

Approaches for Circular Textile and Apparel Industry in India

Baseline Assessment Report



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Mrs. Prajakta L. Verma

IAS, Joint Secretary,
Ministry of Textiles,
Government of India

“The Textile and Apparel sector is a major economic sector in India. Thus, the integration of sustainability and circularity principles in the value chain is imperative for the larger good of our planet and its people. I wish success to the project team in their endeavour to demonstrate circular approaches in the sector.”

Message



Mohamed El-Khawad

Cluster Coordinator- Environment,
Climate Change and Biodiversity
in GIZ - India

As the environmental, social, and economic challenges faced by the world get more complex, the solutions needed to address them are also evolving. Decision makers and citizens equally well know that strong partnerships and collaboration are key to remedy these pressing issues and regenerate our ecological systems.

The world needs multi-pronged, holistic action to tackle the climate crisis. The Indo-German Bilateral Cooperation holds this principle at the core of their developmental interventions in India, with a mission to build a future worth living. One crucial component of their multifaceted work in the country is to integrate the concept of Circular Economy in high impact economic sectors.

It cannot be discounted that India is one of the largest producers and consumers of textiles and apparel

in the world, and the sector is the second largest employer in the country. With this comes the huge burden of understanding and reducing the climate impacts of the sector, without negatively impacting those dependent on it for livelihood.

This can be achieved by strengthening integration of circularity principles in the sector's value chain, with a vision to reinvent the concept of fashion – where product life is extended, recycled and renewable materials prioritised, resource use optimised, and waste generation minimised. This vision requires commitment from stakeholders at all levels, and we see public-private cooperation as an important contributor to that.

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), is the German development agency working jointly with public and private sector partners in India for sustainable economic, ecological, and social development. On behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), GIZ also supports public-private partnerships through its DeveloPPP program. Under the ambit of DeveloPPP, GIZ India is working with Aditya Birla Fashion and Retail Limited (ABFRL), on a joint project titled “Approaches for Circular Textiles and Apparel Industry in India”. The project aims to understand the sector's sustainability and circularity mechanisms, strengthen innovation and capacities, and work with policy makers to contribute to the national agenda.

This baseline assessment report prepared in the project summarises our sectoral understanding of circularity developed in consultation with many stakeholders on the ground – entrepreneurs, waste workers, brands, MSMEs, academic institutes etc. We hope that readers see value and rigour in the findings and consider them while strengthening circularity and sustainability methods in their respective organisations and processes.

I convey my best wishes to the project teams from GIZ, ABFRL and CEE (project implementation partner), and look forward to successful implementation of the joint project.



Message



Ashish Dikshit
Managing Director, ABFRL

At ABFRL, we aim to collaborate, contribute, and co-create a new movement in the Indian textile sector. Our goal is to create a platform for innovators, think-tanks and industry stakeholders to develop sustainable and impactful solutions that raise awareness about textile circularity. As industry leaders in the Indian apparel market, we constantly seek endeavours that transform the industry from a sustainability lens.

What plagues our industry is lack of awareness on sustainable practices and price remains a significant factor in purchasing decisions for many consumers. As such, there is a need for greater education and awareness-raising initiatives to encourage more sustainable consumption patterns among Indian consumers.

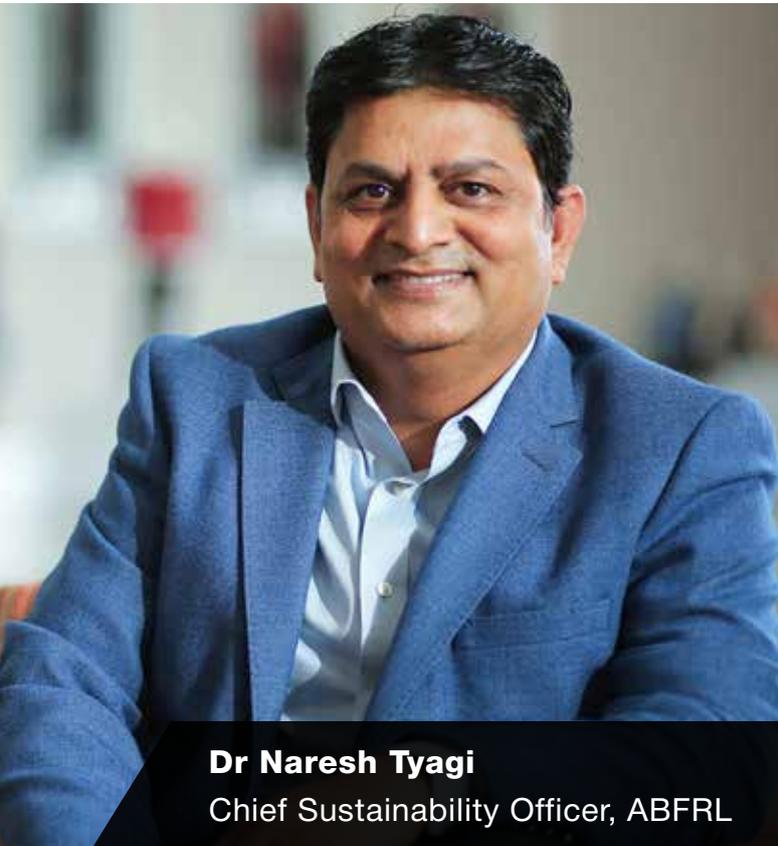
The concept of circularity has emerged as a critical pillar to address these challenges and create a more sustainable future for the industry and the world at large. By adopting best circular practices, companies can reduce their environmental impact, improve resource efficiency, and promote social responsibility. According to a report by the Ellen MacArthur Foundation, a circular economy in the textiles industry could generate \$560 billion in savings globally by 2030.

ABFRL has collaborated with GIZ to promote circular business practices in the Indian market. Implementing circular solutions in the textile and apparel linear value chain not only unlocks untapped commercial potential for existing stakeholders but also reduces the substantial carbon footprint of the industry. With GIZ's support, ABFRL and other industry players can leverage circular business principles and implement technically superior and consumer-friendly processes.

With this recent partnership, our aim is to introduce globally benchmarked circular business practices in India. India's textile and apparel industry is the 6th largest in the world and second largest employment sector. A large part of the textile waste generated is sent to the landfill and incinerated instead of being recycled or reprocessed. There is a need to 'self-disrupt' existing practices and transition to a more circular approach. Promoting a common understanding is therefore crucial from a sustainable development perspective for the entire textile sector in India. Along with our partners, we aim to create awareness among key stakeholders to drive circular approaches, reduce waste, and create closed-loop systems.

The state of circularity in the Indian textile and apparel industry is in the nascent stages, but there is growing awareness and initiatives to promote sustainability and circular practices. With this baseline report, we intend to begin a powerful dialog with diverse industry stakeholders to understand the root causes and how we can find solutions to work through the issues in a collaborative manner.

Foreword



Dr Naresh Tyagi
Chief Sustainability Officer, ABFRL

The Apparel and Textile industry in India is one of the oldest and largest industries in the country, contributing significantly to economic growth and employment opportunities. According to the Ministry of Textiles, as of 2021, the industry accounts for 2.3% of India's GDP and 13% of the country's total export earnings. The industry also employs around 45 million people, making it one of the largest employers in the country.

Rapid growth of the industry in the past few decades has also brought with it several environmental and social challenges. For instance, in 2017 WRI reports that the industry was estimated to consume around 425 billion cubic meters of water per year, leading to water scarcity in many areas. The production of textiles also generates a significant amount of waste and pollution, with the industry accounting for around 10% of global carbon emissions and 20% of global water pollution.

