthetic fibres with cotton fibres.	Ministry of Textiles	(Sutlej, 2020)
Emergency Credit Line Guarantee scheme	2020	National	This scheme aims to clear up any financial challenges being faced by existing players as well as provide a platform to new players.	Ministry of Finance	(Apparel Resource News Desk, 2021; Sutlej, 2020)
Focus Product Incentive Scheme (FPIS)	Upcoming	National	This scheme will provide an incentive from 3% to 15% on stipulated incremental turnover for a period of five years after one year gestation period for brownfield investment and two years gestation period for greenfield investment for garment manufacturing firms.	NA	(Journals of India, 2021)

Name of policy or law	Dates of implementation	Level (national, provincial and municipal)	Contents	Implementing body	Reference
South Asia Free Trade Agreement (SAFTA)	2004	Bilateral	This agreement is intended to strengthen intra-SAARC economic cooperation and maximize the region's economic and social potential through various instruments of trade liberalization. The agreement binds all contracting states to reduce tariffs to 0 to 5% by 31 December 2015. The primary objective of SAFTA is to benefit the small economies of countries like Bhutan, Maldives and Bangladesh and provision of capacity building.	Governments of the SAARC	(Ministry of Commerce and Industry, 1993; Sutlej, 2020) -
India-ASEAN Comprehensive Economic Cooperation Agreement (CECA)	2005	Bilateral	The objectives of this Agreement are to: Strengthen and enhance economic, trade and investment cooperation between the Parties. Progressively liberalize and promote trade in goods and services as well as create a transparent, liberal and facilitative investment regime. Explore new areas and develop appropriate measures for closer economic cooperation between the Parties and facilitate the more effective economic integration of the new ASEAN Member States and bridge the development gap among the Parties.	ASEAN-India Trade Negotiating Committee (TNC)	(Association of Southeast Asian Nations, 2012; Sutlej, 2020)
Integrated Wool Development Programme (IWDP)	2017–20	National	The IWDP is an umbrella programme, implemented in all wool-producing states to support small, medium and large-scale wool-producing units. The scheme was also implemented to boost the wool-producing manufacturers' economic status in the country's rural regions. The primary goal of the scheme is to stop the decline of wool production in India and uplift the manufacturing process by offering various components in this scheme and to enable a steady growth in the production of wool among all rural wool-producing sectors.	Ministry of Textiles	(India Brand Equity Foundation, 2022a; India Filings, n.d.b)
New Textile Policy 2020	2020	National	This policy aims to develop a competitive textile sector that is modern, sustainable and inclusive, with a special focus on the manufacture of apparel and garment, technical textiles, human-made fibre products and exports while maintaining its pre-eminent position in handicrafts and handlooms sectors.	Ministry of Textiles	(The Textile Magazine, 2020)
Integrated Skill Development Scheme for the Textiles and Apparel sector (ISDS)	2008–2022 (2010–11; 2017)	National	This scheme aims to provide specific skills as per the requirement of apparel and other segments of the textile industry, as well as employee-trained people in related occupations. The scheme would be implemented through institutions/textile research associations under the Ministry of Textiles, state government agencies, and private bodies in the Public Private Partnership (PPP). 75% of the cost of funding is provided subject to the ceiling of INR 10 000 (USD 132) per person. Balance 25% will be mobilized by the “implementing agency”.	Ministry of Textiles	(Ministry of Textiles, n.d.; Nayyar et al., 2020)
Scheme for Capacity Building in Textile Sector (SAMARTH Scheme)	2017–18 to 2019–20	National	The aim of this scheme is to provide demand-driven, placement-oriented “skilling” programme to incentivize the efforts of the industry in creating jobs. This scheme targeted to train 1 million people (900 000 in the organized sector and 100 000 in the traditional sector) over a period of three years (2017–20) with an estimated budget of INR 1300 crore (USD 172 million) and another INR 6000 crore (USD 794 million) has been earmarked for the future.	Ministry of Textiles	(Ministry of Textiles, n.d.; Nayyar et al., 2020)

