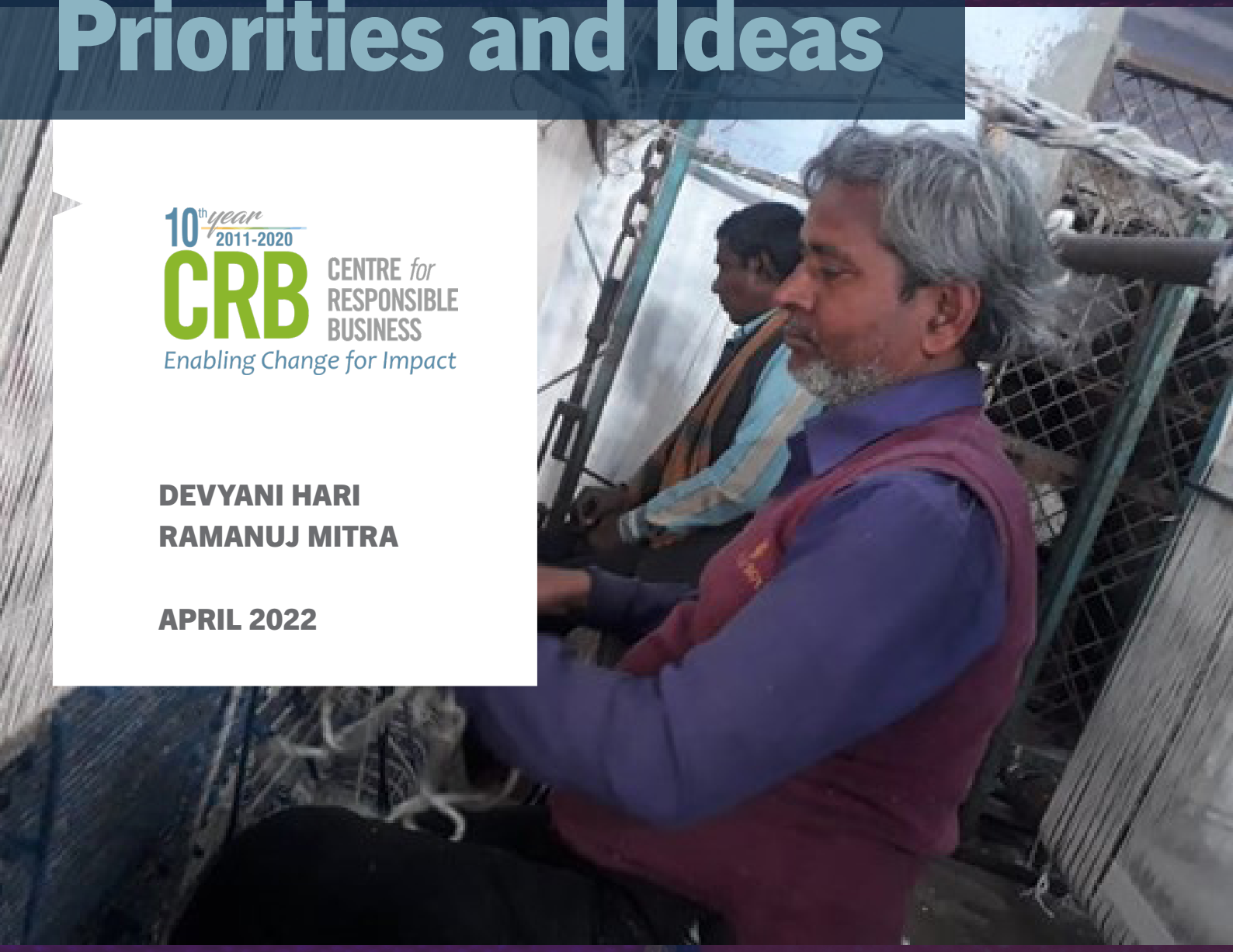
Circular Textile and Apparel in India

Policy Intervention Priorities and Ideas



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Enabling Change for Impact

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APRIL 2022

Table of Content

Table of Content

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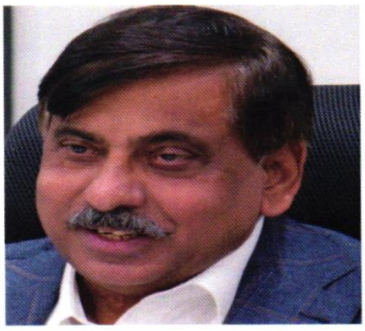

7th April 2022

SPECIAL M E S S A G E

Circular Economy is a system which can replace the linear (take-make-dispose) model of growth and help regenerate our natural ecosystems. It offers a promising pathway for the Indian apparel and textile sector, which endeavors to become a global leader in sustainable manufacturing and exports of high-quality garments. With the right combination of investments and upskilling of young workers, circular economy can unlock millions of green jobs in the apparel and textile as well as allied sectors such as agriculture and chemicals.
The Ministry of Textiles, Government of India is committed to promoting sustainable development of the economy, where the apparel and textile sector can play a key role. The Ministry has launched a number of schemes over the years to upskill garment workers and make them future ready, as smart manufacturing and automation continue to shape the manufacturing landscape.

Circular economy also enables manufacturers reduce their environmental footprint by keeping value in the system longer and thus reduce waste. This is very crucial for the sector as resource scarcity, especially the lack of clean water can be detrimental to both industry as well as the society at large.

This report by Centre for Responsible Business (CRB) is a timely endeavor, as it reminds us the potential of circular economy. The report highlights several key aspects of circular economy and how policy interventions can support them. I congratulate them on this effort and urge both the private sector and the civil society to join hands in creating a circular transition in the sector.

(U.P. Singh)

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Foreword

The Indian textile and apparel sector is at a pivotal moment of its history. Despite many inherent structural weaknesses that affect its global competitiveness and challenges resulting from the COVID-19 pandemic, the future prospects of the industry appear strong with it estimated to reach $190 bn by 2025-26 from $103.4 bn in 2020-21. Despite this bright financial outlook, the sector needs to critically reevaluate its approaches in a world that is increasingly driven by the 2030 Agenda for Sustainable Development and Climate Action.

With the world's biggest fashion brands increasingly committing to Net Zero targets we are witnessing an upwards momentum for sustainability in the international fashion arena. This era of environmental, and social awareness, as well as governance in the textile industry has to be the major focus for India.

Concerted policy action such as the European Union's Circular Economy Action Plan, which paves the way for the transition to a circular economy, the recently introduced New York Fashion Bill for supply chain mapping, and other such positive international developments will significantly affect the Indian textile sector given its crucial role in the global textile and apparel value chains.

UNEP's work focuses on the value chain approach for interventions in the textile sector. Accordingly, the organization noted that coordinated actions in all regions by all stakeholders (government, industry, and consumers) and changes at each stage in the value chain involving players of all sizes and market segments are required to transition to a more sustainable and circular fashion. Additionally, stronger governance and policies were observed to be critical. UNEP is developing a roadmap for a collaborative pathway towards greater sustainability and circularity in the textile value chain. The publication will identify prioritized actions that different stakeholder groups should take to drive this transition and will highlight best practices.

We see several promising initiatives and other actions adopting circular economy approaches in the Indian textile and apparel industry by innovators, pioneering companies across the value chain, as well as by industry-led platforms. Despite these encouraging developments in some market segments, we find that the pace of industry-wide transformation is still slow, especially with SMEs. This can be rectified with a focused policy framework that encompasses the social dimension and a just transition in developing economies like India. This policy framework can help scale up and accelerate the pace of change.

This report by CRB identifying priority areas for Circular Economy interventions in the Indian textile and apparel value chain is a vital piece of work that aims at delivering an aggregated understanding of the sector and stakeholder perspectives, as well as at informing policy on Circular Economy integration.

With the aim to move towards a sustainable and just transition of the sector, UNEP looks forward to supporting and coordinating efforts across the textile and apparel value chain in India as well as advocating for policy reforms in close cooperation with the Ministry of Textiles.

Atul Bagai
Head, United Nations Environment Programme Country Office, India

Preface

The Indian apparel and textile sector contributes significantly to the Indian economy in terms of manufacturing, employment, exports and GDP contribution. This report was created to summarise the scope and potential of circular economy in transforming the apparel and textile (A&T) sector in India. The A&T sector is a crucial component of India's economic backbone. It contributes about 2% to India's GDP, and employs about 10.5 crore workers in the A&T and allied sectors. But the sector has a high impact in terms of environmental pollution. Given India's commitment to improve its environmental performance while expanding its economy, circular economy can show the way forward, by promoting resource efficiency (RE) and helping in creating new business models.

CRB's work on circular economy is motivated by the fact that sectoral RE policies are not yet formulated. Sectoral RE policies must be prepared and integrated in the national RE plan so that the full potential of "Green Growth" could be achieved. Circular Economy is a promising production and consumption paradigm that can help promote resource efficiency. It can minimize resource use impacts and create new jobs in almost all sectors of the Indian economy.

When circular economy priorities are linked with social benefits such as fair wages, good working conditions, augmented by transparency in business practices, opportunities open up for businesses to cater to global value chains. The A&T sector can especially benefit from such a "social circular economy". It can boost exports by adhering to global norms and voluntary sustainability standards, while create new jobs by prompting and formalizing activities such as recovery, repurpose, repair, and recycling of garments, post-production and post-consumer textiles, etc.

This paper aims to highlight the potential of circular economy for the A&T sector and highlight policy interventions to support a transition of the current linear economy. It provides an overview of the sector and some components of circular economy, along with the priority areas that need focus in the coming years.

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April 2022

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Acknowledgement

This report wouldn't have been possible without the guidance of **Mr B N Satpathy,** Senior Consultant, Office of Principal Scientific Advisor (GoI). Mr Satpathy continuously encouraged CRB to put together this document outlining the status of the apparel and textile sector in India. CRB is also indebted to **Mr Dogru Cagdas**, Environmental Sustainability Program Manager, H&M, and **Mr Anjani Prasad**, Archroma for their time and valuable inputs in creating the content for this report. **Mr Ashok Juneja**, President (Textile Association of India) and Advisor to CRB, has also contributed immensely with his knowledge on the sector. CRB is grateful for his continued guidance.

CRB is extremely thankful to **Dr. Naresh Tyagi**, Chief Sustainability Officer, Aditya Birla Fashion and Retail Limited for his continuous engagement, expert guidance and valuable inputs for the preparation of this paper.

We also thank **Mr Debaditya Das** (MBA Candidate, Symbiosis, Pune) for his contribution in research towards this report and compiling data from various sources.

Finally, we thank **IDRC, Canada** for funding the preparation of this report under CRB's project titled PROGRESS (focused on private sector participation in achieving the SDGs), undertaken in partnership with Aston Business School, UK.

Abbreviations

ASSOCHAM: The Associated Chambers of Commerce and Industry of India
NIPFA: National Investment Promotion and Facilitation Agency
FDI: Foreign Direct Investment
CAGR: Compound Annual Growth Rate
WTO: World Trade Organization
ILO: International Labour Organization
MoSPI: Ministry of Statistics and Program Implementation
MoC&I: Ministry of Commerce and Industries
RMG: Ready-made Garments
IIP: Index of Industrial Production
PFCE: Private Final Consumption Expenditure
NSDC: National Skill Development Corporation

Definitions

Textile: Woven or knitted fabric made from yarn, fibre or fabric is known as Textile. They constitute vast areas of constituents like fibres, yarns, fabric manufacturing and processing.

Apparels: They are stitched, semi-stitched, or unstitched materials made out of the textiles and are used for dressing, covering and protection. Apparels are one step value added part of textiles.

NIPFA:

Composite Mills: Relatively large-scale mills that integrate spinning, weaving and, sometimes, fabric finishing now account for about only 3 percent of output in the textile sector in India.

Technical Textile: Technical Textiles is a high technology sunrise sector which is steadily gaining ground in India. Technical textiles are functional fabrics that have applications across various industries including automobiles, civil engineering and construction, agriculture, healthcare, industrial safety, personal protection etc. Based on usage, there are 12 technical textile segments; Agrotech, Meditech, Buildtech, Mobiltech, Clothtech, Oekotech, Geotech, Packtech, Hometech, Protech, Indutech and Sportech.

Agrotech: Special textiles that are manufactured for agricultural applications is known as AGROTECH or AGROTEXTILES. Fibers used for Agro Textiles man-made fibers are preferred for agricultural product than the natural fiber due to their high strength, durability and other suitable properties of agricultural applications

Protech: encompasses all those textile materials and products used in the production of protective clothing of various types.

Meditech: Meditech products are textile products such as bandages, wound dressings, hospital linen, surgery material etc that are used in medical services.

Buildtech: Buildtech textiles are used in: construction concrete reinforcement, façade foundation systems, interior construction, insulations, proofing materials, air conditioning, noise prevention, visual protection, protection against the sun, building safety.

Composites: A composite textile material (also called a composition material or shortened to composite) is a material made from two or more constituent materials with significantly different physical or chemical properties that, when combined, produce a material with characteristics different from the individual components.

Sportech: Manufacturing activities of textiles for sports including adventure sports are shifting from developed countries to developing countries.

Geotech: These are used in reinforcement of embankments or in construction work. The fabrics in geo textiles are permeable fabrics and are used with soils having ability to separate, filter, protect or drain.

Nonwovens: Nonwoven fabric is a fabric-like material made from staple fibre (short) and long fibres (continuous long), bonded together by chemical, mechanical, heat or solvent treatment. The term is used in the textile manufacturing industry to denote fabrics, such as felt, which are neither woven nor knitted.

Indutech: Textiles used for chemical and electrical applications and textiles related to mechanical engineering. Silk-screen printing, filtration, plasma screens, propulsion technology, lifting/conveying equipment, sound-proofing elements, melting processes, roller covers, grinding technology, insulations, seals, fuel cell.