Yet, there is a sliver of hope in the way the industry intends to create an environmental balance. In recent years, there has been a growing awareness and interest

among Indian consumers in sustainability and ethical practices in the Apparel and Textile industry. A study by Nielsen India found that 85% of Indian consumers are willing to pay more for sustainable products, and 74% consider environmental and social impact when making purchasing decisions. This report presents a comprehensive baseline analysis of circularity practices in the Apparel and Textile industry in India. Based on extensive research and analysis of existing literature, academia, industry reports, and interviews with industry experts and stakeholders, the report deep dives into the overview of the Indian Apparel and Textile industry, highlighting its economic significance and social and environmental challenges.

There is a strong focus on waste management in the industry, and the report offers a detailed analysis of the different types of waste generated in the production process and their impact on the environment. It also explores the current waste management practices in the industry and identifies the gaps and challenges in managing waste effectively.

While there is support from Government agencies across the country for the cause of circularity, the efforts are still at very nascent stages. The report explores the current state of circularity practices in the industry, including the adoption of sustainable materials, circular product design, and closed-loop systems. It further tries to identify key drivers and barriers to the adoption of circular practices in the Textile and Apparel industry in India. Eventually, the idea of this report is to unearth approaches and strategies that companies can adopt to make circularity a reality in their operations. Innovation, technology, and collaboration play a big role in promoting circularity and the report can provide examples of best practices for leading companies in the industry.

We hope that this report will serve as a valuable resource for policymakers, industry stakeholders, and companies interested in promoting sustainable practices and contributing to a more circular economy in India. By highlighting the challenges and opportunities in adopting circular practices, we aim to provide actionable insights that can help drive progress towards a more sustainable and circular future for the industry.

Preface



Kartikeya Sarabhai,
Director,
Centre for Environment Education

The textile industry is a vital sector for the Indian economy, employing millions of people and contributing significantly to the country's GDP. India is the world's second largest exporter of textiles and clothing, but the rapid expansion has resulted in drastic environmental issues, and the industry has to move towards a circular economy to reduce waste, safeguard resources and keep materials circulating within the value chain. The ever-growing textile and apparel industry in India is facing inevitable challenges at its doorstep now. Beyond challenges like industry fragmentation, marginal client base, and inefficient production there are several environmental problems that also need attention.

It gives me immense pleasure to introduce the Baseline Assessment Report of the 'Approaches for Circular Textiles and Apparel Industry in India' programme. The aim of this project is to help India's

textile and garment industry embrace circular economy principles while growing exponentially.

This report includes first-hand data on India's textile and apparel industry, including current practices on sustainability and circularity, existing gaps and challenges and potential areas for pilot implementation from innovations. The study addresses textile industry circularity and stakeholders at each step of the value chain, including design, manufacturing, distribution, retail sale, and consumer use.

The team interviewed numerous stakeholders, visited various facilities and mapped the waste cycles of India's major textile clusters to understand how textile waste is generated throughout the value chain. The waste generated at the production and consumption stage has been divided into pre and post-consumer waste, and the report documents the economic and practical worth of both these types of waste.

While India has always had a tradition of circularity, and has a large informal sector which is engaged in waste segregation for further use, it was determined that textile circularity in its contemporary sense is still in its initial stage in India due to various challenges. We found several aware stakeholders who are investing incessant efforts to promote textile circularity in the existing scenario. The project stakeholders will support such innovators and help them get an opportunity to collaborate with India's leading fashion giant - Aditya Birla Fashion and Retail Ltd.

I am confident that this report will provide valuable insights into India's textile industry's circular practices, challenges, and potential areas for improvement.

Glossary

ACTAII	Approaches for Circular Textiles and Apparel Industry in India
ABFRL	Aditya Birla Fashion and Retail Limited
ATDC	Apparel Training and Design Centre
ATIRA	Ahmedabad Textile Industry's Research Association
BMZ	Federal Ministry for Economic Cooperation and Development, Germany
BOD	Biochemical Oxygen Demand
C2C	Cradle to Cradle
CAIF	Circular Apparel Innovation Factory
CE	Circular Economy
CEE	Centre for Environment Education
CII	Confederation of Indian Industry
CMAI	Clothing Manufacturers Association of India
COD	Chemical Oxygen Demand
CPCB	Central Pollution Control Board
CSR	Corporate Social Responsibility
develoPPP	Develop Public Private Partnership
EOL	End of Life
EPR	Extended Producer Responsibility
ESG	Environmental, Social and Governance
FDI	Foreign Direct Investment
FICCI	Federation of Indian Chambers of Commerce & Industry
GDP	Gross Domestic Product
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
GOI	Government of India
GRS	Global Recycled Standard
IC	Innovation Challenge
MITRA	Mega Integrated Textile Region and Apparel
MMF	Man-Made Fibre
MOEFCC	Ministry of Environment, Forest and Climate Change
MOT	Ministry of Textiles
MSME	Micro, Small and Medium Enterprises
NGO	Non-Governmental Organization
NID	National Institute of Design
NIFT	National Institute of Fashion Technology
OE	Open End
PLI	Production Linked Incentive Scheme
SHC	Second Hand Clothes
SIDT	Sasmira's Institute of Design and Textile
T & A	Textile and Apparel
VOC	Volatile Organic Compound
ZDHC	Zero Discharge of Hazardous Chemical
ZLD	Zero Liquid Discharge



Executive Summary

The Indian Textiles and Apparel Industry is known for its commitment to circularity, which began with a rich culture of reusing and recycling textiles in some form or the other. Companies in the domain have been actively advocating, promoting and adopting circular practices, such as recycling, reusing and upcycling, to reduce waste and promote sustainability.

In a step to strengthen circularity practices in this sector, Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) and Aditya Birla Fashion and Retail Limited (ABFRL) are collaborating on “Approaches for Circular Textiles and Apparel Industry in India (ACTAIL)” as part of the Indo-German Development Public-Private Partnership program (develoPPP). The ACTAIL project aims to help India’s textile and apparel industry embrace circular economy principles by developing circular economy guidelines, circularity training modules, and collaborating with startups through an innovation challenge.

To start with project activities, a baseline study was essential to determine the present status of circularity adoption in the Indian Textile & Apparel (T&A) sector. The study was initiated with a focus on the sector’s current situation concerning circular business practices, and the challenges, hotspots and potential areas of circular interventions. It was conducted across the value chain and involved various stakeholders across India that provided valuable insights into resource consumption, waste generation, and potential areas for improvement. It was found that while considerable opportunities exist to reduce wastage, challenges such as inadequate infrastructure, limited Government support, and lower consumer demand for sustainable products exist.

Academic stakeholders, the ecosystem’s foundation, were the first to be approached during the baseline assessment. The study subsequently continued with visits to various production facilities across the value chain, contributing to mapping fibre and textile waste in pre-consumer processes. During the assessment, it was found that wet processing units, the most water- and energy-intensive processes following fabric production, contribute to high resource consumption and low process efficiencies. Neither a national quality

benchmarking system nor data were found for variables such as the quantity and quality of chemicals and auxiliaries used, water consumption per kg of fabric, etc.

Waste mapping is essential in the apparel business because cotton solids, natural and man-made fibre blends, and printed textiles account for a significant portion of total waste produced. Typically, cutting waste is sold as “mixed waste” and is divided hierarchically at its source into small, medium, and large pieces.