Name of policy or law	Dates of implementation	Level (national, provincial and municipal)	Contents	Implementing body	Reference
PowerTex India	2017–2020	National	The scheme aims to boost the existing infrastructure and encourage modernization in the power loom sector at an even larger scale. The total outlay for PowerTex India Scheme and knitwear scheme is INR 487 crore (USD 64 million).	Ministry of Textiles	(Nayyar et al., 2020)
Integrated processing development scheme (IPDS)	2014	National	This scheme was introduced to enable the textile processing sector to meet environmental standards through appropriate technology, including marine and river monitoring and protection, as well as zero liquid discharge policies. This scheme has funding of INR 500 crores (USD 66 million). The main objectives of this scheme are to promote the textile sector so that it becomes competent on a global level, facilitate the usage of eco-friendly technology in textile processing, help textile processing units to meet environmental standards fixed by various agencies of the government, encourage R&D activities geared towards innovative and clean technology and to create new processing parks and upgrade existing ones for better productivity.	Ministry of Textiles	(India Filings, n.d.c; Nayyar et al., 2020)
Project SU.RE	2019	National	Driven by the Clothing Manufacturers Association of India (CMAI), along with IMG Reliance (now RISE Worldwide), this will be the first step by the apparel industry to introduce critical sustainability goals. This would help the industry reduce its carbon emissions, increase resource efficiency, tackle waste and water management, and create positive social impact to achieve long-term sustainability.	Ministry of Textiles	(Ministry of Textiles, 2019b; Nayyar et al., 2020)
Remission of duties and taxes on exported products (RODTEP) scheme	2021	National	This scheme is envisioned to lead to the cost competitiveness of exported products in international markets and better employment opportunities in export-oriented manufacturing industries through a refund of GST taxes and import/customs duties for inputs along with VAT on fuel used in transportation, mandi tax, duty on electricity used during manufacturing.	World Trade Organization	(ClearTax, 2022)
Production linked incentive (PLI) scheme	NA	National	This scheme aims to boost local manufacturing, attract large investments in the textile and apparel sector, the government is planning to expand its PLI scheme.	NA	(Nayyar et al., 2020)
Integrated Scheme for Development of Silk Industry	2017–18 to 2020–21	National	This scheme aims to scale up production of the silk industry by improving the quality and productivity and to empower downtrodden, poor & backward families through various activities of sericulture in the country.	NA	(IIPNews, 2021)
National Handloom Development Programme	2017–18 to 2019–20	National	The basic concept of the scheme is to set up a Common Facility Centre at the Block Level along with a Common Service Centre to serve weavers of the Block with all facilities of pre-loom and post-loom activities. Computerized designing and card automatic punching is another component included so that the weavers could be assisted with required designs in electronic format as well as in the jacquard cards weave out the same in fabrics. Skill upgradation facility of weavers has been included in all the disciplines of weaving, dyeing and designing part from the managerial and IT skills. The scheme also provides the facility of modern Fly Shuttle Frame Looms with latest developed design development equipment as well as quality maintenance equipment. A Block Level Cluster is budgeted for involvement of Rs.200.00 lakhs.	Ministry of Textiles	(Ministry of Textiles, 2017; National Handloom Development Corporation Ltd., 2022; Shrivastava, 2020)

Name of policy or law	Dates of implementation	Level (national, provincial and municipal)	Contents	Implementing body	Reference
National Resource Efficiency Policy	2019	National	The guiding principles of the policy are reduction of primary resource consumption to 'sustainable' levels, create higher value with less material through resource efficient and circular approaches, minimize waste creation and loss of embedded resources at the end-of-life of products, ensure security of material supply and reduce import dependence 183 for essential materials and create employment opportunities and business models beneficial to the cause of environment protection and restoration.	Ministry of Environment, Forest and Climate Change	(Ministry of Environment and Forests (MoEF), 2019)
National Environment Policy (NEP)	2006	National	This policy aims to protect and conserve critical ecological systems and resources and to ensure equitable access to environmental resources and quality for all sections of society, and in particular, to ensure that poor communities, which are most dependent on environmental resources for their livelihoods, are assured secure access to these resources through Polluter Pays fees, Cost Minimization and Fault based liability.	Ministry of Environment and Forests (MoEF)	(Ministry of Environment and Forests (MoEF), 2006, 2019; Paper Tyari, 2022)
Zero Liquid Discharge	2014	National	This policy aims to reduce indiscriminate use of water and issues related to wastewater disposal and pollution of natural water bodies. It mandates zero discharge to textile units irrespective of their wastewater discharge.	Central Pollution Control Board (CPCB)	(Prabhakar, 2018; SMSEnvocare, 2016)
EU-INDIA Joint Declaration on Resource Efficiency and Circular Economy	2017	International	This partnership is intended to support dialogue and cooperation between both sides on resource efficiency and circular economy; the respective capacity of both sides to implement global commitments in the framework of Agenda 2030 and the Paris Agreement, and to advocate for bold transformational developments in relevant multilateral environmental agreements (MEAs) and forums (such as United Nations General Assembly, United Nations Environment Assembly, the G20 resource efficiency dialogue) and designing, planning, implementation, promotion and dissemination of policies, strategies, technologies, business solutions and financing mechanisms on resource efficiency and circular economy.	NA	(EU-India Summit, 2020)
The Agreement on Textiles and Clothing (ATC)	1973	International	This agreement is an attempt to correct the violation of the General Agreement on Tariff and Trade (GATT) principles of non-discrimination and transparency in respect of the Multi Fibre Agreement (MFA) that governed textile trade from 1974 to 1994. This is a transitional agreement that regulates trade in textiles for 10 years after which trade in textiles and clothing is to be completely integrated into the GATT.	WTO	(D'Souza, 2003)
General Agreement on Tariff and Trade (GATT)	1948	International	This legal agreement minimizes barriers to international trade by eliminating or reducing quotas, tariffs and subsidies while preserving significant regulations. The GATT was intended to boost economic recovery after World War II by reconstructing and liberalizing global trade.	WTO	(Majaski, 2022; World Trade Organization, 1986)
Export Promotion Capital Goods (EPCG) Scheme	NA	International	Zero duty EPCG scheme allows import of capital goods for pre-production, production and post-production (including CKD/SKD thereof as well as computer software systems) at zero Customs duty, subject to an export obligation equivalent to six times the duty saved on capital goods imported under EPCG scheme, to be fulfilled in six years, reckoned from Authorization issue-date.	Ministry of Commerce and Industry	(Directorate General of Foreign Trade 2022)