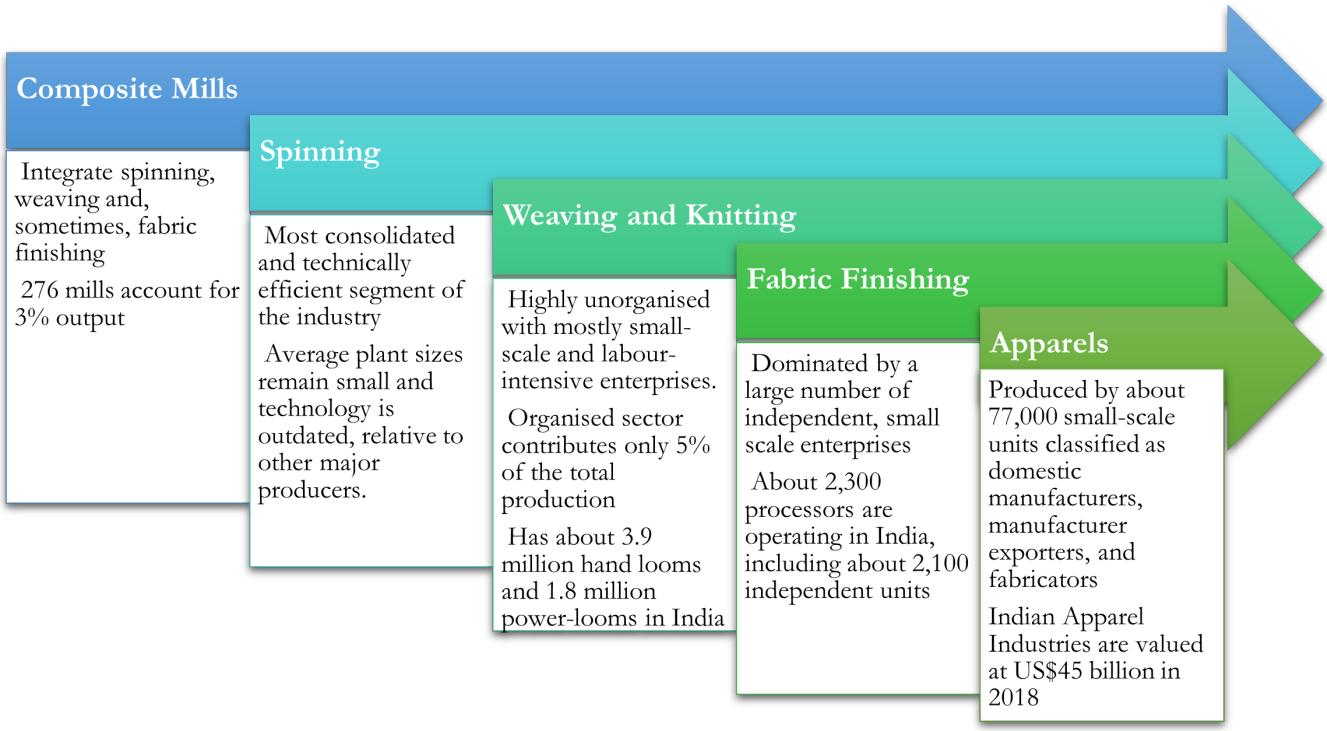
Executive Summary

Textile and apparel sector in India: Overview

The ***Textile***[1] sector is one of the oldest industries in India contributing approximately 2 % of the GDP and 18 % of manufacturing (2017-18)[2]. India is the 6th largest apparel and textile exporter of the world (Economic Survey 2020-21). In 2019-20, India's total exports of textile and clothing were about 12 % of overall India's exports (Economic Survey 2019-20). India has been witnessing a rapid growth in the Textile and Apparel industries due to rapid urbanization, increasing disposable income, increasing customer base and retail penetration. ***Apparel***[3] is one of the major finished products of the sector. Apparel worth INR 5478 billion along with Technical Textiles (See section 6) worth INR 1406 billion and home furnishing worth INR 518 billion make the major share of India's domestic demand story (NIPFA, 2020). European Union and USA are the major trading partners of Indian Apparel industry. The apparel sector in India contributes to 14% of the IIP (Index of Industrial Production) and 17% of India's export earnings (CARE Ratings, 2019).

The Textiles and Apparel industry in India plays a **major role in generating jobs and 'Make in India'** campaign. It **employs 45 million people directly and 60 million in allied sector** (Economic Survey, 2019-20). However, with the increasing focus on yarn and fabric to final products, there is expected to be a change in the skills and characteristics of potential candidates. Tamil Nadu employs about a quarter of its total work force in this sector, also the largest by share of any Indian states followed by Gujarat, Karnataka, Maharashtra, West Bengal and Punjab.

The Indian Textile and Apparel Industry mostly comprises of small-scale non-integrated spinning, weaving and knitting, fabric finishing, and apparel-making enterprises. In contrast, the Textile sector in developed economies is dominated by large scale mills with modern technology and machinery, that integrate spinning, weaving and, sometimes, fabric finishing.



Structure of the Indian Textile Industry [4]

[1] "Textile" generally refers to woven fabric, but the term can broadly be applied to any fabric, fibre, yarn or their products
[2] Economic Survey of India. 2019-20
[3] "Apparel " refers to clothes or garments as sold in stores or other forms of retail.
[4] The Textiles and Apparels Industry contributing to Make in India, ASSOCHAM

The Indian Textile and Apparel industries faces unprecedented challenges due to few structural weaknesses like highly fragmented industry, lack of product diversification, limited client base, and inefficient productivity compared to its competitors (China, Bangladesh, Vietnam, etc.) and lack of supportive governance policies. Our Textile and Apparel exports are highly dependent on cotton. Price of the cotton yarn produced in India is amongst the highest in the world. This can largely be attributed to the high minimum support prices.[5] This high input costs are offsetting the benefits of weakening currency, thus subliming the net benefits in terms of overall competitiveness in the sector.

What is Circular Economy and its role in making the Indian T&A sector competitive

The Indian textile and apparel industry is in need for urgent transformation given India's weakening position globally. The apparel and textile sector in India contributes to widespread pollution[6] - that needs to be addressed vis-a-vis international competitiveness. Customers as well as brands are demanding sustainable products. Globally, the fashion industry especially with its focus on fast fashion is under immense scrutiny due to its adverse environmental and ecological impacts. These impacts broadly relate to:

- ***Raw Materials used*** - For e.g. cotton is highly resource intensive and one production of one cotton shirt can use up to 2700 litres of water.[7] Further, cotton also consumes high amount of pesticides and insecticides, traces of which remain in finished garments. On the other hand polyester while consuming less resources, is non-biodegradable and contributes immensely to the problem of micro-plastics[8] that are released during washing of synthetic fibres such as polyester

- ***Chemicals*** – The textile and apparel industry uses over 8000 chemicals starting right from production of fibres and continuing to dyeing, processing and finishing of textiles. Almost 20% of water pollution can be attributed to textile dyeing and treatment[9]

- ***Waste Generation*** – Given the trends of fast fashion (styles changing much faster at much more affordable rates) has meant that consumers are buying a lot more clothes but using them for a much shorter time. This has translated to large amounts of waste being sent to landfills – almost 85% of all clothes end up in landfills[10]. The rate of recycling of these clothes is abysmally low at just about 15%[11].

- ***Energy consumption*** – The spinning and weaving processes are energy intensive processes and research indicates that energy costs account for nearly 15% - 20% of total production costs in the sector[12]. Modernisation and use of cleaner and more efficient machinery can lead to considerable gains for the industry across the value chain.

- ***Water use efficiency and managing water pollution*** - Given the increasing demand for transparency and rising consumer awareness in developed economies, the industry is beginning to explore solutions to contain and combat its adverse effects. Circular economy (CE) principles offer a viable solution. Circular Economy is an **economic system where materials and energy circulate in loops** and stay within the value chain, as opposed to a linear system of take-make-dispose. In a circular economy **material is reduced, reused, recycled and repurposed**.

[5] Cogencis. http://www.cogencis.com/newssection/hike-in-msp-curbs-cotton-exports-only-600000-bales-shipped-so-far/
[6] Various components of the apparel/textiles industry are categorised as highly polluting, by the Central Pollution Control Board, MoEFCC, GoI (http://www.indiaenvironmentportal.org.in/files/industrialcluster.pdf)
[7] https://www.wri.org/blog/2017/07/apparel-industrys-environmental-impact-6-graphics
[8] Plastic particle of less than 1mm in diameter
[9] https://www.commonobjective.co/article/the-issues-chemicals
[10] https://www.businessinsider.in/slideshows/miscellaneous/the-fashion-industry-emits-more-carbon-than-international-flights-and-maritime-shipping-combined-here-are-the-biggest-ways-it-impacts-the-planet-/slidelist/71640838.cms#slideid=71640858
[11] https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/textiles-material-specific-data
[12] https://textilevaluechain.in/news-insights/renewable-energy-weaved-into-indias-textile-industry/

Indian suppliers and manufacturers stand to make considerable gains if they proactively adopt good practices and innovate through circular business models and practices and get ready to be part of the transformation that is happening globally. The Indian government, both at state and national levels, therefore, should move forward with favourable policies and programmes that support transition to environmentally sustainable practices. India has already made significant progress towards the sustainable development goals adopted by the UN in 2015. The NITI Aayog has launched the SDG India Index 2019-20 to track the country's progress on the SDGs.[13] Similarly, the Economic Survey 2021 underscores the government's commitment towards supporting holistic sustainable development[14]. Finally, the Central government announced 100% FDI through the direct route[15] - implying that domestic manufacturers may face stiffer competition from foreign firms setting up shop in India in coming years, if they do not raise themselves quickly to international standards while limiting costs.

Circular economy can be a gamechanger for Indian suppliers and manufacturers. However, global discussions on circular economy have to be clearly contextualised for India. India is both a major producer and consumer of textiles and apparels and any circular economy intervention has to be aligned to the requirements of the value chain actors in India. This paper has been developed through extensive engagement with the stakeholders of the Indian Textile and Apparel industry and identifies the CE priorities for the Indian context.

Centre for Responsible Business (CRB, www.c4rb.org), a think tank based out of New Delhi, has created the framework to capture the circular economy priorities or action points in alignment with the principles of circular economy- i.e. (i) design out waste and pollution; (ii) keep products and materials in use;, and (iii) regenerate natural systems - and set targets in consultation with relevant stakeholders. Capturing the CE priorities of design, material, water, energy, waste and business models at various nodes of the textile and apparel value chain, the framework provides a standardized means to gather input on the most critical aspects of circular economy. Further, the framework also helps to inform policy making in the sector to enable the Indian textile and apparel industry to adopt more circular practices.

Circular Apparel Policy Priorities

The CRB team has identified CE interventions based on secondary research and extensive stakeholder consultations across various value chain actors especially with brands (domestic and international), suppliers and manufacturers, dyeing and chemical companies, academia, innovators, and state government officials.[16] These ideas, aligned to the CE priorities defined in the framework, have been broadly categorised as actions proposed for practitioners and as possible policy interventions. Some of the main recommendations include:

- ***Clear design guidelines*** should be defined indicating the types of material to be used (virgin + recycled), chemicals to be avoided/used, design for durability, design for end-of-life processes/ purposes, cost of collection for end of life should be factored in, clear labelling (transparency and traceability), patterns/design innovation (role of designers and brands).

Potential policy action: Issue advisory on textile production parameters and processes and constitute a task force (suggested to be anchored with Ministry of Textiles) that can facilitate setting of industry guidelines for circular design and manufacturing amongst the industry players. For e.g. Ellen McArthur's guidelines on jeans manufacturing[17]. Wastewater effluent standards for the Textile

[13] SDG India Index. https://niti.gov.in/sdg-india-index-dashboard-2019-20
[14] https://www.indiabudget.gov.in/economicsurvey/doc/vol2chapter/echap06_vol2.pdf
[15] Ministry of Textiles. http://texmin.nic.in/fdi-cell
[16] Consultation have been held at Ahmedabad, Bengaluru, Panipat and Tirupur (virtual), covering stakeholders from other clusters in their respective states (Gujarat, Karnataka, Haryana, and Tamil Nadu).
[17] https://www.ellenmacarthurfoundation.org/news/make-fashion-circular-launches-the-jeans-redesign

and dyeing industries should be developed by Central Pollution Control Board (CPCB) along with the State Pollution Control Boards (SPCBs) under the supervision of Ministry of Environment, Forest and Climate Change. To cater the localised needs with an aim of achieving absolute Zero Liquid Discharge. Implementation guidelines to be prepared by CPCB with significant empowerment to ULBs to sensitize with the local needs.

- ***Alternative/ Recycled fibres*** – There is a need to work with alternate materials that are less water and energy intensive, can be easily recycled, and are more durable. For example hemp, banana fibre, and other sources of cellulose. Emphasis has to be given to manmade fibres and extensive R&D is needed both for alternate materials and on cost effective recycling technologies. Further, innovation in these areas should be supported. Transparency and traceability will be required to authenticate material sources and fibre content to support recycling.

Potential policy action: Policy actors can define a "content law", provide incentive and tax perks for use of alternate materials. Sustainable public procurement can provide impetus to use of alternate/ recycled materials. Clear labelling and quality norms for apparel made from recycled materials will instil confidence amongst consumers.

- **Compliance (measuring and monitoring) related to chemical use** – Emphasis to be placed monitoring chemical use in fibre manufacturing, washing and dyeing and garment manufacturing – different fibres have different challenges – cotton requires excessive use of pesticides (focus on organic cotton), other fibres require use of oil that is discharged with wastewater, toxic chemicals harm aquatic life. Also, focus on dry cleaning for the chemicals used

Potential policy action: Regulation can play a crucial role in banning or defining the quantities and discharge of hazardous chemicals. Incentives can be provided for use of natural dyes and for uptake of waterless dyeing techniques that can considerably reduce water pollution.