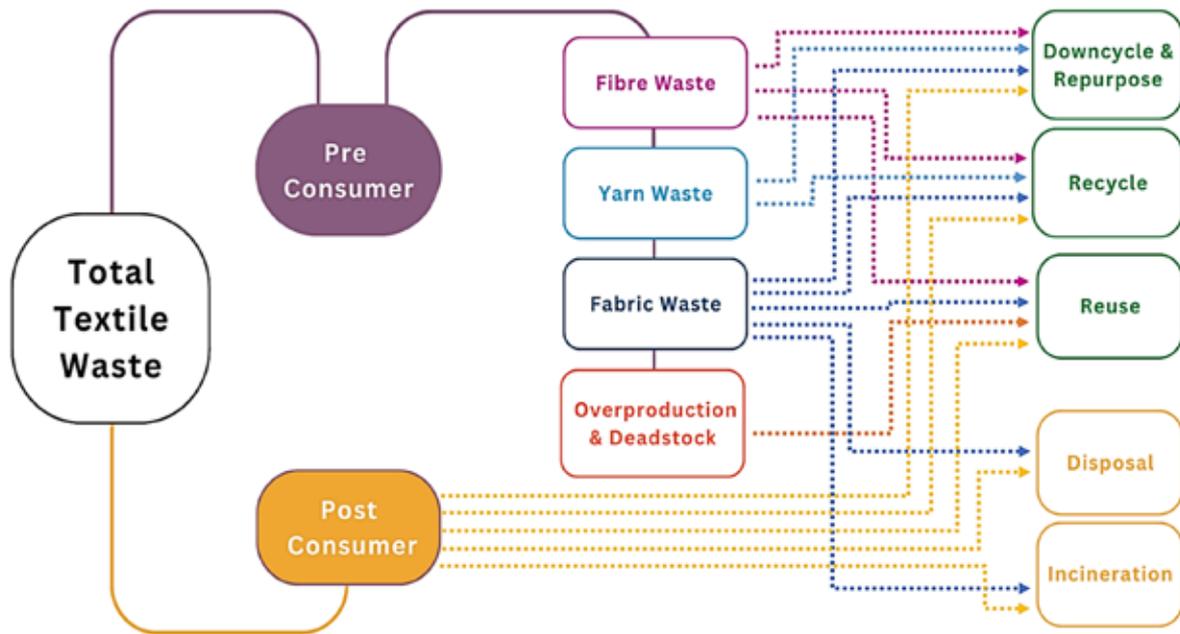
In apparel industries, cutting waste is collected from production facilities and transported to India’s main recycling and downcycling plants that manufacture recycled fibre. Small-cut waste is shredded into fibres and blended with virgin fibres to produce recycled clothing. Pre- and post-consumer wastes are not sorted or pre-processed, resulting in higher virgin resource demand. NGOs, brands and charitable organizations are major sources of formal post-consumer waste collection via donation campaigns and take-back programmes.

The figure (see next page) represents the five current approaches to textile waste management: recycling, reuse, downcycling, landfilling, and incineration.

Every stakeholder in the Indian waste industry attempts to maximize profits by selling waste, and soiled textile waste is dumped in landfills since they are unaware of waste utilization techniques.

There are various ways by which textile waste can be managed. The most common methods include downcycling, recycling, reuse, and disposal. Downcycling involves converting waste into a lower-quality product, while recycling involves converting waste into a new product of the same quality. Reuse involves using waste products again without converting them into a new product. Disposal involves sending waste to a landfill or incinerator.

The best method for managing textile waste will vary depending on the specific type of waste and the available resources. However, by combining these methods, it is possible to significantly reduce the amount of textile waste that ends up in landfills and incinerators.



Waste Type	End Use	Waste	Application
Fibre Waste	Downcycle & Repurpose	Cotton sweep waste and waste from OE spinning mills	As raw material for allied industries
	Recycle	Comber and Pneumafil waste	As coarser yarn for denim
Yarn Waste	Downcycle & Repurpose	Denim yarn, End bits of Beam	Used to make ropes
	Recycle	Sized yarn	Shredded into fibres
Fabric waste	Downcycle & Repurpose	Blended and mixed colour fibres	Bags
	Recycle	Knitted and woven white and solids cotton cut waste	White and coloured recycled yarn
	Reuse	Clean bigger and medium cut piece	Apparel
	Disposal	Soiled small cut waste	Worn clothes are sent to landfill
	Incineration	Polyester cut waste	As boiler fuel
Overproduction & Deadstock	Reuse	Garments from overproduction	Stock lot sale Stock lot sale Stock lot sale
Post-Consumer Waste	Downcycle & Repurpose	Blended and mixed colour clothes	Bags, filler for mattress and cushion
	Recycle	Knitted and woven white and solids cotton clothes	White and coloured recycled yarn
	Reuse	Outsized clothes	Second-hand apparel
	Disposal	Wipes made from clothes	Sent to landfill
	Incineration	Soiled clothes	Municipal incineration plant

It has been identified that most waste is recycled and reused, and individuals unknowingly engage in circularity. In addition, it is also observed that waste is downcycled and used in other industries, such as pulp and paper, automobile, home textiles industry, etc. Small enterprises further utilize waste as fuel.

The clothing's recycling potential is influenced by its quality, degree of usage, physical condition, and inclusion of accessories such as buttons, emblems, labels, etc. Artificial recycled fibres come from sources other than clothing, such as PET bottles and pre-consumer waste. The recycling fibre hierarchy begins predominantly with producing coarse recycled yarn through open-end spinning. The raw materials for recyclers consist of imported textile waste, brand-driven collection initiatives, and donated clothing.

Findings indicate that practices in the T & A value chain contribute to the circular economy to a certain extent. However, significant challenges and gaps remain in scaling up and formalizing these practices and implementing novel circular practices.

The following are some key areas that have been identified by observing existing circularity practices where the industry can focus its efforts to improve circularity:

1. Waste management - The industry can reduce waste by improving its product design, using more sustainable materials, and recycling more waste.

2. Infrastructure - The industry must invest in infrastructure supporting circularity, such as recycling facilities and collection centres.

3. Value chain education and awareness - The industry needs to educate its stakeholders about the benefits of circularity and how they can contribute to it.

4. Government policy - The Government can support circularity by providing incentives for sustainable practices and regulating the industry to reduce its environmental impact.

5. Research & Development - The industry must invest in Research and Development to develop new technologies and manufacturing processes, supporting circularity.

6. Consumer engagement - The industry needs to engage consumers in circularity by making it easy or them to recycle their clothes and buy sustainable products.

7. End-of-life management – Recycling, upcycling, donation, and other practices should be explored to manage post-consumer waste properly.

By taking these steps, the Indian T&A industry can lead in the transition to a circular economy.

The '6Rs Strategy' is a comprehensive approach to textile waste management that can be implemented by all stakeholders in the value chain. These include:

- **Redesign** practices that are not sustainable.
- **Reduce** resource utilization and waste disposal in textile production by minimizing the amount of water, energy, and chemicals used in apparel manufacturing and the amount of waste generated by industrial processes.
- Utilizing durable materials and repairing, refurbishing, or repurposing textiles constitute **reuse**.
- **Remanufacturing** is an effective method for extending clothing life by disassembling aged clothing, recovering valuable components, and then redesigning and reassembling parts to produce new clothing or accessories of equal or higher quality.
- Old textiles can be **recycled** into new fibres using mechanical or chemical processes.
- All post-use fabrics that cannot be recycled should be returned to nature, where they can decompose and **regenerate** into new fibre crops.

By implementing the '6Rs Strategy', the Indian textile and apparel industry can significantly reduce its environmental impact and contribute to a more circular economy.