Name of policy or law	Dates of implementation	Level (national, provincial and municipal)	Contents	Implementing body	Reference
Advance Licensing Scheme	2015–2020	National	This Scheme is a type of duty exemption scheme where exemption of import duties for raw materials required for manufacture of export products.		(Impex Consultancy Services, n.d.)
Duty Exemption Pass Book (DEPB) Scheme	2005–06	National	DEPB credit rates have been prescribed for 79 textiles and clothing products (The DEPB credit rates cover about 150 textile and clothing products, for which Standard Input Output Norms (SION) are prescribed).	Ministry of Textiles	(Ministry of Textiles, 2003, p. 20)
Duty Drawback Scheme	1962	National	The exporters are allowed a refund of the excise and import duty suffered on raw materials etc. under the scheme to make the products more competitive in the international market.	Ministry of Finance	(Thaker, 2020)
Apparel Park for Exports Scheme	NA	National	The scheme is intended to impart focused thrust to setting up of apparel manufacturing units of international standards at potential growth centres and to boost exports.	Ministry of Textiles	(India Filings, n.d.a.)
Textile Centres Infrastructure Development Scheme (TCIDS)	2002	National	This scheme is a part of the drive to improve infrastructure facilities at potential textile growth centres and therefore aims at removing bottlenecks in exports so as to achieve the target of USD 50 billion by 2010 as envisaged in the National Textile Policy, 2000.	Apparel export promotion council	(Apparel Export Promotion Council, 2022; Howtoexportimport, 2022)
Factory Act	1949	National	Under this policy all industrial units with an investment in plant and machinery to a maximum of INR 6 million as designated as small-scale units. In addition, the government has declared more than 800 products for exclusive production by small-scale factories.	Ministry of Labor and Employment	(Ramaswamy & Gereffi, 2000)
Garments and Knitwear export entitlement (quota) policy	2000–04 (until 2021)	National	Under this policy, export entitlements are offered to ready-made garments and knitwear to the US, Canada and the EU.	Ministry of Textiles	(Ministry of Textiles, 1999a)
Textile Modernization Scheme	1986–91	National	Under this scheme, a fund of INR 7.5 billion was implemented with the Industrial Development Bank of India (IDBI) as the Nodal Agency. Restrictions on the imports of textiles machinery have been relaxed or removed and incentives provided for the import of capital goods for modernization and exports.	Ministry of Textiles	(Narayanan, 2009)
Excise Tax Reform (Central Excise Act)	1944	National	The tax is charged on the manufacture of goods and are meant for domestic consumption. Special excise duty and Additional duty of excise are also charged under the said act.	Ministry of Finance	(Indirect Taxes Committee, n.d.; Lal & Mohnen, 2009)
Technology Mission on Cotton	2000–2010	National	This mission aims to direct, coordinate and fund initiatives to raise the productivity and quality of Indian cotton and strengthen returns to growers. The focus areas are: (1) research and technology generation; (2) the transfer of technology to farmers; (3) the improvement of the marketing infrastructure; and (4) the modernization of gins.	Ministry of Textiles	(The Cotton Corporation of India, 2018)
Hank Yarn Obligation	2003	National	This rule aimed at guaranteeing an assured supply of cheap and coarse yarn to the handloom sector, so that it can, in turn, churn out “cheaper” fabric.	Regional Office of the Textile Commissioner	(Banerjee et al., 2016; Regional Office of the Textile Commissioner, 2003)