- **Managing Waste from the Apparel & textile sector** - Pre consumption waste can either be reduced through technology adoption (for larger units) or through linking production units to up cyclers/ recyclers to prevent waste from going to landfills. Consumers need to be educated and incentivised to recycle used garments. Reverse logistics need to be considerably strengthened to support a recycling /upcycling/ repair eco-system.

Potential policy action: As a start, the landfilling of textile waste (pre and post consumption) can be completely banned. An Act along the lines of Solid Waste Management 2016 can be defined for the textile and apparel sector. Government funded research institutions can undertake research on cost-effective recycling options. Common waste management infrastructure especially for smaller units should be encouraged and supported through government support. Extended Producer Responsibility guidelines for the apparel sector need to be defined.

- **Adopting energy efficiency and renewable energy interventions** - The need for energy efficient machinery and use of cleaner energy is well understood amongst the industry actors. However, a need for a stable policy has been identified as a major requirement.

Potential policy action: Policies can be implemented to prioritise renewable energy over conventional sources. Policy must be long-term and stable as renewable energy requires large investments from companies. Innovation at the MSMEs should be promoted (including handicrafts), focussing on in-situ technical/technological innovations. Official case studies should be documented and scaled/replicated elsewhere. The Technology Upgradation Funds Scheme (TUFS) should be amended to include more energy efficient technologies/ equipment.

- **Water Consumption in the sector** – Industry can undertake detailed water audits to measure

its water footprint along its operations and identify measures to reduce water consumption. Technologies for wastewater treatment are very costly at the moment and adoption at scale is hindered.

Potential Policy Action: Incentives can be provided for use of recycled water. Regulations can be passed to mandate the partial use of recycled water. Modernisation of dyeing units should be incentivised as this directly impacts the consumption of water. Common infrastructure will need to be considered for smaller units and all polluting processes can be clustered in a common facility.

Apart from the issues highlighted above, the following are important cross cutting issues that need to be considered for promoting circular practices in the textile and apparel sector:

- **Training/skilling** – higher-order skills should be imparted; industry should be consulted about the kind of training required. Industries have claimed that skills imparted by the Integrated Skills Development Scheme (ISDS) were not sufficient to raise worker productivity or were not aligned with exact requirements. Circular economy transition would need workers trained in repair, refurbishment, redesign, etc.
- **Sustainable Public Procurement**– Public procurement can play a big in transition. Sustainable procurement guidelines should be issued for buying uniforms for officers, police force, workers, etc. as well as miscellaneous cloth materials. Ideally, uniforms and other materials made from made from recycled fibres or textile waste or eco-friendly fibres should be encouraged/procured through Government E-Marketplace. This would nudge suppliers to look into alternative fibres, green production processes, as well as decent working conditions/wages, etc.
- **Role of R&D, Technology, Technology Institutes** –
    - R&D to be incentivised for: 1) alternate materials, 2) waterless dyeing, 3) water saving technologies, greener chemicals, natural dyes, 4) water treatment etc.
    - Technology compendium for all available technology that enable better resource efficiency or minimise waste (for reducing water consumption, less energy usage, wasting less fabric, recycling waste etc) – No comprehensive information available for the same
- **Education** - Curriculum in textile engineering colleges can be upgraded to introduce element of efficiency at this stage itself.

There is no doubt that adoption of circular economy principles will provide a competitive advantage to the Indian textile and apparel sector. However, these interventions require close collaboration of all stakeholders and appropriate policy support.

Way forward

- A systematic, human centred transition to a circular economy is needed for the textile and apparel industry for better environmental and social performance, as well as to improve competitiveness and improve market access. Opportunities are also emerging for attracting international and domestic sources of sustainable (ESG) finance, especially with the Government of India developing a roadmap on Sustainable Finance in India. A continued and concerted support involving various segments of the government at all levels is needed to create the enabling environment for circularity.
- Skill and capacity building of workers and entrepreneurs is required and critical, especially from the point of 'just transition'. This will ensure that a circular transition not only creates new job opportunities but also existing jobs are protected in a transitioning sector. Further,

certain categories of consumers can start to play a key role in influencing the brands (national and international)

- A move to support integration of circular economy must be institutionalised and led by the Ministry of Textiles. The Ministry of Textiles should develop a roadmap for the sector, with inputs and consultation with suppliers, exporters, brands, experts, CSOs, etc. Some Ministries like the Ministry of Electronics and IT have realised the importance of such a roadmap already (MeiTY released a policy paper to this end in May 2021).
- EPR and reverse logistics need to be deployed especially by brands/buyers to reduce textile waste

1. Introduction

Textile and apparel sector in India: Overview

The ***Textile***[18] sector is one of the oldest industries in India contributing approximately 2 % of the GDP and 18 % of manufacturing (2017-18)[19]. India is the 6th largest apparel and textile exporter of the world (Economic Survey 2020-21). In 2019-20, India's total exports of textile and clothing were about 12 % of overall India's exports (Economic Survey 2019-20). Textile sector in India attracted US$3.1 billion as investments in the form in 2018-19 (NIPFA, 2020). The Textile and apparel industry is the second largest employer in India after agriculture (CARE Ratings, 2019). India has been witnessing a rapid growth in the Textile and Apparel industries due to rapid urbanization, increasing disposable income, increasing customer base and retail penetration. USD 20.5 billion worth of Textile, USD 16.1 billion worth apparel along with handlooms worth USD 3.8 billion are exported from India every year (NIPFA, 2020).

Table 1: Share in Global Textile Export [20]

Share in Global Textile Exports (%)			
	India	China	USA
2000	3.6	10.3	7
2005	4.1	20.2	6.1
2010	5.1	30.4	4.8
2018	5.8	37.6	4.4

Textile Market

"Textile" generally refers to woven fabric, but the term can broadly be applied to any fabric, fibre, yarn or their products. The domestic demand for textiles is worth USD 100 billion (including handlooms) whereas, exports are worth about USD 40 billion every year (NIPFA, 2020). Power looms & knitting segments are the largest components of the sector but are highly decentralized (IBEF, 2019).

Indian Textile industries is expected to grow from its worth of USD 140 billion industry in 2018 to USD 223 billion industry by 2023. Out of this, the projections for exports are valued at USD 185 billion, maintaining a CAGR is 15%. (MoC&I, 2018)

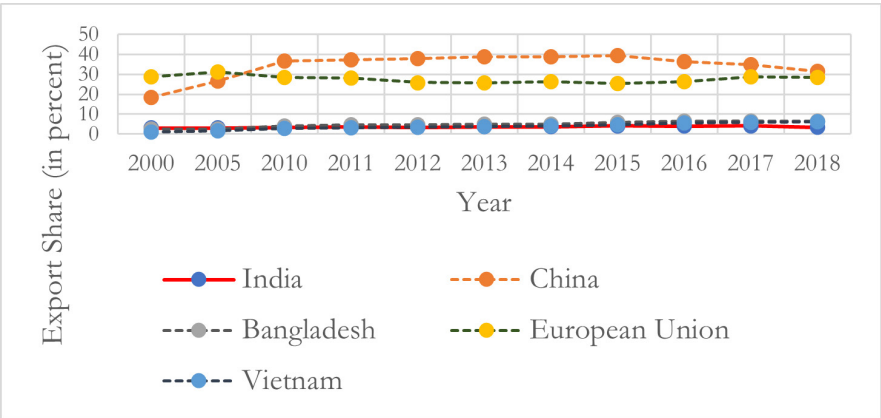


Figure 1: Global Textile Exports share of selected countries[21]

[18] "Textile" generally refers to woven fabric, but the term can broadly be applied to any fabric, fibre, yarn or their products
[19] Economic Survey of India. 2019-20
[20] WTO Trade Statistical Review, 2019
[21] WTO Trade Statistical Review, 2011 to 2019

Apparel Market

"Apparel" refers to clothes or garments as sold in stores or other forms of retail. It is one of the major finished products of the sector. Global Apparel Market is the most dynamic product among manufactured goods with an annual growth rate of 3.3% (WTO, 2019). The overall demand growth for 2019 in the Global Apparel market witnessed a subdued growth rate due to various geo-political tensions, particularly the US-China trade wars and weak demand across the globe. (MoC&I, 2018)

Apparel worth USD 74 billion along with Technical Textiles (See section 6) worth USD 19 billion and home furnishing worth USD 7 billion make the major share of India's domestic demand story (NIPFA, 2020). The Apparel industry in India is largely a labour-intensive industry directly employing more than 10 million people (ILO, 2015). European Union and USA are the major trading partners of Indian Apparel industry. The apparel sector in India contributes to 14% of the IIP (Index of Industrial Production) and 17% of India's export earnings (CARE Ratings, 2019). Due to the challenges in gathering information about domestic market size because of lack of data maintenance, data is collected through a proxy known as PFCE (Private Final Consumption Expenditure) method. The forecast data at 95% confidence level suggests the Indian Apparel industry will follow a linear growth pattern with a CAGR of 13% (Refer: Figure 2: Growth forecast of the Indian Apparel Industry).

The Value-Added Multiplier Effect

Value addition happens in every step of the textile and apparel manufacturing process. The Value-added multiplier is 3.92[22] (ASSOCHAM, 2015). This means, value added in the economy because of a Rs. 1 rise in demand of the textiles and apparels industry is almost four times of the value added in the industry itself. This would happen because of the strong linkages which the industry has with ancillary industries.

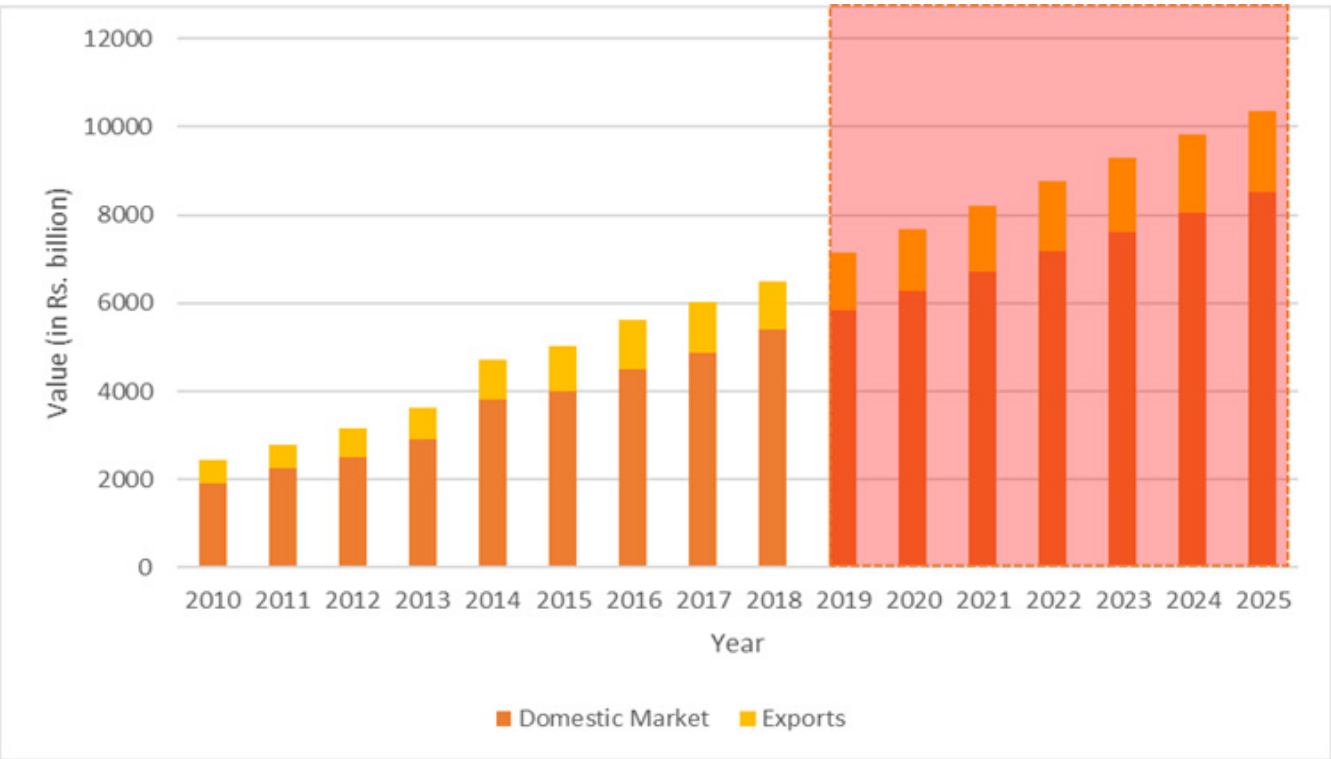


Figure 2: Growth forecast of the Indian Apparel Industry[23]

[22] The Textiles and Apparels Industry contributing to Make in India, ASSOCHAM
[23] CARE Ratings, 2019