In conclusion, the Indian textile and apparel industry is making significant strides towards circularity. By leveraging traditional practices of reusing and recycling textiles and adopting circularity principles, the industry can contribute to waste reduction, resource conservation, and the overall sustainability of the sector. Scaling up identified circular practices and promoting novel innovations throughout the value chain will showcase India's commitment to a circular economy in the industry.

Contributors

GIZ Team



Dr. Shailendra Dwivedi

Dr. Shailendra Dwivedi is Director-Climate Change & Circular Economy in GIZ India. He has over two decades of experience in the climate change and development sector in the fields of urban and industrial environment, rural development and decentralization with GIZ and other civil society organizations. He possesses a Doctoral degree in Sociology from Indian Institute of Technology, Kanpur and a Master's degree in Rural Development.



Ms. Meghana Kshirsagar

Meghana Kshirsagar is a Senior Advisor - Climate Change & Circular Economy in GIZ-India. She leads projects on circular economy approaches in the textile & apparel value chain, and mainstreaming climate actions from local to global. She is a Climate change and Sustainability professional with 21 years of professional experience working with Govt, Non- Govt. & Private sector.



Ms. Kavya Arora

Kavya Arora has seven years of professional experience in the sustainability and development cooperation space. She is a Junior Technical Advisor - Climate Change & Circular Economy at the Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ) in Delhi, India. She specializes in working with public and private stakeholders on the themes of circular economy, climate change adaptation, waste management, livelihoods, and the SDGs.



ABFRL Team



Mr. Padmakar Pandey

Padmakar Pandey is Assistant Vice President – Sustainability at Aditya Birla Fashion and Retail Limited. He currently leads Product Stewardship & Supply Chain Sustainability and playing a crucial role in helping brands and supply chains to integrate ESG and Circularity into their core business principles. He is a B. Tech, IIM LKO Alumni and Six sigma black belt practitioner with vast experience in the apparel Industry.



Ms. Janet Arole

Janet Arole is Assistant Vice President and Head of Corporate Communications at Aditya Birla Fashion and Retail Limited. She currently leads Branding, Media Relations, Internal Communications and Digital Communication. She has an MBA from Universitas 21 Global Singapore, and is pursuing Stanford Business Education. She has immense experience in the retail and apparel sector.



Mr. Merwyn Fernandes

Merwyn Fernandes is Manager, Corporate Communications at Aditya Birla Fashion and Retail Limited. He is a Digital Marketer with a passion for helping businesses succeed through effective digital marketing strategies, skills in social media advertising, content marketing, email marketing, SEO, SEM and more. He has a Bachelor's in Mass Media from Mumbai University.



Ms. Kamakshi Venugopal

Kamakshi Venugopal is Manager, Corporate Communications at Aditya Birla Fashion and Retail Limited. She is a Content Specialist with a flair for storytelling across digital mediums. She has a Masters in English and Sociology from Pune University, LLB from Govt. Law College, Mumbai and a PGDBM in HR from SP Jain School of Global Management.



CEE Team



Mr. Tushar Jani

As a professional in Industrial Sustainable Development, Tushar Jani has worked on various environmental and sustainability projects across India. He has over 40 years of experience, including 16 years in the developmental sector. At present, he is engaged as Senior Programme Director for the Centre for Environment Education, where he oversees nationwide initiatives for textile value chain circularity and sustainability.



Mr. Nitesh Patel

Nitesh Patel is an expert in climate change and circular economy and has experience in planning, coordinating and implementing technical cooperation projects on Sustainable Industrial Development. In the textile domain, he implemented projects on the Best Available Techniques Reference (BREF) Document for Textile Sector and Environment-Friendly Techniques in the textile sector. Having practical experience in implementing improvement measures within industries and bringing those practices up to policy level, with various stakeholders involving private and government.



Mr. Kashyap Arya

Kashyap Arya is a Chemical Engineering graduate with expertise in conducting Resource Efficient and Cleaner Production (RECP) studies in the textile industry. Currently working as a Project Officer at the Centre for Environment Education, focusing on sustainable practices and environmental awareness.



Mr. Himanshu Nainani

Ahmedabad-based former Journalist who has always been a curious Digital Marketeer too. A Content Creator & Hobbyist Poet at heart, Himanshu has a knack for storytelling through various mediums.

Project Overview

01





India's textile sector is one of the oldest industry in the Indian economy, dating back several centuries. It is highly diverse, with hand-spun and hand-woven textiles at one end of the spectrum and capital-intensive sophisticated mills at the other, spread across India. This sector is crucial in supporting and boosting the national economy.

Decoding the Indian Textile Sector

India is the world's 6th largest exporter of Textiles and Apparel (T & A). The share of T & A, including handicrafts, in India's total exports stood at 12% in FY 20-21. India has a share of 4% in the global trade for textiles and apparel.¹

India's textile industry is booming because it manufactures a variety of yarns and fibres, including natural fibres such as cotton, jute, silk, wool and synthetic fibres like polyester, viscose, nylon, and acrylic (see Chapter 2).

The Textile sector is dominated by decentralized

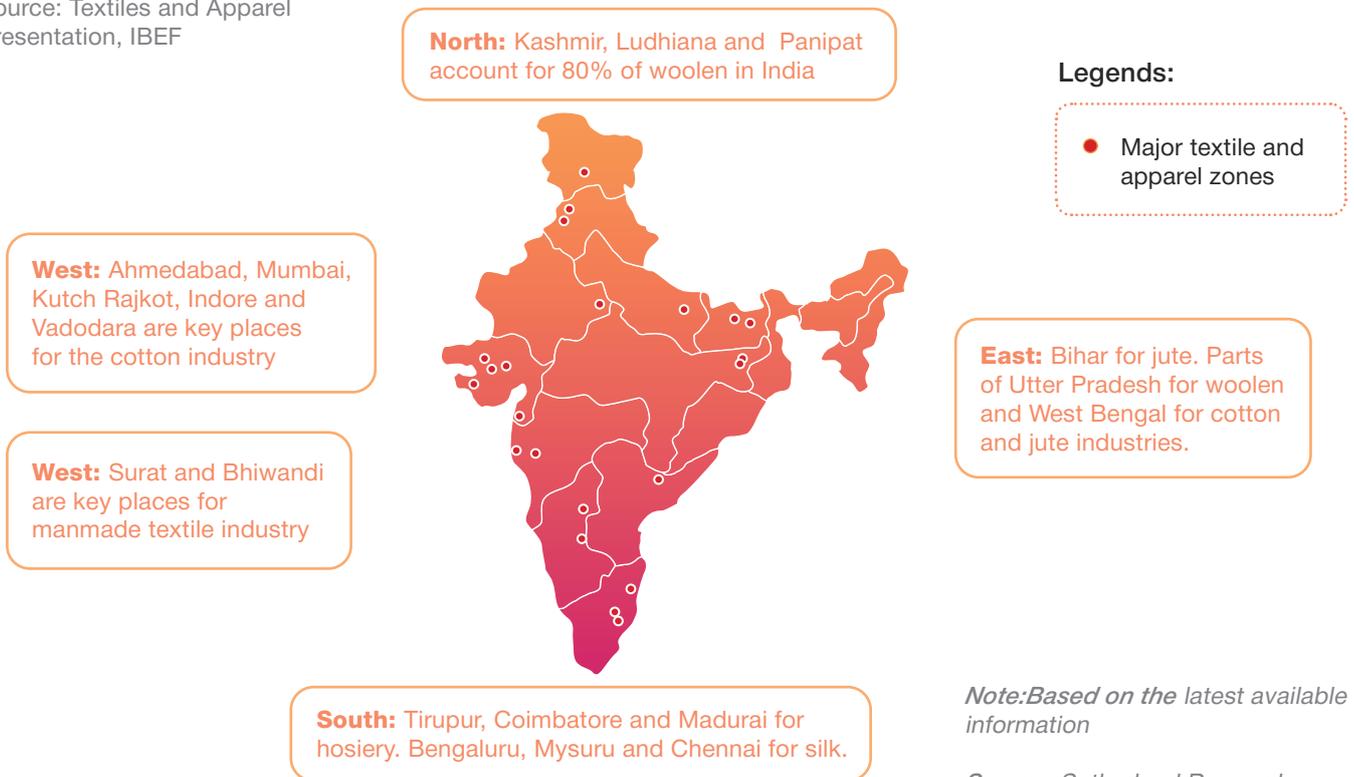
power looms/hosiery and knitting. The industry currently employs more than 45 million people, making it the second largest employer in the country and contributes to more than 15% of the country's export earnings with almost 7% of the country's industrial output. Handloom, handicrafts, and small-scale power-loom operations, create employment opportunities for millions of rural and semi-urban people.³