Name of policy or law	Dates of implementation	Level (national, provincial and municipal)	Contents	Implementing body	Reference
Quota entitlement policy	2000–04	National	This policy allocates quotas on the country's exports of textiles and apparel to the above-referred countries. The textile ministry revises the policy from time to time with the prime objective of promoting exports and attaining its policy goals.	Ministry of Textiles	(Ministry of Textiles, 1999b; United States International Trade Commission., 2001)
Duty Entitlement Passbook Scheme (DEPS)	1997	National	Objective of this scheme is to neutralize incidence of customs duty on import content of export product.	Government of India	(Agricultural and Processed Food Products Export Development Authority, n.d.; United Nations Conference on Trade and Development et al., n.d.; United States International Trade Commission., 2001)
Export Promotion Capital Goods (EPCG) Scheme	2015	National	This scheme is available to export companies and traders who provide the Indian government with information on the type and value of capital goods they are importing and the exports they expect to produce using those imports. Textile firms importing machinery and equipment under the EPCG scheme must export at least six times the c.i.f. value of imported goods within 6 years.	Directorate general of foreign trade	(United States International Trade Commission., 2001)
Concessional Credit for Handloom Sectors-Weavers Mudra Scheme	2011	Regional	The objective of the scheme is to make available the credit to handloom weavers at concessional interest rates.	Ministry of Textiles	(Ministry of Textiles, 2011)
India Handloom Brand (IHB) and Handloom Mark	2015	National	The main objective of the Indian Handloom Brand is to brand handloom products and secure a premium position for them in the Domestic as well as international market.	Ministry of Textiles	(National Handloom Development Corporation Ltd., 2022)_
Handloom Mark Scheme	2006	National	This scheme was launched to provide assurance to the consumers about the authenticity of handloom products.	Ministry of Textiles	(National Handloom Development Corporation Ltd., 2022)
Yarn supply Scheme	2011–12	National	The Yarn Supply Scheme (YSS) seeks to provide under-privileged handloom weavers with subsidized yarn and help them compete with the mill and power loom sectors.	Ministry of Textiles	(Ministry of Textiles, 2016, 2018)
Mahatma Gandhi Bunkar Bima Yojana (MGBBY)	2012–13 to 2016–17	National	This provides enhanced insurance cover to the handloom weavers in the case of natural as well as accidental death and in cases of total or partial disability.	NA	(India Filings, n.d.d)
Pradhan Mantri Suraksha Bima Yojana (PMSBY)	2015	NA	The scheme is being offered by Public Sector General Insurance Companies or any other General Insurance Company who are willing to offer the product on similar terms with necessary approvals and tie up with banks for this purpose.	NA	(Ministry of Finance, 2022)
Comprehensive Handloom Cluster Development Scheme (CHCDS)	2017–20	National	This scheme is implemented for development of mega handloom clusters having at least 15 000 looms. Under the scheme, various projects like setting up of Common Facility Centre, Dye House, Garmenting Unit, Silk Spinning Unit, Automatic Silk Reeling Unit, etc., have been taken up in PPP mode.	Ministry of Textiles	(Development Commissioner for Handlooms, n.d.; Ministry of Textiles, 2019a; StartupIndia, 2022)

Visit us

SEI Headquarters

Linnégatan 87D
Box 24218
104 51 Stockholm Sweden
Tel: +46 8 30 80 44
info@sei.org

Måns Nilsson
Executive Director

SEI Africa

World Agroforestry Centre
United Nations Avenue Gigiri
P.O. Box 30677 Nairobi 00100 Kenya
Tel: +254 20 722 4886
info-Africa@sei.org

Philip Osano
Centre Director

SEI Asia

Chulalongkorn University
Henri Dunant Road Pathumwan
Bangkok 10330 Thailand
Tel: +66 2 251 4415
info-Asia@sei.org

Niall O'Connor
Centre Director

SEI Latin America

Calle 71 # 11–10
Oficina 801
Bogotá Colombia
Tel: +57 1 6355319
info-LatinAmerica@sei.org

David Purkey
Centre Director

SEI Oxford

Oxford Eco Centre
Roger House Osney Mead
Oxford OX2 0ES UK
Tel: +44 1865 42 6316
info-Oxford@sei.org

Ruth Butterfield
Centre Director

SEI Tallinn

Arsenal Centre
Erika 14
10416 Tallinn Estonia
Tel: +372 6276 100
info-Tallinn@sei.org

Lauri Tammiste
Centre Director

SEI York

University of York
Heslington
York YO10 5NG UK
Tel: +44 1904 32 2897
info-York@sei.org

Sarah West
Centre Director

SEI US
Main Office

11 Curtis Avenue
Somerville MA 02144-1224 USA
Tel: +1 617 627 3786
info-US@sei.org

Michael Lazarus
Centre Director

SEI US
Davis Office

501 Second Street
Davis CA 95616 USA
Tel: +1 530 753 3035

SEI US
Seattle Office

1402 Third Avenue Suite 925
Seattle WA 98101 USA
Tel: +1 206 547 4000

SEI Stockholm Environment Institute

sei.org

@SEIresearch @SEIclimate