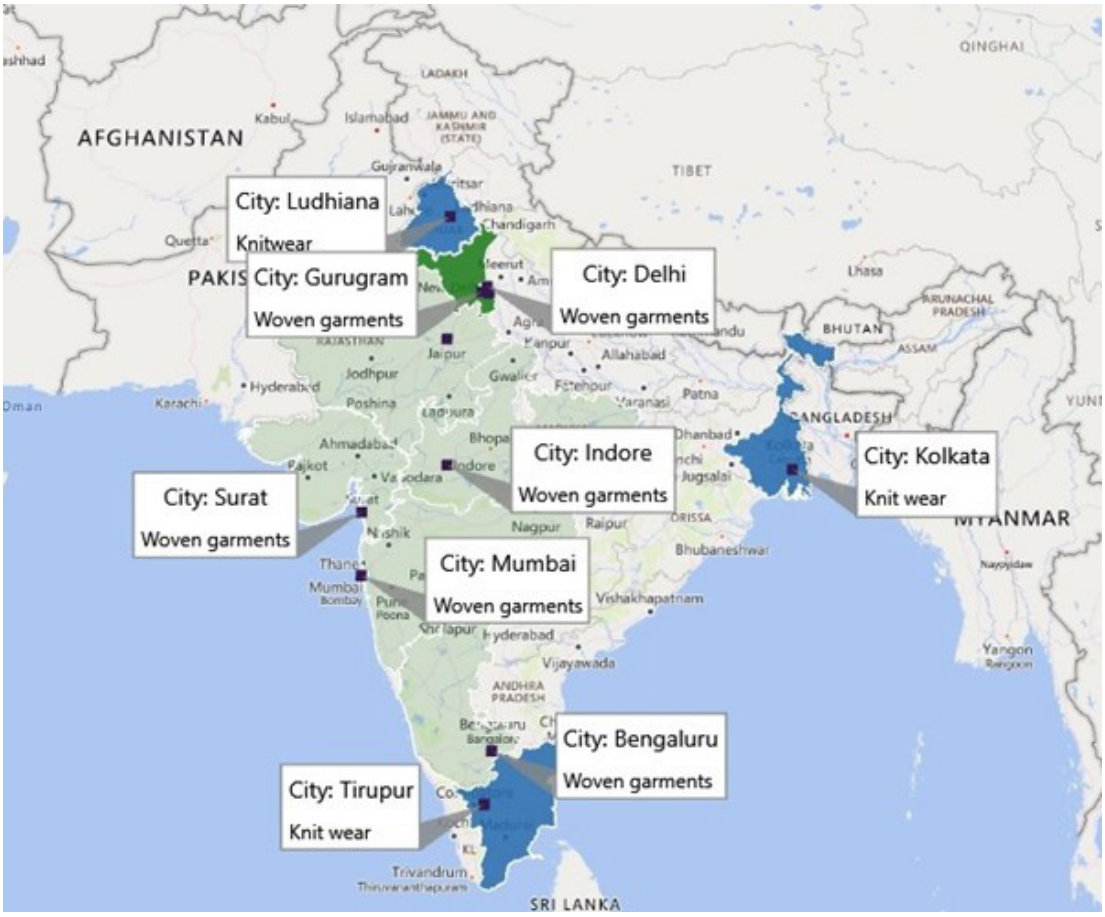


Figure 3: Major Ready-made garment clusters in India

Care Ratings, 2018

2. Structure of the Indian Textile Sector

The textile sector in developed economies such as in the North America and Western Europe is dominated by large scale mills with modern technology and machinery, that integrate spinning, weaving and, sometimes, fabric finishing. This allows for higher efficiency and in-house utilisation of process by-products. In contrast, the Indian Textile and Apparel Industry is highly fragmented. It mostly comprises of small-scale non-integrated spinning, weaving and knitting, fabric finishing, and apparel-making enterprises. This unique industry structure in India is primarily a result of government policies on tax, labour and other regulations that have promoted labour-intensive, small-scale operations often discriminating against larger scale firms (ASSOCHAM, 2015).

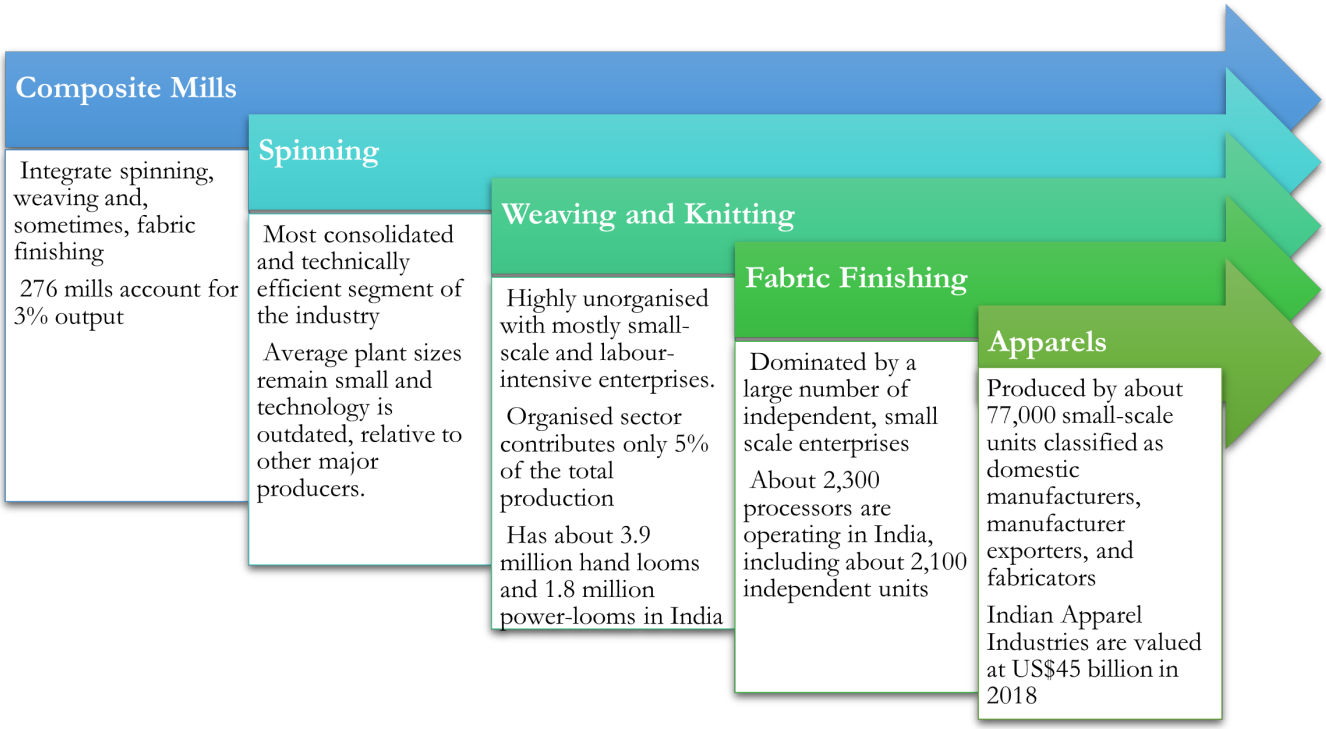


Figure 4: Structure of the Indian Textile Industry[24]

[24] The Textiles and Apparels Industry contributing to Make in India, ASSOCHAM

3. Employment

The Textiles and Apparel industry in India plays a major role in generating jobs and 'make in India' campaign. It employs 45 million people directly and 60 million indirectly (Economic Survey of India, 2019-20; NIPFA, 2020). The employment multiplier of the Textile and Apparel Industry in India is 5.172[25]. Since, there is no significant change in technology and structure happened in the sector, we can consider the same co-efficient holding true for 2020. This means, employment generated in the economy because of a rise of Rs.1 in demand of the industry, is more than 5 times the employment created in the sector itself, thus indicating the huge potential in the industry to generate employment.

However, with the increasing focus on yarn and fabric to final products, there is expected to be a change in the skills and characteristics of potential candidates. Tamil Nadu employs about a quarter of its total work force in this sector, also the largest by share of any Indian states followed by Gujarat, Karnataka, Maharashtra, West Bengal and Punjab.

According to a report by Ministry of Skill Development and Entrepreneurship, Government of India[26], the textiles and apparels industry has a major role to play in the Government's *Make in India* campaign through its contribution to employment generation. The report states that the overall employment in the sector would increase from about 33-35 million in 2008 to about 60-62 million by 2022.

Table 2: Projected additional Human Resource Requirement (in millions) across various functional level by 2020[27]

Functional Distribution of work force	Procurement	Production	Sales	Quality	Engineering & Maintenance	Support	Total
Spinning	0.02	0.98	0.03	0.06	0.05	0.13	1.27
Fabric Manufacturing	0.09	4.68	0.06	0.06	0.29	0.67	5.58
Fabric Processing	0	0.26	0	0	0.02	0.04	0.33
Garmenting	0.09	7.48	0.37	0.37	0.28	0.75	9.34
Total	0.21	13.39	0.46	0.50	0.64	1.59	16.79

[25] The Textiles and Apparels Industry contributing to Make in India, ASSOCHAM
[26] Human Resource and Skill Requirements in the Textiles and Clothing sector (2013-17,2017-22), Ministry of Skill Development and Entrepreneurship, Government of India
[27] NSDC estimates

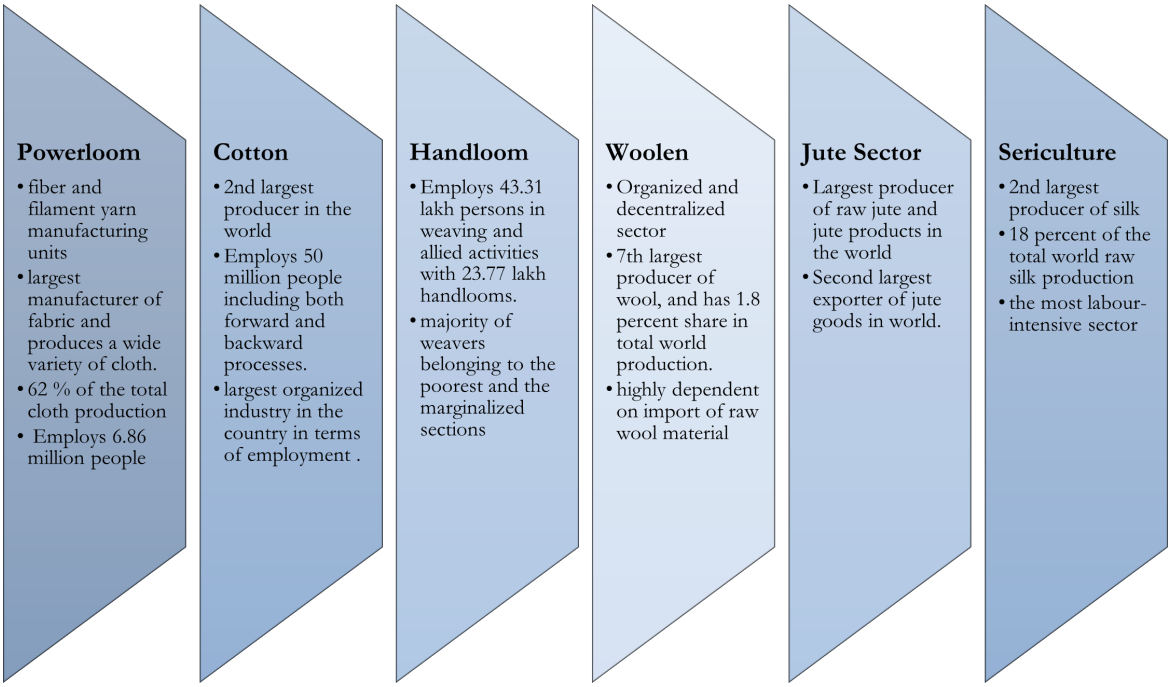


Figure 5:Employment by subsectors of the Textile Industry (2019) [28,29]

[28] Employment Intensity of Output: An Analysis of Non-Agriculture Sectors
[29] The Textiles and Apparels Industry contributing to Make in India, ASSOCHAM

4. Structural Challenges in the sector

The Indian Textile and Apparel industry faces a number of challenges due to certain structural weaknesses viz. highly fragmented industry, lack of product diversification, limited client base, and inefficient productivity compared to its competitors (China, Bangladesh, Vietnam, etc). Our Textile and Apparel exports are highly dependent on cotton. Price of cotton yarn produced in India is amongst the highest in the world, due to various socio-economic factors.[30] High input costs are offsetting the benefits of weakening currency, thus undermining the net benefits in terms of overall competitiveness in the sector and exports.

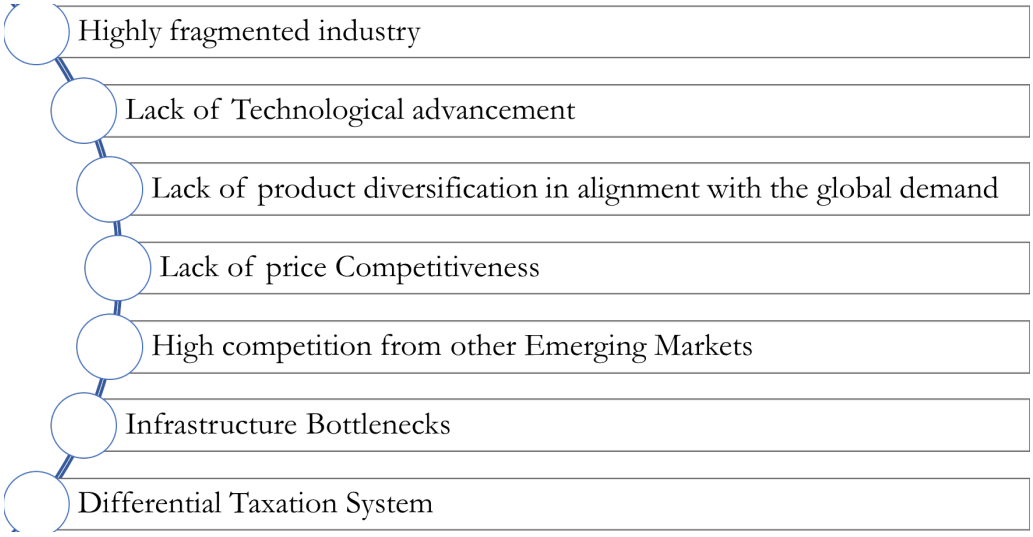


Figure 6: Important challenges faced by the Indian Textile and Apparel Industries

Discussion on some of the challenges – scope for circular economy

Fragmented structure of the Indian Textile and Apparel industries

The apparel & textile industry is highly fragmented with a large number of MSME players. Further, there are low rates of technology upgradation and the sector remains largely labour intensive.[31] The fragmented nature implies that the industry lacks collective bargaining power and is vulnerable to stiff competition. To protect these MSME sectors from external competitions, Government of India had earlier taken various measures and introduced both tax and non-tax barriers in the sector, such high duties on imported parts of mobile phones, vehicles, etc. and cap on Foreign Direct Investment (FDI) for certain sectors. For the textile sector various duties were levied on imported equipment, yarn, etc. These measures safeguarded these MSMEs from external competitions, but created a market inefficiency which is undermined by lack of product diversification, stagnation of exports, over reliance on domestic consumptions etc.