The Indian Government has lately introduced numerous export promotion policies and initiatives to prioritize the textile sector and boost its GDP share to attract FDI and promote employability.

- Textile makers will benefit from the Rs.10,683 crores (US\$ 1.44 billion) Production-Linked Incentive

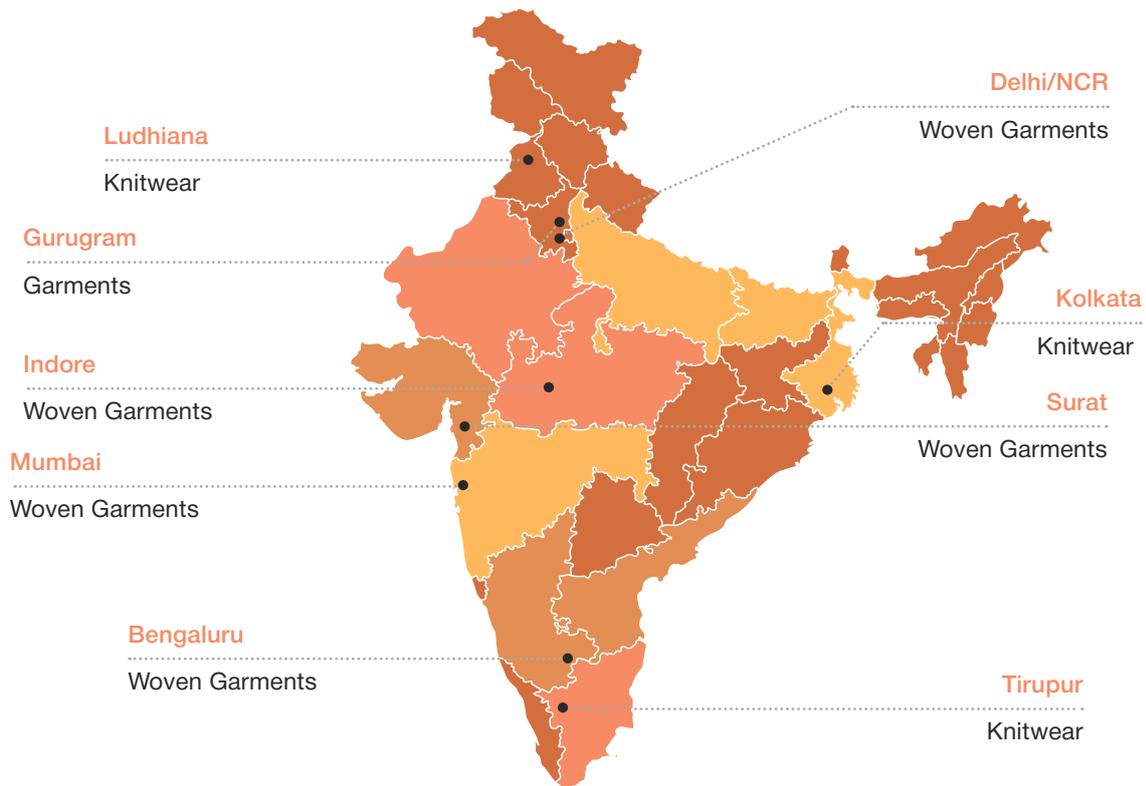
Figure 1: Mapping the significant textiles zones in India

Source: Textiles and Apparel Presentation, IBEF



¹ Indian Textiles and Apparel Industry Analysis Presentation, June 2022 | IBEF

Figure 2: Identifying the major readymade garment clusters in India



Source: Circular Textile & Apparel in India Policy Intervention Priorities and Ideas by CRB

(PLI) scheme introduced in 2022. The scheme encourages Man-made Fibre (MMF) apparel, fabrics, and ten technical textiles categories.

- The Government has also approved the Mega Integrated Textile Region and Apparel (MITRA) Park scheme worth Rs.4,445 crores (US\$ 594.26 million) to build seven integrated mega textile parks over the next three years. It will have state-of-the-art infrastructure, common utilities, and R&D facilities to boost textile manufacturing in the country.⁴

Though the Government has introduced many initiatives, policies and schemes for supporting the Textile sector, the Indian Textile & Apparel industry still faces unprecedented challenges. It is due to a few structural weaknesses such as a highly fragmented industry (increased logistics cost), lack of product diversification (Apparel, Home & Industrial textiles), limited client base

(MSMEs majorly catering to the local market), and inefficient production (due to obsolete technology usage) as compared to its competitors (China, Bangladesh, Vietnam, etc.).

Moreover, the Indian Textile & Apparel industry comprises MSMEs involved in non-integrated spinning, weaving and knitting, fabric finishing, and apparel-making. In contrast, the textile sector in developed economies is dominated by large-scale integrated mills with modern technology and machinery that combines spinning, weaving, and fabric finishing to achieve higher efficiencies and further in-house utilization of process by-products.⁵

Therefore, given India's position as a major global hub for consumption and production, the sector must be reformed to sustain long-term competitiveness.

² Textile Industry in India, Leading Yarn Manufacturers in India – IBEF (<https://www.ibef.org/industry/textiles>)

³ Indian Textiles and Apparel Industry Analysis Presentation, June 2022 | IBEF

⁴ Textile Industry in India, Leading Yarn Manufacturers in India – IBEF (<https://www.ibef.org/industry/textiles>)

⁵ Circular Textile & Apparel in India Policy Intervention Priorities and Ideas, CRB, April 2022

Need for Textile Sector Transition Towards Circular Economy

Environmental and social awareness has made sustainable manufacturing a primary focus for all countries worldwide.

Over the past years, the spotlight has increasingly turned on environmental impact of rapidly increasing production volumes and shorter product shelf life. In the past 15 years, apparel production has doubled while the number of times garments are worn before being discarded has reduced by 36%. The rapid growth in textiles has largely been accounted to be synthetic fibres (mainly produced from crude oil), which, over the last 20 years, have grown from less than 20% of global fibre production to 62% of global fibre production in 2018 [Preferred Fiber and Materials Market Report 2018, Textile Exchange]. With less than 1% of the fibres used for producing recycled clothing, the textile industry uses large amounts of resources, negatively impacting the environment.⁸

A linear approach increases resource demand, consumption and waste, which must be disposed of in an environmentally acceptable manner, creating an inefficient linear economy.