In recent years, the government has moved towards incentive and efficiency-based support for MSMEs. These include (but not limited to) credit guarantee schemes, collateral-free loans, equity infusion to support growth, and increasing public procurement from MSMEs by barring global tenders for projects and supplies costing up to INR 200 crores[32]. For the textile industry, Technology Upgradation Fund Scheme (TUFS) was introduced to encourage MSMEs to upgrade their equipment for better efficiency.

Circular economy brings an unique opportunity for the MSME businesses in the A&T sector – it not only will help create new businesses focused on closed-loop manufacturing and provide services

[30] Cogencis. http://www.cogencis.com/newssection/hike-in-msp-curbs-cotton-exports-only-600000-bales-shipped-so-far/
[31] NITI Aayog. https://niti.gov.in/weaving-way-indian-textile-industry
[32] https://www.businessinsider.in/india/news/fm-nirmala-sitaraman-announces-six-steps-for-msme-sector/articleshow/75717258.cms

such as collection, recycling, sorting etc both within clusters and outside. Adhering to the principles of circular and closed-loop manufacturing paradigm (see Section 5) will help small business connect with global value chains, and also coordinate better among other businesses to aggregate their goods and services for better competitiveness. The Economic Survey of India (2019-20) also mentions the utilization of e-commerce to connect the handicrafts businesses with global clients; online aggregation would be a viable option for MSME clusters to sell their products. This would offset the disadvantages of a physically fragmented set up for the sector.

Lack of Technological Advancement

Indian Textile and apparel industry lack technological advancements due to fragmented nature of the industry. Majority of the cooperative textile mills operate on obsolete technology for knitting, weaving and production of yarn making them less cost effective compared to its peers. Export of cotton products constitutes about 75% of our Textile and Apparel exports. While the Global consumption of man-made fibres (MMF) and cotton is in the ratio of 7:3[33], Indian Textile and Apparel industry is not able to update itself with respect to the global trend primarily due to its inability to equip itself with the latest technological advancement in the sector.

Being a highly resource intensive industry, it is imperative to update the technology for its own sustainability. As the per capita availability of resources is shrinking, the industry has to explore and adopt more resource efficient processes and practices. Circular economy principles can provide guidance in transitioning into a more resource-efficient sector, while cutting down on harmful effluents by adopting sustainable alternatives (raw materials, chemicals, etc.).

Investment in domestic R&D and/or FDI in R&D is a must to technologically upgrade the sector.

Factors of production

The three major factors of production viz. land, labour and capital are costlier in India than other competitive economies like Bangladesh, Philippines, Vietnam etc. The average cost of capital in India is 15% in dollar terms, significantly higher than the developed economies which averages at 4% (Hindu, 2018) while in Bangladesh it is 10.44% as per Bangladesh Bank. Lower cost of capital increases the profitability at lower prices, thus making more competitive in the industry. The other important factors of production, i.e. land and labour laws are redundant in India. The pace of change in the laws is slow. Land acquisition policies in India is still not very competitive as compared to its competitors. The Government has been pushing for several reforms in the policies, such as the Ease of Doing Business Reforms[34], and labour reforms where 44 codes were amalgamated into 4 codes, for the purpose of easing governance[35]. But, the real impact of these changes will take a while to be reflected in the overall competitiveness of the textile and apparel sector.

Overall, cost of the factors of production increase over time in a country as it develops or when its per capita income increases, and the average inflation rises. To counter the effect of this inevitable change, the A&T sector in India should diversify its products (and services). Circular economy can show the way to produce to market value-added goods and services, e.g. genuine handicraft products made from sustainable raw materials and processes, block-printed apparel manufactured with organic cotton and natural dyes, services such as a reverse logistics, recycling within clusters, etc. As global consumer preferences lean towards sustainability, such products and services will find a high demand globally.

Lack of diversification of demand

Indian Textile and Apparel industry relies on the domestic consumption for almost 82%[36] of its production. This over reliance on a single sector carries significant inherent risk due to lack of market diversification. This risk is worsened from the fact that India relies for more than 80% of its textiles and

[33] Weaving a new future for India's ailing textiles industry: Financial Express
[34] DPIIT. https://dipp.gov.in/ease-of-doing-business-reforms/reforms-towards-ease-of-doing-business
[35] Ministry of Labour. https://labour.gov.in/labour-law-reforms
[36] Average of last five years (2013-18)

apparel exports to the developed economies like the US and the European Union markets (WTO, 2019). An economic slowdown in any of these countries will have tremendous negative impact on the Indian Textile Sector. This risk is being proved in the World Economic Outlook 2020 by IMF which indicated India will witness -26% growth in its merchandise exports.

Lack of competitiveness will result in negative growth rate of exports. These weaknesses result in serious problems in testing times like the current situation: exports worth over USD 8 billion had been cancelled in the months of March and April.

Based on above observations, Circular economy will help the Indian A&T sector better prepare itself to cater to the global market when the demand goes back up, if the sector proactively adopts a path of circular transition.

5. Expected Benefits from a Circular T&A Sector

The Indian textile and apparel industry is in need for urgent transformation given India's weakening position globally. The apparel and textile sector in India contributes to widespread pollution[37] - that needs to be addressed vis-a-vis international competitiveness. Globally, the fashion industry especially with its focus on fast fashion is under immense scrutiny due to its adverse environmental and ecological **impacts**. These impacts broadly relate to:

- ***Raw Materials used*** - For e.g. cotton is highly resource intensive and one production of one cotton shirt can use up to 2700 litres of water.[38] Further, cotton also consumes high amount of pesticides and insecticides, traces of which remain in finished garments. On the other hand polyester while consuming less resources, is non-biodegradable and contributes immensely to the problem of micro-plastics[39] that are released during washing of synthetic fibres such as polyester

- ***Chemicals*** – The textile and apparel industry uses over 8000 chemicals starting right from production of fibres and continuing to dyeing, processing and finishing of textiles. Almost 20% of water pollution can be attributed to textile dyeing and treatment[40]

- ***Waste Generation*** – Given the trends of fast fashion (styles changing much faster at much more affordable rates) has meant that consumers are buying a lot more clothes but using them for a much shorter time. This has translated to large amounts of waste being sent to landfills – almost 85% of all clothes end up in landfills[41]. The rate of recycling of these clothes is abysmally low at just about 15%[42].

- ***Energy and water footprint*** – Textile has embedded water and energy, which are thrown out of the value chain when clothes are discarded.

Customers as well as brands are demanding sustainable products. Given the increasing demand for transparency and rising consumer awareness in developed economies, the industry is beginning to explore solutions to contain and combat its adverse effects. Circular economy (CE) principles offer a viable solution. Circular Economy is an economic system where materials and energy circulate in loops and stay within the value chain, as opposed to a linear system of take-make-dispose. In a circular economy material is reduced, reused, recycled and repurposed. The Ellen Macarthur Foundation lays down the following three principles for circular economy:[43]

- Design out waste and pollution
- Keep products and materials in use
- Regenerate natural systems

The above principles of Circular Economy provide a framework and means for systems transformation across industry sectors. There is a significant body of knowledge that demonstrate how resource efficiency (through circular business models and practices) have contributed to sustainable development outcomes[44].

Indian suppliers and manufacturers stand to make considerable gains if they proactively adopt good

[37] Various components of the apparel/textiles industry are categorised as highly polluting, by the Central Pollution Control Board, MoEFCC, GoI (http://www.indiaenvironmentportal.org.in/files/industrialcluster.pdf)
[38] https://www.wri.org/blog/2017/07/apparel-industrys-environmental-impact-6-graphics
[39] Plastic particle of less than 1mm in diameter
[40] https://www.commonobjective.co/article/the-issues-chemicals
[41] https://www.businessinsider.in/slideshows/miscellaneous/the-fashion-industry-emits-more-carbon-than-international-flights-and-maritime-shipping-combined-here-are-the-biggest-ways-it-impacts-the-planet-/slidelist/71640838.cms#slideid=71640858
[42] https://www.epa.gov/facts-and-figures-about-materials-waste-and-recycling/textiles-material-specific-data
[43] Ellen Macarthur Foundation. Circular Economy in Details. Accessed at https://www.ellenmacarthurfoundation.org/explore/the-circular-economy-in-detail on 14 Dec 2019
[44] https://www.resourcepanel.org/reports/resource-efficiency-sustainable-development

practices and innovate through circular business models and practices and get ready to be part of the transformation that is happening globally. Below are some of such gains:

- Better access to Western markets governed by stringent quality norms and human rights legislations
- Achieve product differentiation by demonstrating good practices (climate and socially conscious)
- Achieve better brand value by building goodwill with different stakeholders

The Indian government, both at state and national levels, therefore, should move forward with favourable policies and programmes that support transition to environmentally sustainable practices. India has already made significant progress towards the sustainable development goals adopted by the UN in 2015.

The NITI Aayog has launched the SDG India Index 2019-20 to track the country's progress on the SDGs.[45] Similarly, the Economic Survey 2021 underscores the government's commitment towards supporting holistic sustainable development. Finally, the Central government announced 100% FDI through the direct route[46] - implying that domestic manufacturers may face stiffer competition from foreign firms setting up shop in India in coming years, if they do not raise themselves quickly to international standards while limiting costs.

It is important to note here that brands and retailers have an important role to play to facilitate a transition from the linear model of take-make-dispose to more circular designs, practices and business models. Further, for a complete transition to circularity, consumer will also have to be encouraged towards responsible consumption. Business models based on rentals, recycling and reuse should be incentivised. Such trends and consumer preferences can already be seen. Needless to say technology and innovations will underline the transition to circularity as these will be crucial to the development of eco-systems, cost reduction, quality development, and material redesigns.

Circular economy can be a gamechanger for Indian suppliers and manufacturers. However, global discussions on circular economy have to be clearly contextualised for India. India is both a major producer and consumer of textiles and apparels and any circular economy intervention has to be aligned to the requirements of the value chain actors in India. This paper has been developed through extensive engagement with the stakeholders of the Indian Textile and Apparel industry and identifies the CE priorities for the Indian context.

[45] SDG India Index. https://niti.gov.in/sdg-india-index-dashboard-2019-20
[46] Ministry of Textiles. http://texmin.nic.in/fdi-cell

6. Framework on Circular Economy

Centre for Responsible Business (CRB, www.c4rb.org) is a think tank based out of New Delhi, India with a vision that "Businesses integrate sustainability into their core business practices". CRB is mandated to support and enable corporates adopt more sustainable practices and to define clear roadmaps and strategies for their journey towards sustainability. Circular Economy is one of the key focus areas in CRB's work and the organisation is undertaking several initiatives to promote the dialogues and uptake of Circular Apparel and Textile practices especially through identifying relevant policy interventions. The policy recommendations are being identified based on innovations and practices on the ground and through inputs from key and relevant stakeholders in the Apparel & Textile sector. CRB has also undertaken research and initiatives to promote Circular Economy in the IT and the Agriculture sector.

CRB has created the framework (provided below) to capture the circular economy priorities or action points in alignment with the principles of circular economy- i.e. (i) design out waste and pollution; (ii) keep products and materials in use;, and (iii) regenerate natural systems - and set targets in consultation with relevant stakeholders.

The framework captures the textile and apparel value chain on one axis (from fibre to retail and post consumption). The other axis highlights the various CE priorities such as design, material use, water aspects, use of energy, waste management and business model that would be most relevant for various segments of the textile and apparel value chain. The framework provides a standardized means to gather input on the most critical aspects of circular economy that would allow players in the Indian textile and apparel industry to adopt more circular practices and also to identify suitable policy intervention areas and ideas that can support a transition of the sector into a circular economy. The findings (priorities for the industry) have been recorded in the framework (provided in Annexure 1)[47]. These findings are based on inputs received from various stakeholders in the textile and apparel value chain.

[47] CRB. Circular Apparel Policy Innovation Lab. http://c4rb.org/circularapparel

	Textile & Apparel Value Chain				
Circular Economy Aspects	Fibre production	Textile production	Readymade garment (RMG) production: suppliers to	Logistics and retail	Post-consumer processing
Design - Circular design (reduces environmental impacts, slows down or closes material cycles, prevents waste by design)					
Raw Material - Conventional & Alternative fibres					
Chemicals/Dyes/ Acids - rational/judicious use of chemicals, use of natural dyes, quality of chemicals/dyes used, etc.					
Waste - Material/ Water/ Hazardous Waste - reduction/minimisation in use of hazardous chemicals (generation of hazardous waste), scope of industrial symbiosis (waste from one industry as input for another one)					
Energy - Grid Captive power plants Renewables Heat/energy recovery Process efficiency – modern equipment with lower energy consumption					
Water - Raw material – low-water intensive options (alternative natural fibres) Dyes – one-shot dyeingProcess efficiency – lower water requirement Recycling – process water, effluent water treatment, recovered steam,					
Business models and ecosystem - Circular Supply Chain/Resource Recovery/Product Lifetime Extension/Product as Service/Sharing Platforms Socio-political situation; credit; financial system					

Stakeholder Inputs

Fig. 7: Framework on Circular Economy Priorities in Apparel & Textiles (See Annexure 2)

Components of the Framework

- **Design**

Design is the most crucial element for circular transition. Products, services, processes, business models, etc. must be designed in a way that reduction of resource intensity, recovery and reuse are enabled along all segments of industrial value chains. In the case of textile, design elements begin at selection of the raw material, followed by resource-efficient processes, green chemicals and equipment. Apparel should be designed for the ease of recovery, dismantling, sorting and recycling.