A shift to a circular economy (CE) is gaining traction and momentum to preserve natural resources and keep products within the value chain cycle.

In contrast to the linear economy, a circular economy designs durable, reusable, and repairable products utilizing resources that can be recovered and recycled at the End of Life (EOL). Therefore, Governmental and Corporate groups at the national and global levels are demanding increasing circularity to address climate change, save finite natural resources, minimize pollution, and prevent supply chain disruptions. (e.g., Ellen MacArthur Foundation, 2017; European Commission, 2018, 2022; United Nations, 2022).⁹

With the most significant fashion businesses in the world progressively pledging to achieve Net Zero standards, there is a rising trend for sustainability in the global fashion industry.

Such positive international developments will significantly influence the Indian textile sector, given its crucial role in the global Textile & Apparel value chains.

Hence, 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

Figure 3: A typical linear apparel life cycle chain



Source: Cradle to Cradle Approach in the Fashion Industry, www.onlineclothingstudy.com

⁶ A New Textiles Economy: Redesigning Fashion’s Future, Ellen McArthur Foundation 2017

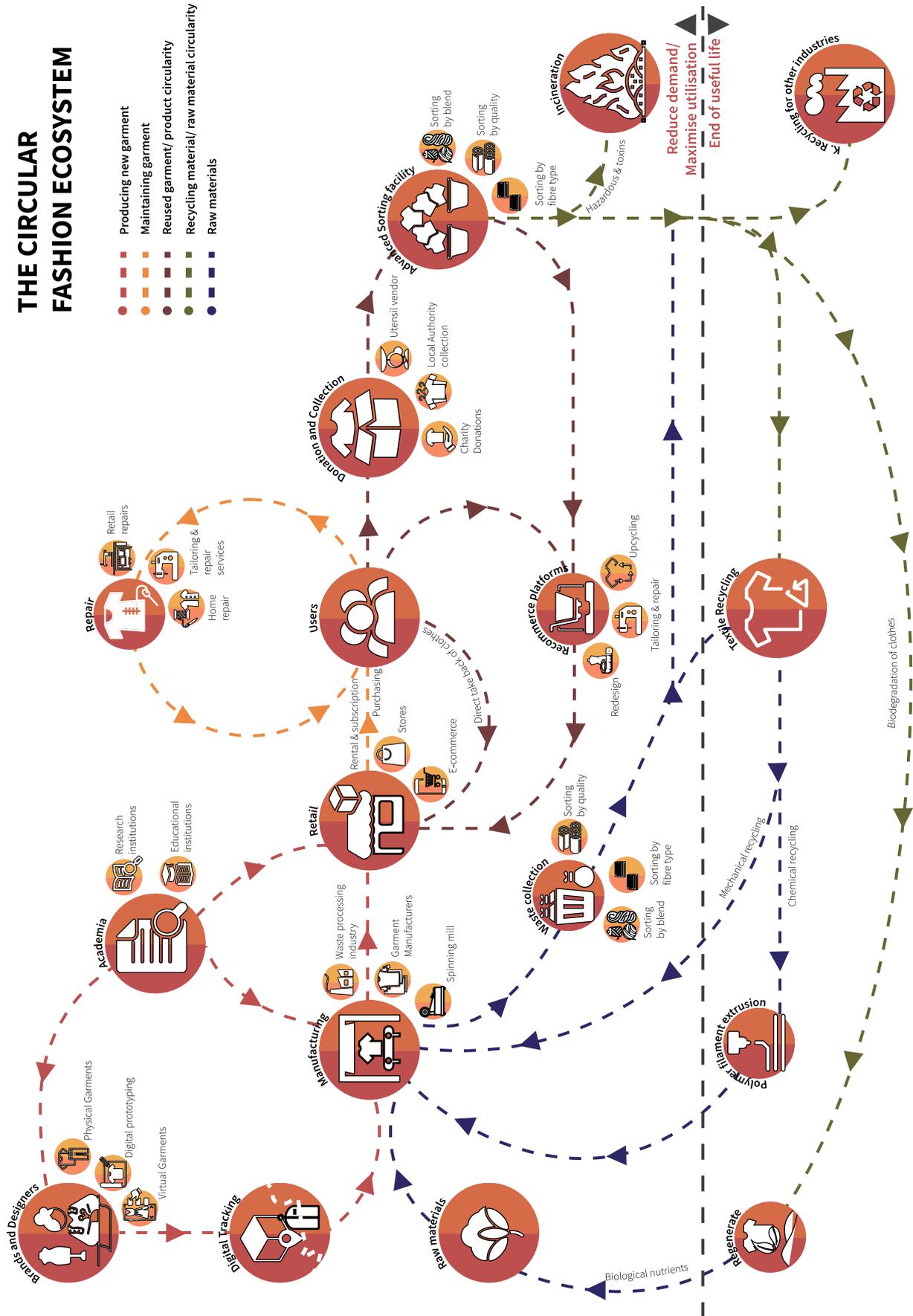
⁷ Preferred Fiber and Materials Market Report 2018, Textile Exchange

⁸ A New Textiles Economy: Redesigning Fashion’s Future, Ellen McArthur Foundation 2017

⁹ Textiles in a circular economy: An assessment of the current landscape, challenges, and opportunities in the United States 2022, Kelsea A. Schumacher * and Amanda L. Forster

THE CIRCULAR FASHION ECOSYSTEM

- Producing new garment
- Maintaining garment
- Reused garment/ product circularity
- Recycling material/ raw material circularity
- Raw materials



for switching to a more sustainable and circular fashion, as shown in the illustration below (adapted from the circular fashion ecosystem – A blueprint for the future, Institute of Positive Fashion and modified based on the information obtained during baseline assessment).

Preparing the Textiles & Apparel Sector for Circular Economy

Implementation of circular principles in the Indian Textile & Apparel industry has been a cumbersome task, as communication channels between recyclers, yarn makers, and designers in the Textile sector and other industries are still in their infancy. Furthermore, knowledge about recycling is often still rudimentary and not fully integrated into strategic business developments.

Thus, to strengthen the capacities of the Indian Textile & Apparel industry to impart and implement circular approaches, a joint project “**Approaches for Circular Textiles and Apparel Industry in India**” was conceived between Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and Aditya Birla Fashion and Retail Ltd (ABFRL) under BMZ’s public-private partnership programme (DeveloPPP.de). Centre for Environment Education (CEE) is the implementation partner for the project.

India Agenda: develoPPP project

The project aims to strengthen Circular Economy mechanisms throughout the textile value chain, develop circular business practices guidelines, harmonize textile clusters and create a Circular Economy ecosystem in India’s Textile & Apparel sector. It will allow the sector to achieve its SDG goals and aid in competing with international textile hubs across the globe.

The intended development impact of this project is a contribution to a less wasteful, less polluting Textile & Apparel industry. The project follows a four-fold approach as detailed below:

- The introduction and **strengthening of circular business practices** within ABFRL and Textile & Apparel industry in the areas of
 - ❖ reducing use of harmful substances through material innovation,
 - ❖ increasing textile-to-textile recycling

- ❖ alternatives to plastic packaging and
- ❖ traceability through the different demonstration projects.