- **Material**

India has the entire value chain of apparel and textile production, boosted by abundance of raw materials like cotton, silk, jute, and wool, and availability of skilled workforce. India contributes about 14% of total global production of textile fibre and yarn. Globally, cotton perhaps accounts for 30 % – 40% of materials in contrast to India wherein cotton accounts for almost 60% - 70% of textile and apparel manufacture in India.[48] Brands are beginning to explore alternative materials and can support suppliers develop appropriate capacities to work with more sustainable materials.

- **Chemicals**

Chemicals are used extensively during the life cycle of garment and textile manufacturing (over 8000 chemicals for various processes). 20% of overall industrial water pollution can be attributed to textile manufacturing[49]. While China leads in the use of consumption of textile chemicals; India along with US and China is a big consumer of textile chemicals[50]. Awareness about harmful chemicals is gradually increasing and brands leading on circular practices are ensuring that certain chemicals are completely excluded from their supply chains and manufacturing processes. Healthier and greener alternatives to toxic chemicals are available but their uptake remains limited on account of low awareness, costs and performance of the chemicals.

- **Waste**

There are 3 kinds of fabric waste[51] that are largely generated: ***Pre-consumer textile waste*** - manufacturing waste that is generated by processing fibres and the production of finished yarns and textiles, technical textiles, non-wovens, garments including off-cuts, selvages, rejected material; ***Post-consumer textile waste*** – garments or household textiles that are no longer fit for use. Usually the quality of the waste is good that can be recycled or reused; Industrial textile waste - Waste generated from industrial and commercial applications (e.g. carpets, curtains, upholstery etc.) This kind of waste is usually incinerated or disposed to landfills. In addition, textile wastewater is heavily laden with chemicals and dyes, high suspended solids, acidity, salts, alkalis etc. that need to be removed to avoid wastewater pollution[52].

- **Energy**

The textile industry globally lies among those with the lowest energy efficiency. Among the processes, spinning consumes about 34% of total energy while weaving consumes around 23%.[53] In Indian textile industry cotton is the predominant material, with about 60% of total energy consumption. Further, 75% of all spinning mills in India are dedicated to cotton. In 2015, the sector contributed 2102 Billion USD worth of GDP, while consuming 1.24 million TOE (Total Oil Equivalent). Under the PAT Scheme (Perform Achieve and Trade), Indian textile industry is expected to reduce its energy intensity (Total oil eq. per million USD production value) to almost half of its current value (in terms of percent points). [54]

[48] Feb 2020. Expert Consultation, Mr. Ashok Juneja (Textile Association of India).
[49] http://www.fashionatingworld.com/new1-2/textile-industry-uses-toxic-chemicals
[50] https://ihsmarkit.com/products/chemical-textile-scup.html
[51] http://www.homesciencejournal.com/archives/2018/vol4issue1/PartC/4-1-32-981.pdf
[52] https://www.slideshare.net/SilanTharakan/textile-industries-wastes
[53] https://www.fibre2fashion.com/industry-article/3377/energy-conservation-in-textile-industries-savings
[54] PAT Scheme. Performance and Way Forward. https://www.keralaenergy.gov.in/files/Resources/TEXTILE_Sector_Report_2018.pdf

- **Water**

The textile sector is highly water-intensive; its long-term sustainability depends on judicious water use, given that most districts in India face water scarcity in the range of 20-80%. Also, groundwater exploitation occurs much faster than natural recharge, putting strain on this precious resource. Lack of adequate effluent treatment facilities has led to pollution of soil and groundwater, impacting the quality of groundwater available to local populations for domestic purposes.[55] On an average, it takes about 200 litres of water to produce 1 kg of textile.[56] By 2030, India will face an aggregate gap of over 50% demand and supply of water.[57] There is a need to focus on water efficiency and reduce the consumption of water across the various processes of the textile and apparel value chain. Moreover, the technologies available for wastewater treatment are expensive and unaffordable. Further, the incentive to innovate and reduce water consumption is low where water is treated as a free resource.

Note:

Prima Facie, Circular Apparel[58] interventions and priorities are more concerned with environmental and material resource aspects. However, the apparel and textile sector with its large engagement of the workforce, use of hazardous chemicals, and generation of large quantities of waste and toxins, is intricately linked to both livelihoods and human health & well-being.

Adoption of circular practices will go a long way in negating the well – documented adverse impacts of the sector. In addition, circular apparel also provides immense opportunity for livelihood generation, especially for the informal sector (waste collection and management, repair culture, etc.). Many innovators and start-ups are adopting circular business models. But a systems-thinking approach must be applied to understand and analyse the full impact of circular interventions especially from a livelihood perspective. For e.g. a shift away from cotton to less resource intensive or man-made fibres will directly impact the cotton farmers; policies and interventions are needed to account for the potential loss of livelihoods.

Further, adopting circular apparel practices will require extensive capacity building and creating awareness amongst key stakeholders including academia, research and development institutions, practitioners, workers, consumers, policy actors etc. This paper does not delve deeply into these aspects but is cognizant of their importance in the discourse on circular apparel.

[55] Water Governance Mapping Report. https://www.siwi.org/wp-content/uploads/2017/06/Water-Governance-Mapping-Report-INDIA.pdf
[56] http://www.indiaenvironmentportal.org.in/files/file/CSE-study-on-textile-pollution-in-Pali_0.pdf
[57] 2030 Water Resources Group. 2009. Charting Our Water Future. Economic Frameworks to inform decision making.
[58] Circular Apparel refers to circular practices both in the textile and apparel segments and is referred to as Circular Apparel just for ease of reference

7. Ideas for policy interventions to promote Circular Apparel[59]

The interventions below have been identified based on secondary research and extensive stakeholder consultations across various value chain actors especially with brands (domestic and international), suppliers and manufacturers, dyeing and chemical companies, academia, innovators, and state government officials.[60] These ideas, aligned to the CE priorities defined in the framework, have been broadly categorised as actions proposed for practitioners and as possible policy interventions.

Design

Practice level interventions

- **Clear design guidelines** should be defined indicating the types of material to be used (virgin + recycled), chemicals to be avoided/used, design for durability, design for end-of-life processes/ purposes, cost of collection for end of life should be factored in, clear labelling (transparency and traceability), patterns/design innovation (role of designers and brands).
- **Innovative collaboration between stakeholders** –
    - Apparel brands and manufacturers can collaborate with design institutes like NID and NIFT to come up with innovative designs, patterns and other techniques to support circular transition.

Suggested Policy Intervention

- **Issue advisory** on textile production parameters and processes –
    - Guidelines should be published to indicate the acceptable percentage of waste at each stage of production, along with water, energy and chemical consumption. The standard input output norms (SION - Standard Input Output Norms (SION) are published by the Direct General of Foreign Trade to specify the required amount of inputs to produce a unit of output for exports)[61] can be modified in the lines of circular economy principles.
    - Ministry of Textiles can constitute a task force/ Working group that can facilitate setting of industry guidelines for circular design and manufacturing standards amongst the industry players. For e.g. Ellen McArthur's guidelines on jeans manufacturing[62]

Suggested Policy Actor

- Clear design guidelines can be prepared by the Ministry of Textiles along with partner academic institutions like National Institute of Fashion Technology and National Institute of Design.

Material

Practice Level Interventions

- **Alternative/ Recycled fibres** – There is a need to work with alternate materials that are less water and energy intensive, can be easily recycled, and are more durable. E.g. hemp, banana fibre, and

[59] Policy intervention ideas in this section has been informed by CRB's project titled "Circular Apparel Innovation Lab", undertaken in collaboration with Circular Apparel Innovation Factory (CAIF) and Fashion For Good (FFG). The project was funded by Laudes Foundation.
[60] Consultation have been held at Ahmedabad, Bengaluru, Panipat and Tirupur (virtual), covering stakeholders from other clusters in their respective states (Gujarat, Karnataka, Haryana, and Tamil Nadu).
[61] https://www.dgft.gov.in/CP/?opt=adnavce-authorisation
[62] https://www.ellenmacarthurfoundation.org/news/make-fashion-circular-launches-the-jeans-redesign

other sources of cellulose.

- At the moment, there is not sufficient focus on man-made fibres.
- Need to include more recycled fibres – however at the moment, it is challenging to separate mixed fibres, and maintain high quality of recycled yarn.
- More R&D needed for alternate materials. Some brands undertaking own R&D activities and these can be cost prohibitive after a point. A robust start up eco-system for supporting start-ups focussing on alternate materials
- R&D on recycling technologies with focus on chemical recycling
- Link Innovators to brand to facilitate innovation for Circular Textiles and Apparel (Fashion For Good)
- Awareness needed among consumers for raise demand for alternative fibres.

- **Transparency and traceability would be important** – for virgin materials, farm level traceability and for recycled materials it is important to know source of material (e.g. recycled PET bottles, recycled garments)

Suggested Policy Interventions

- Better incentives for manufacturers and designers to work with proven alternate sustainable (e.g. bio-degradable polyester) materials.
- Incentivize the use of alternative materials through tax schemes at all segments of textile value chain. Cotton cultivation is a major generator of employment; farmers have to be incentivized to move to more sustainable fibres by providing evidence of better incomes and lower costs.
- **Content law required** – Need for manufacturers and retailers to declare the exact content (fabric fibres) used, so that consumers can make an informed choice and make it easier for recycling. A content law should be declared, specifying inputs for apparel, in line with recycling requirements. The law should cover various aspects like labelling, fibre traceability, as well as production parameters (as guidance for manufacturers). The Ministry of Textiles and the Ministry of Commerce and Industry will be the key regulators for bringing in such policies.
- **Incentivize local infrastructure** – baling of cotton degrades its quality, leading to loss in value. Setting up small yarn production units in proximity to cotton production centres will eliminate losses due to baling and transportation. Gujarat accounts for about 33% of India's cotton production. This would provide additional entrepreneurship opportunities (on-site industrial processing on/near farms). Karnataka sells about 90% of its cotton to spinning mills in neighbouring states; investing in ginning and spinning units that would be built close to cotton production centres will boost job creation too. The Mudra loan scheme can be tweaked to provide institutional support to entrepreneurs who want to set up small units near natural fibre production centres.
- **More demand for sustainable/circular apparel through sustainable public procurement, consumer awareness**
- Need for **transparent Quality Norms for Products made from Recycled textiles/textile waste** – Products containing recycled textiles/textile waste should undergo rigorous checks, for quality and contamination. This would instil confidence in buyers and consumers, leading to greater market value for recycled materials.

Suggested Policy Actor

- Ministry of Textiles, Ministry of Labour, the Confederation of Indian Textiles Industries and the

Ministry of Finance should decide on performance-based incentives for the industries.

- A common compliance standard can be jointly developed between the various ministries / departments to optimise the due diligence requirement and enhancing the ease of doing business along with increasing transparency and sustainability.

Chemicals

Practice level interventions

- Compliance (measuring and monitoring) related to chemical use – Emphasis to be placed monitoring chemical use in fibre manufacturing, washing and dyeing and garment manufacturing – different fibres have different challenges – cotton requires excessive use of pesticides (focus on organic cotton), other fibres require use of oil that is discharged with wastewater, toxic chemicals harm aquatic life. Also, focus on dry cleaning for the chemicals used

Suggested policy interventions

- **Waterless dyeing** – Incentivize adoption of waterless dyeing techniques. E.g. Foam-based dyeing, single-sheet dyeing, digital dyeing, supercritical CO2-based dyeing, etc. Waterless dyeing leads to minimal chemical discharge, apart from the obvious benefit of saving water.

- **Natural dyes** – Incentivize adoption of natural dyes. Tax incentives to natural dyes manufacturers, as well as favourable policies towards certified users of natural dyes can boost uptake of the same in the sector. Awareness on such alternatives to chemicals is also crucial.

- **Regulation and programs to reduce use of hazardous chemicals** – Certain chemicals should be banned completely, while other need to be regulated in terms of maximum content and discharge; Programs like Responsible Care by International Council of Chemical Association (the Indian Chemical Council is a signatory)[63], "Roadmap to Zero" by ZDHC [64] can help guide this process. There is a need for compliance to MSDS (Material Safety Data Sheet) verification, specify restricted substance lists to control adverse environmental impacts

Suggested policy partners

- The State Pollution Control Board along with the local governments can be empowered with detailed guidelines by the Central Pollution Control Board on the roadmap to achieve 'Zero Hazardous Liquid Discharge' about ensuring the compliance and monitoring of the hazardous chemicals used in the textile industries and ensure Zero Hazardous Liquid discharge.

- New Research and Development Centres can be developed by the Ministry of Textiles in consultation with the Ministry of Chemicals along with partner research organizations like National Institute of Fashion Technology, Indian Institute of Technologies and NITRA regarding the sustainable solutions for the environmental concerns of the Textile Industries.

Waste

Practice level interventions

- **Enhance reducing waste, and recycling during production** – For automated units catering to very large orders, laser cutting can be a viable option. Evidence from Vietnam shows that laser cutting creates 1% waste, as compared to manual cutting where waste goes up to 5% of fabric. Smaller units which may face cost barriers in introducing new technology should be connected with up-cyclers/recyclers who create new products with textile waste.

[63] Responsible Care. https://www.indianchemicalcouncil.com/responsible_care.htm
[64] ZDHC. https://www.roadmaptozero.com/

- **Reverse logistics** for waste collection (post consumption) needs to be strengthened to make recycling, repair, refurbishing etc viable
- Brands can offer **incentives for customers** to return old and used clothes.
- Promote and support Zero waste to landfill. Incentivise models that utilise waste as input materials or other sustainable uses

Suggested Policy Recommendations

- Clear ban on landfilling of textile wastes
- **Policy and Act on textile and apparel wastes-** In the textile industry, waste management has to be regulated through an Act, along the lines of SWM 2016. Although hazardous waste is covered under existing acts, Non-hazardous waste like fabric, waste fibre, cutting and stitching waste must be banned from being landfilled. Textile and apparel waste must be dealt with through multi-stakeholder efforts, as in apparel.
- **Official waste audits** – extensive audits are required to record the nature and quantum of waste produced in every textile and apparel cluster. This data would be used to plan industrial symbiosis and support innovative business models that strive to utilize and repurpose/reuse waste.
- **Implementing relevant clauses of SWM 2016** – Inclusion of waste collectors and processors in the formal sector. "Reverse logistics" is a major hurdle; a network of waste collection entities can offer options to the industry. Collaboration among stakeholders is an important aspect of waste management. Further, some of the good practices from other sectors (e.g. Extended Producer Responsibility through PRO in case of e-waste) can also be explored
- **Research on cost-effective recycling options**– Government funded textile research institutions such NITRA and SITRA should focus on cost-effective recycling solutions, so that value of recovered materials is higher than the cost of recovery. Organizations such as NITRA are already involved in research on process improvement and analysis of fabric; additional funds focused on increasing materials efficiency can help industries (especially SMEs, who can't fund their own R&D) will benefit immensely.
- **Common infrastructure**– akin to CETPs (Common effluent treatment plants), common waste management infrastructure (physical as well as digital) is required. Smaller units that can't process waste in-house, can avail common waste sorting and processing facilities, rather than landfilling/dumping their wastes/by-products. Every cluster should have an online exchange for surplus materials and waste.
- **EPR and Traceability**– Extended Producer Responsibility guidelines are required for the apparel sector. Onus is on the brands and consumers to make sure that post-consumer waste finds its way back in the production system. Traceability can be ensured using digital technologies, as well as rigorous record keeping at factory level. Adequate labelling will help consumers make informed choices (recycled fabric/fibre can be termed as "green" alternatives).

Suggested policy partners

- Ministry of Textiles can come up with comprehensive detailed operational guidelines highlighting the ways to reduce and recycle wastes and Extended Producer Responsibility within the purview of Solid Waste Management Act, 2016 and Environmental protection Act, 1986. They can also come up
- Trainings can be provided to the Textile mills by organizations regarding waste recycling and reduction by organizations like Centre of Responsible Business with collaboration from the District Development Commissioner of Micro, small, and medium enterprises on the lines of the concept of circular economy.

- The local governing bodies along with the SPCBs can ensure zero wastes to reach the landfill sites from the textile industries and also regular inspection for the compliance of such policies.
- Detailed labelling guideline should be provided by the BIS jointly with Ministry of Textiles regarding the issue of eco-mark in the products confirming to the prescribed standards.
- District Planning Authorities can be empowered to form clusters for the various players and segments of the Textile industries as a form of spatial intervention and rearrangement so that waste collection can be efficiently provided.

Energy

The need for energy efficient machinery and use of cleaner energy is well understood amongst the industry actors. However, a need for a stable policy has been identified as a major requirement. The following policy asks have been identified:

- **Policy on renewable energy**– Renewable energy must be incentivized over conventional energy. DISCOMs, state electricity board can collaborate to set up dedicated micro-grids for textile and apparel hubs. Waiving off the wheeling charges for renewable energy can make it easier for operators to supply to the grid.
- **Long-term stable policies required** – transition to renewable sources require investments from companies; investments must be backed up by long-term policies. Frequent changes in policy can hamper the prospects of growth of renewables.
- **Technology upgradation and Energy Efficient manufacturing**– many units run by cooperatives and MSMEs are operating with obsolete equipment. Arrears under TUFS (Technology Upgradation Funds Scheme) must be cleared, and a consultation with sectoral stakeholders should be held to determine which components and machinery should be brought under the TUF scheme. TUFS should ideally cover equipment that will help manufacturers become energy efficient and reduce load on the grids.
- **Small-scale innovations** – Innovation at the MSMEs should be promoted (including handicrafts), focussing on in-situ technical/technological innovations – evidence from Ahmedabad and Vadodara suggests that small-scale on-site innovations, like bio-remediation units for effluent treatment, are both viable and effective. Official case studies should be documented and scaled/ replicated elsewhere.

Suggested policy partners

- Ministry of Power and the Ministry of Renewable Energy through the National Electricity Policy can come up with detailed guidelines regarding implementation of on-site renewable production and distribution of the same.
- Various Centres of Excellence in the textile technology along with partner institutions can provide technological innovations for the MSME industries along with financial and logistic support and incentive from the Ministry of MSME.
- For Energy consumption and efficiency, guideline can be prepared with the help of Bureau of Energy Efficiency.

Water

Practice level interventions:

- Industry can undertake detailed water audits to measure its water footprint along its operations and identify measures to reduce water consumption.

Suggested policy interventions

- Partial use of recycled water in textile and garment manufacturing should be mandatory. State governments can further incentivise this approach by providing discounts on municipal taxes to units using recycled water (proportional to percentage of recycled water used).
- Technology upgradation for small units – Modernisation of dyeing units offers scope for reducing water consumption.
    - Small units cannot easily modernise due to lack of space and resourced. Clustering and **shared infrastructure** needs to be explored especially for all polluting processes
    - **Upgradation of existing units to be prioritised** – new units are deploying ZLD technologies as per rules and regulations – old units continue to discharge water without treatment

Suggested policy actors

- Ministry of Textiles can enforce mandatory water audit to medium and large-scale industries in the sector and can provide incentives for the micro and small-scale enterprises to voluntarily follow the standards.
- Textile equipment manufacturers can be provided subsidy for producing resource efficient machineries and improve their reliability and quality and invest more in the technological upgradation of the machineries.
- District Planning Committee with the URDPFI guidelines[65] can discourage small standalone textile mills and dyeing units discharging effluents. Spatial interventions (planning for appropriate location of infrastructure and services) can be done by the authorities for better utilization of the shared infrastructures like CETP.
- Wastewater effluent standards for the Textile and dyeing industries should be developed by Central Pollution Control Board (CPCB) along with the State Pollution Control Boards (SPCBs) under the supervision of Ministry of Environment, Forest and Climate Change. To cater the localised needs, state and district industrial committees or relevant bodies should be consulted for state-specific guidelines. Implementation guidelines to be prepared by CPCB with significant empowerment to ULBs to incorporate local needs.

Miscellaneous/overlapping

- **Training/skilling** – higher-order skills should be imparted; industry should be consulted about the kind of training required. Industries have claimed that skills imparted by the Integrated Skills Development Scheme (ISDS) were not sufficient to raise worker productivity or were not aligned with exact requirements. Circular economy transition would need workers trained in repair, refurbishment, redesign, etc. The ISDS scheme should be re-evaluated in consultation with industry and training institutes and modified to include circular aspects as well.
- **Sustainable Public Procurement**– Public procurement can play a big in transition. Sustainable procurement guidelines should be issued for buying uniforms for officers, police force, workers, etc. as well as miscellaneous cloth materials. Ideally, uniforms and other materials made from made from recycled fibres or textile waste or eco-friendly fibres should be encouraged/procured through Government E-Marketplace. This would nudge suppliers to look into alternative fibres, green production processes, as well as decent working conditions/wages, etc.
- **Role of R&D, Technology, Technology Institutes** –
    - R&D to be incentivised for: 1) alternate materials, 2) waterless dyeing, 3) water saving technologies, greener chemicals, natural dyes, 4) water treatment etc.

[65] Urban and Regional Development Plans Formulation and Implementation guidelines, 2014 (Ministry of Urban Development). http://mohua.gov.in/link/urdpfi-guidelines.php

- o Technology compendium for all available technology that enable better resource efficiency or minimise waste (for reducing water consumption, less energy usage, wasting less fabric, recycling waste etc) – No comprehensive information available for the same

- **Education** - Curriculum in textile engineering colleges can be upgraded to introduce element of efficiency at this stage itself.

- **Consumer Engagement Strategy** – Consumers will play a strategic role in creating demand for sustainable and circular products and business models. However, various stakeholders will have to collaborate to influence and incentivise responsible consumption. Brands and retailers will be important partners in this initiative.

Suggested policy actors

- National Skill Development Council along with Confederation of Indian Textile Industries can identify the relevant skill gap in the national level and prioritise the skill requirements depending on the latest technologies and trends.

- Government of India along with the various ministries like ministry of textiles, ministry of railways, ministry of defence can ensure the procurement of their uniforms only from the sustainable sources.

- R&D institutes should be encouraged to research on advanced materials specially in the technical textiles sectors along with innovation of the sustainability practices in the industry.

- AICTE and UGC can partner up with large R&D centers and industries to prepare an industry-oriented courses focussing on latest trends, technologies and sustainability measures in the textile education of the country.

8. Technical Textiles: a special opportunity for circularity

Technical textiles can be defined as functional textiles that are not produced for aesthetic purposes. They have application in several sectors such as automotive, construction, agriculture, health care, furniture etc. The figure below provides an overview of the various categories of technical textiles.

Figure 8: Classification of Technical Textiles [66]

It is to be noted that while India consumes all types of technical textiles, the country produces domestically only for a few segments viz. Packtech, Clothtech, hometech and sportech. The country largely produces technical textiles that are not very R&D intensive. The reliance on imports is high especially for products such as baby diapers, adult diapers, polypropylene spunbond fabric for disposables, wipes, protective clothing, hoses, webbings for seat belts, etc. [67]

The Government of India has laid special emphasis on developing the technical textiles sector in India in order to develop domestic capacities and to reduce dependency on imports. Some of the measures have included the National Mission on Technical Textiles (with 2 sub-missions: i) standardisation, setting up of centres of excellence, testing facilities etc, and ii) Research & Development), inclusion of technical textiles in ATUFS, subsidies on textile machinery etc.

Based on feedback received from experts in the technical textile sector, there is immense scope for applying circular economy principles. However, there is a need for standards, strong collection mechanisms for used technical textiles and R& D in the sector – and to assess cost and benefits for each of these options. Following are the areas for circular practices in the technical textile sector:

[66] http://www.makeinindia.com/article/-/v/technical-textiles-a-bright-future
[67] https://www.technicaltextile.net/articles/india-to-grow-faster-in-technical-textiles-5365

1. There is huge potential in adopting circular economy principles in the technical textiles segment as most of the segment (~90%) is based on man-made fibres; use of natural fibres in technical textiles is low. There is ***high potential of recycling.***

2. Non-woven (spunbond) plastic bags (made of polypropylene) degrades in a couple of months under sunlight exposure; while they do not choke drainage basins, harm animals immediately by suffocation, etc., but they contribute rapidly to microplastics as they degrade. These bags have been banned under the Plastic Waste Management rules, but continue to be used by many shopkeepers and households due to low costs, and lack of awareness amongst users.

3. HDPE (high density polyethylene) causes major environmental damage, as indicated above. There is great scope in recycling HDPE; but it is used mainly in consumer products. Therefore, ***strong collection mechanisms*** are needed to bring back HDPE in the recycling system especially in active commercial areas like vegetable mandis, shopping areas etc.

4. ***Labelling and regulation*** is important in manufacture and marketing of "bio-degradable" plastics. Many products described as such are only 40-45% biodegradable. Only those materials that are 80% or more degradable materials should be classified as biodegradable, and these are expensive to produce. These are usually made from corn starch, molasses, etc. Indian Institute of Packaging (Mumbai) is working on providing a classification for these bags (along with BIS).

5. Biodegradable and bio-compostable are different terms; products should be tagged accordingly, along with instructions on end-of-life processing/take-back, etc. Jute and hemp have less scope as substitutes in technical, but bamboo (with natural antibacterial properties) is already being adapted in many places. ***R&D is required to reduce the costs of working with bamboo fibre***. China has successfully commercialised the bamboo fibre.

6. PET bottles have been converted into polyester for manufacturing apparel. This reconversion is done in a highly controlled and automated manner thus eliminating the scope of micro plastics.

7. Cellulosic fibres have great scope in technical textiles. Post-consumer cotton clothes can be converted into pulp, and then into cellulosic fibre. Grasim has been working on cellulose.

8. ***Personal protection equipment***, like masks, fire-fighting garments, bullet proof vests, etc. are usually discarded after they are used/damaged. There is scope for ***recycling***. Again, a need for ***clear regulation on end of life use and disposal is needed along with robust collection mechanisms***. Separation of blended fibres is possible, but is very costly. Cotton can be removed from polyester by acid-melting.

9. There is a high scope for recycling in nets too: fishing nets, nets used in agriculture especially for protecting agricultural produce or hay against changing weather, nets used for food packaging, etc. Improper disposal of these can cause environmental problems.

10. In technical textiles, ***chemicals*** are largely used for purposes of coating (used as additives to polymers for coating). Many of the process chemicals can harm (pollute) air and water, like VOCs. Green chemicals have made an entrance, but their use is costly as of now. Further, there is a need for **capacity building and awareness** in the industry to shift to green chemicals

9. Way forward

To enable a transition to circular economy, an integrated approach is needed as the sector is disaggregated. Every cluster must adopt best practices on water, energy and other aspects needed for circularity. This is difficult at individual firm level, as most manufacturing units are micro and small; the cluster management authorities and associations must be engaged in the transition and common infrastructure must be built. A systematic, human centred transition to a circular economy is needed for the textile and apparel industry for better environmental and social performance, as well as to improve competitiveness and improve market access.