- Creation of **voluntary circular business guidelines** for the Indian textile industry. It is a compendium of good industry practices, key performance indicators (KPIs), and metrics that guide Indian brands and their supply chains from the current status quo to more circular business practices. It acts as a benchmarking tool. The guidelines would include environmental and social aspects and business practices that are required for a circular textile economy.
- The project will **build on existing standards, benchmarks or frameworks** (e.g. the Ellen MacArthur Foundations framework for circular economy or Circle Economy’s 7 R’s framework) and contextualize it to the Indian geography and Textile & Apparel industry.
- **Building and strengthening of capacities** in areas including 1) use of sustainable materials, 2) recycling, 3) use of renewable resources and inputs in production and 4) implementation of internationally applicable social and working conditions within textile supply chains.
- To strengthen and develop an industry-led platform of the Indian textile, apparel and fashion industry for consultation, knowledge exchange and collaboration among industry players on ‘what works’ around circular Textile & Apparel business practices and the potential of innovative products, processes, or business model innovations.

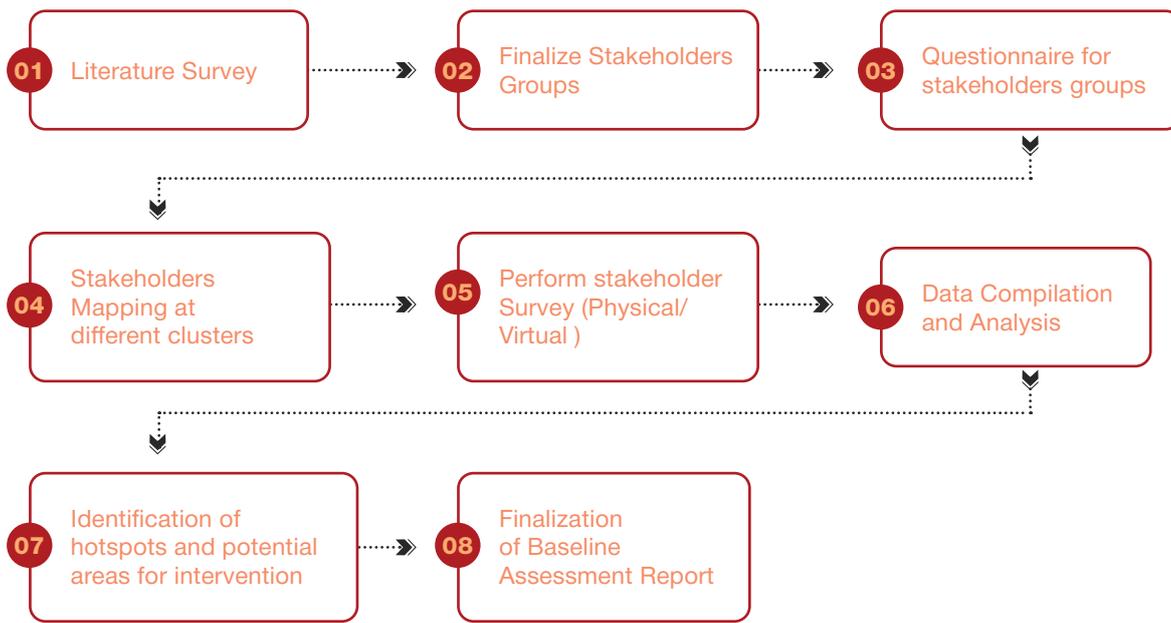
A baseline study is essential to determine the present status of the adoption of circularity in the Indian Textile & Apparel sector.

About Baseline Assessment Study

The objective of baseline assessment is to understand approaches to circular economy in India’s Textile & Apparel sector. This report focuses on the current situation of the sector concerning circular business practices, and the challenges, hotspots and potential areas of circular interventions.



Figure 4: Process Flow Chart of Methodology



The baseline study was initiated with a defined approach, as illustrated in Figure 3, across India’s entire Textile & Apparel value chain to cover the significant stakeholders.

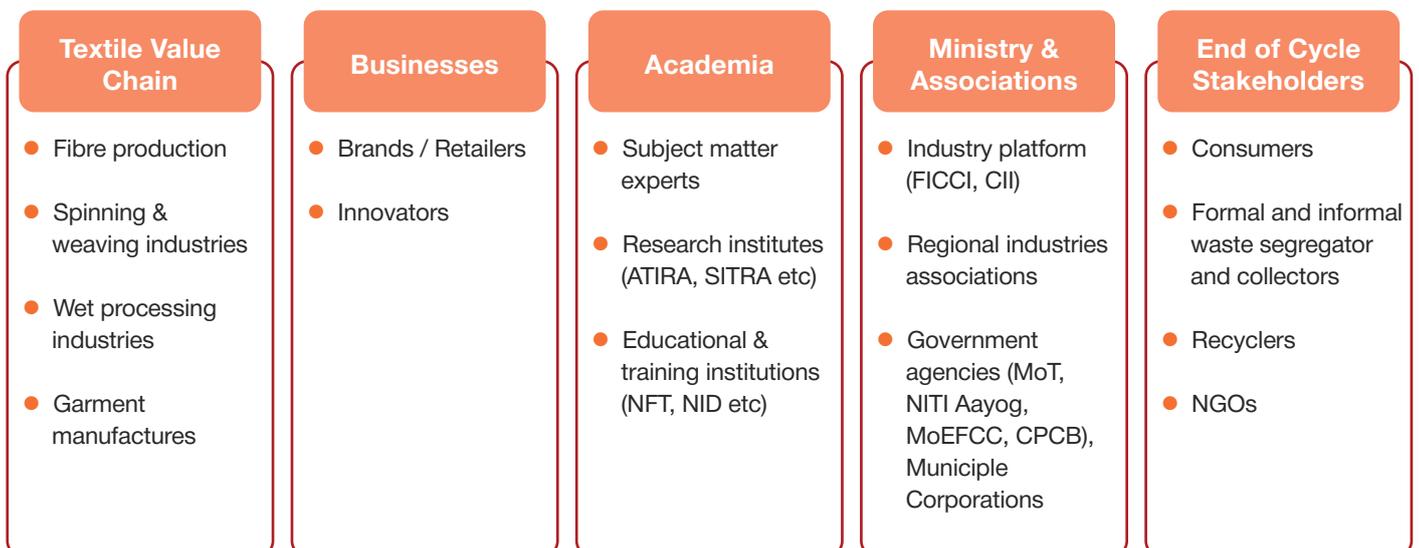
A. Literature Survey

Secondary sources were used to review literatures, reports, research papers and publications of national and international origin. The information related to sustainability and circularity was obtained and compiled. It included an overview of the following:

- Industrial sector,
- Pollution sources and types,
- Environmental standards,
- Existing environmental management and circularity practices,
- Key issues related to circularity,
- Various stakeholders and their roles and responsibilities, etc.

Based on the broad literature investigation, clusters and key stakeholders were shortlisted to undertake physical

Figure 5: Stakeholders across T & A industry



(primary) assessments and interviews to understand the pulse of sustainability and circularity in the Textile & Apparel sector.

B. Stakeholder Groups

Based on the findings from the literature survey, Key stakeholders directly or indirectly associated with the Textile & Apparel value chain were identified:

C. Questionnaire for Stakeholder Group

Based on each group's position along the value chain, respective questionnaires were developed to map the current circularity practices and challenges associated with their adoption or upscaling.