There is a clear business case in adopting circular economy. Opportunities are emerging for attracting international and domestic sources of sustainable (ESG) finance, especially with the Government of India developing a roadmap on Sustainable Finance in India. A continued and concerted support involving various segments of the government at all levels is needed to create the enabling environment for circularity.

Skill and capacity building of workers and entrepreneurs is required and critical, especially from the point of 'just transition'. This will ensure that a circular transition not only creates new job opportunities, but also existing jobs are protected in a transitioning sector. Further, certain categories of consumers can start to play a key role in influencing the brands (national and international)

A move to support integration of circular economy must be institutionalised and led by the Ministry of Textiles. The Ministry of Textiles should develop a roadmap for the sector, with inputs and consultation with suppliers, exporters, brands, experts, CSOs, etc. Some Ministries like the Ministry of Electronics and IT have realised the importance of such a roadmap already (MeitY released a policy paper to this end in May 2021).

Brands must step up their commitment towards reducing social and environmental impacts of their value chains. EPR and reverse logistics need to be deployed especially by brands/buyers to reduce textile waste.

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Annexure – I: Academic Institutions and Research and Development Centres

Table 3: List of Centres of Excellence of Textile Research[68,69]

Name	Lead	Partner
COE for Protech	NITRA, Ghaziabad	IIT Delhi
COE for Composites	AITRA, Ahmedabad	
COE for Sportech	Wool Research Association, Thane	
COE for Geotech	BTRA, Mumbai	AITRA
COE for Agrotech	SASMIRA, Mumbai	MANTRA, Surat Navsari Agricultural University, Navsari
COE for Nonwovens	DKTES Textile & Engineering Institute, Ichalkaranji	
COE for Indutech	PSG College of Technology, Coimbatore	
COE for Meditech	SITRA, Coimbatore	AC College of Technology, Chennai

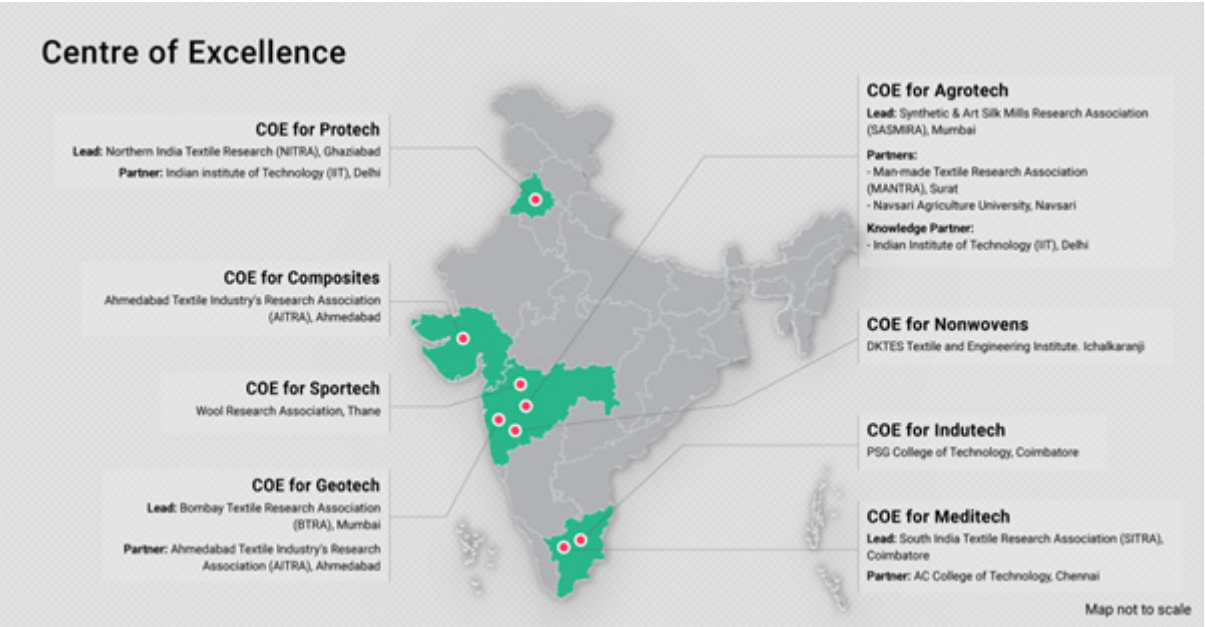

Figure 9: Map of Textile Centres of Excellence in India[70]

[68] https://www.investindia.gov.in/sector/textiles-apparel
[69] For definitions kindly refer to Definition section
[70] National Investment Promotion & Facilitation Agency, 2019

Table 4: Government of India Funded R&D centres in India[71]

Research Institute	Location
Northern India Textile Research Association	Ghaziabad
Central Sericulture Research and Training Institute	Mysuru, Karnataka Berhampore, West Bengal
South India Textile Research Association	Coimbatore, Tamil Nadu
Synthetic & Art Silk Mills' Research Association	Mumbai, Maharashtra
Man-Made Textile Research Association	Surat, Gujarat
Indian Jute Industries' Research Association	Kolkata, West Bengal
Wool Research Association	Mumbai, Maharashtra
Central Institute for Research on Cotton Technology	Mumbai, Maharashtra
Central Institute of Cotton Research	Nagpur, Maharashtra
Central Sheep and Wool Research Institute	Aviknagar, Rajasthan
Central Research Institute for Jute & Allied Fibres	Kolkata, West Bengal
National Institute for Research in Jute and Fiber Technology	Kolkata, West Bengal

Table 5: Other Textile R&D centres in India[72]

Research Institute	Location
Ahmedabad Textile Industry's Research Association	Ahmedabad, Gujarat
Wool Research Association	Thane, Maharashtra
The Bombay Textile Research Association	Mumbai, Maharashtra

[71] Ministry of Textiles, Government of India & Department of Science and Technology, Government of India
[72] Ministry of Textiles, Government of India & Department of Science and Technology, Government of India

Table 6: Academic Research centres in India[73]

Research Institute	Location
Indian Institute of Technology, Delhi	Delhi
Maharaja Sayajirao University of Baroda	Vadodara, Gujarat
Institute of Chemical Technology	Mumbai, Maharashtra
Veermata Jijabai Technological Institute	Mumbai, Maharashtra
Dr B R Ambedkar National Institute of Technology	Jalandhar, Punjab
Aligarh Muslim University, Aligarh	Aligarh, Uttar Pradesh
DKTE Society's Textile and Engineering Institute	Ichalkaranji, Maharashtra
Government College of Engineering and Textile Technology	Berhampore, West Bengal
University College of Technology, Osmania University	Hyderabad, Telangana
Sasmira Institute of Man-Made Textiles, Mumbai	Mumbai, Maharashtra
Indian Institute of Fashion Technology	Delhi, Kolkata, Bengaluru, Mumbai
National Institute of Fashion Technology	16 centres in India

[73] Department of Science and Technology, Government of India

Annexure – II: Circular economy priorities identified through stakeholder consultations[74]

	Fibre production	Textile production	Readymade garment (RMG) production	Logistics and retail	Post-consumer processing
Design - Circular design (reduces environmental impacts, slows down or closes material cycles, prevents waste by design)	R&D on man-made fibres (less impact, more durability); design fibres/fabric suitable for recycling and other downstream circular activities	R&D to reduce material use. e.g. single-shot dyeing (saves chemical and water)	Circular Design guidelines for garments needs to be defined - for e.g as the Jeans Redesign guidelines by Ellen McArthur; Packaging material; design for easy repair and refurbishment of garments	design for sustainable reverse logistics	R&D on fibre separation and sorting, recycling
Raw Material - Conventional & Alternative fibres	availability of cotton for local spinning mills	Manufacturers should be incentivised to work with alternate materials. Single brands cannot influence	RMG manufacturers should be incentivised to procure sustainably produced fabric; traceability is important	tracability required - consumers should be able to make informed choices	Collection and sorting of post consumption apparel ; assessment for different options - repair, refurbishing, recycle etc
Chemicals/Dyes/ Acids - rational/judicious use of chemicals, use of natural dyes, quality of chemicals/dyes used,	Organic fertilizers, herbicides	List of excluded chemicals, List of green and healthy chemicals needs to be identified		Import only green chemicals	R&D on chemical-based recycling
Waste - Material/ Water/ Hazardous Waste - reduction/minimisation in use of hazardous chemicals (generation of hazardous waste), scope of industrial symbiosis (waste from one industry as input for another one)	Quality of raw material (cotton has seeds, leaves etc thus leading to higher wastage)	Integrated facilities are preferred as they can reuse waste in-house. Small scale players need logistics support to use waste sustainably	Reduce need for freshwater - use of technology to capture and resuse steam - Need to take stock of all available technology for reducing waste for various aspects	Plastic waste at retail	Sorting at source; directive to consumers to not dump garments/textiles with municipal waste
Energy - Grid Captive power plants Renewables Heat/energy recovery Process efficiency – modern equipment with lower energy consumption		Use of energy efficient machines, clean energy. Equipment upgradation	Energy efficient technology, sources of clean energy	Use of cleaner transport, transport aggregation services (for reverse logistics)	Reverse logistics with less impactful options (electric powered vehicles); R&D on energy-efficient recycling equipment (fibre separation)
Water - Raw material – low-water intensive options (alternative natural fibres) Dyes – one-shot dyeingProcess efficiency – lower water requirement Recycling – process water,	less water-intensive fibres	Automation can lead to saving of water but challenging for smaller dyeing units due to space constraint in individual units; use recycled water	Common infrastructure development for smaller units (ETP, coloured water holding tanks, separate tanks for chemical sludge - to be recycled separately)		
Business models/practices - Circular Supply Chain/Resource Recovery/Product Lifetime Extension/Product as Service/Sharing Platforms	Incentivise farmers to switch to alternative fibres		Place order to cluster, help clusters modify, Price points not the only consideration for suppliers	Buy back used clothes; provide collection points along with outlets	Collection, sorting and reverse logistics

[74] Consultation have been held at Ahmedabad, Bengaluru, Panipat and Tirupur (virtual), covering stakeholders from other clusters in their respective states (Gujarat, Karnataka, Haryana, and Tamil Nadu).

Annexure – III: Current Circular Economy Practices in India

Brand / Cluster	Production category	Circular Initiative Category	Initiatives / Focus areas
Tirupur [75] Coimbatore	Knitwear & Dyeing	Wastewater recycling	• Achieved 100% Zero Liquid Discharge and 95% water recycle and reuse. • Efficiency rate >95% • 99% salt is recycled
Bawana[76]	Textile, dyeing along with other industries	Wastewater recycling	• Actual efficiency is 90% but designed efficiency rate is 95%. • Water reusing rate is 85%
Aditya Birla Fashion and Retail Ltd[77]	Textiles and Apparels	• Product and Design evelopment • Raw material Sourcing • Manufacturing / Processing • Logistics, storage & packaging • Marketing and sales • Use • End of use	• leveraging technologies and innovative solutions to reduce environmental footprint by enhancing resource efficiency • Use Sustainable cotton procurement • Member of Sustainable Apparel Coalition • Focus of reduced impact on environment from dyeing. • Use blockchain technology for traceability and transparency. • Introduced Product, people and environment stewardship • Extended producer responsibility. • Water & Energy Management • Plastic free & durability • GHG emission management • Sustainable packaging • Take back programme • Life cycle approach

[75] https://gpcb.gov.in/images/pdf/ZLD_PRESENTATION_11.PDF
[76] Bwana CETP Case Study , Rai, A., & Fulekar, M. H. (2020). Wastewater Treatment: Common Effluent Treatment Plant—Case Study. Bio-remediation Technology, 267-284. doi:10.1201/9780429296031-14
[77] http://www.abfrl.com/docs/sustainability/ABFRL-Sustainability-Report-2018-19.pdf

Arvind Limited	Textiles and Apparels	• Product and Design Development • Raw material Sourcing • Manufacturing / Processing • Logistics, storage & packaging • Marketing and sales • Use	• Innovation in material processing and manufacturing to reduce material wastage and increasing energy efficiency. • Member of BCI • Zero waste discharge • Supporting farmers for organic procurement • Reduction in environmental impact in overall manufacturing process • Life cycle assessment of products • Sustainable packaging • Reduce, recycle and reuse principle • Focus on achieving triple bottom line of businesses. • Integrated CSR in business sustainability
Alok Industries Limited	Textiles and knitwear	• Sustainable and organic product sourcing • Technological innovations	• Technical support to farmers for organic and sustainable raw material sourcing. • Improving water and energy efficiency through innovation and technological upgradation throughout the manufacturing period. • Asia's first farmer owned Fair trade certified company. • Waste reuse and recycle • Aims in lowest energy consumption per unit production
Levi Strauss (India) Private Limited[78]	Apparels and accessories	• Raw material sourcing • Refurbishment • Recycling • Resource Efficiency • Energy Efficiency • Superior technology • Superior products	• Partnered with Cotton Incorporated's Blue Jeans Go Green denim recycling programme • Member of better cotton initiative • Waste reuse and recycle • Encouraging recycling and refurbishing • Waterless dyeing • Member of NRDC Responsible sourcing Initiative • Facilitate in reduction in usage of water, chemical and energy through innovation in technology

[78] https://store.levi.com/waterless/

Raymond Industries Limited	Textile and Apparel	• Innovation in raw material and raw material sourcing • Product design • Resource Efficiency • Recycling	• Developed the greenest fabric in the world jointly with Reliance Industries Limited from recycled pet bottles[79] • Higher durability • Recycling and refurbishing • BCI fair trade certified company • Promotes sourcing of organic raw materials. Member of Global Organic Textile Standard • Manufacturing plants use 80% recycled water • Use alternative fuels and energy sources

[79] https://apparelresources.com/business-news/sustainability/raymond-group-reliance-industries-join-hands-launch-green-fabric/

10th year 2011-2020

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