D. Stakeholder Mapping at different clusters and performing studies (Physical/Virtual)

Virtual assessment

It primarily included consumers, where bulk

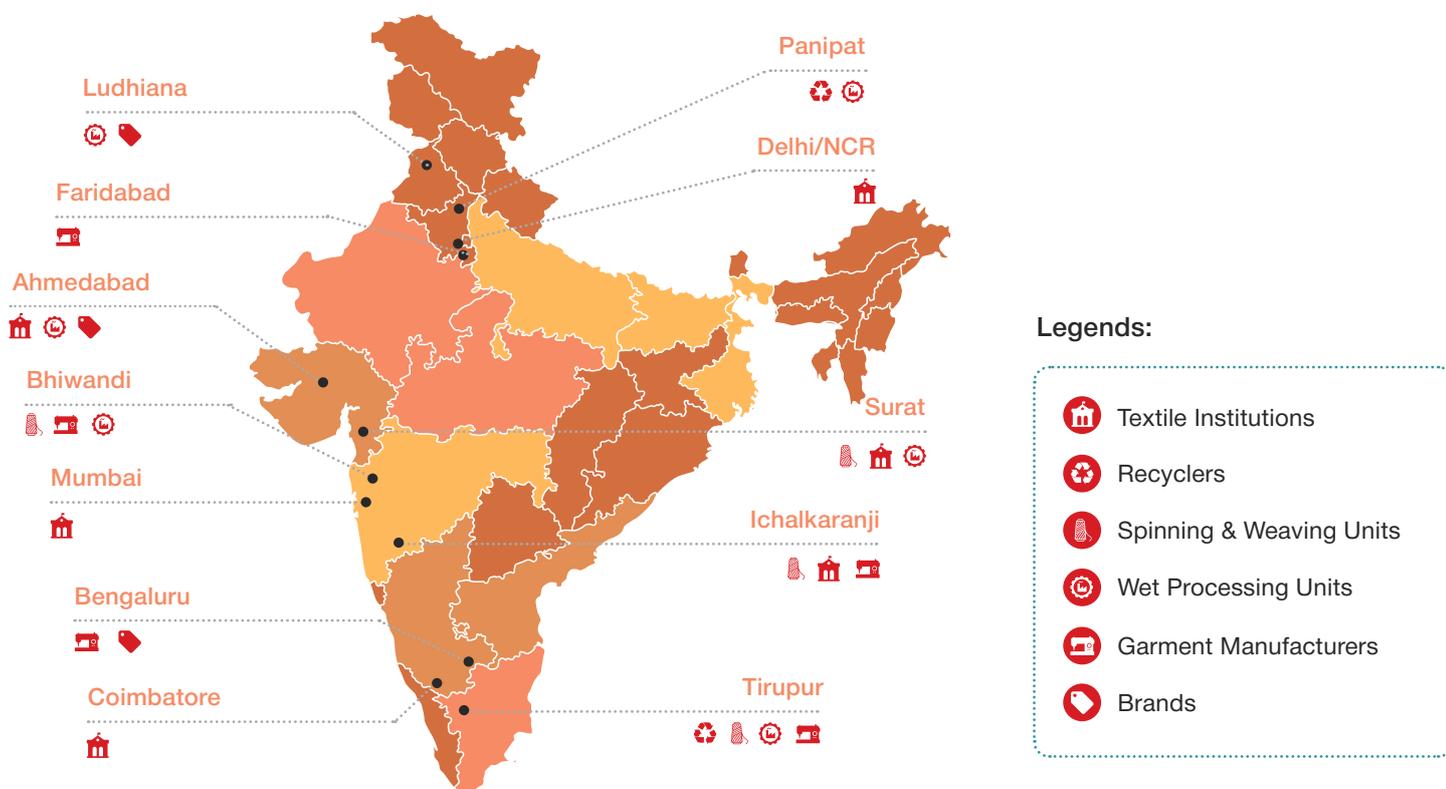
responses were required to assess the possible acceptability of circular and sustainable products. It will be the key decisive factor in the Textile & Apparel sector's approach to a circular economy.

Physical Assessment

Various stakeholder groups mentioned above have been interviewed in person, including academia, industries, recyclers, brands, waste segregator and collectors, among others. This has helped in acquiring critical and decisive information such as practices being implemented, their effectiveness, contribution to circularity, negative impacts associated, and challenges (technical/demand) in implementing or upscaling circular practices in the Textile & Apparel sector.

Specific geographical locations, predominantly known as manufacturing hubs for specific textile products, have been covered. As illustrated in Figure

Figure 6: Stakeholder Mapping



The brief of textile clusters visited by the assessment is given in Table 1

5, the assessment team visited 12 different clusters across India to meet stakeholders and identify circularity practices.

The brief of textile clusters visited by the assessment is given in Table 1

The mapping of clusters will assist in identifying local support partners to carry out subsequent project activities.

E. Data compilation and analysis

Based on the assessment, information and inputs collected have been assessed and processed to showcase the current practices on implementing circularity in the Textile & Apparel sector, associated challenges in implementation or upscaling, and potential categories for designing pilots to showcase the circular practices.

F. Identification of hotspots and potential areas for intervention

The challenges, hotspots and potential regions of circular interventions found during data analysis and based on that, possible innovations will be considered to bridge the gap through the innovation challenges, considering categories of interventions. It will further act as a guide to prepare circularity guidelines and policy papers.

G. Finalization of Baseline Assessment Report

The final Baseline Assessment Report is developed to highlight current practices on sustainability and circularity, associated gaps and challenges in implementing or upscaling circular practices, which will define potential areas for pilot intervention to promote circular practices, stakeholders associated and capacity building efforts.

Outcome of Baseline Assessment

The baseline assessment supported in identifying potential categories of interventions for implementing circularity across the value chain by overcoming barriers to Circular Economy transition. Furthermore, the study will be used as a foundation for the project's future activities, as listed below:

- Innovation Challenge – Identified circularity focus points in each stakeholder group

will be addressed through six priority action areas across the entire sector. The same will also be used to identify the criteria for innovation challenge, which aims to bring together diverse next-generation startups contributing to the circularity sector. A jury will evaluate the three most suitable circularity practicing businesses for pilot scale implementation from numerous innovators nationwide.

- Circularity Trainings & Workshops – Baseline assessment identified training needs in circularity aspects for Top Management, Middle Management, and Ground/Field workers within Textile & Apparel value chain stages.
- Creating a Circularity Textile Manifesto - A textile circularity framework with a holistic approach that considers all aspects of the product life cycle will be created from learnings of Baseline Assessment, this includes, material selection, product design, supply chain management, waste management, consumer engagement, data and metrics and stakeholder engagement.
- Policy white paper – Several circularity-enabling stakeholders, including academic institutions such as NIFT and NID, subject expert organizations such as Su.Re, CAIF and FFG, research organizations such as ATIRA and SITRA, and leading Organizations such as ABFRL, Arvind, H&M and Shahi Exports, etc. will collaborate to frame a policy white paper, which will be presented to the Ministry of Textiles, GOI. It will outline the initiatives and measures required to promote circular economy approaches in the Textile & Apparel sector.



Table 1: Textile cluster brief

Cluster	Ahmedabad	Bengaluru	Bhiwandi	Faridabad
Description / known for	Hub for wet processing industries processing cotton woven fabrics	Hub for woven garment manufacturing industries	Hub for polyester weaving and garment manufacturing industries	Hub for woven garment manufacturing industries
Location	Gujarat	Karnataka	Maharashtra	Haryana
Interaction with stakeholders in the cluster	Arvind Ltd, NID, NIFT, ATIRA, , Birla Cellulose, Welspun	ABFRL, ATDC, Arvind, Prateek Apparels, Shahi Exports, Madura Clothing, Texport, Khaloom India, H&M, Goonj, Saahas Zero Waste	Asmeeta Textile Park	Shahi Exports, Shyam Tex Exports Ltd
Key circularity /sustainability attributes of the cluster	Major industries have adopted renewable energy (solar rooftops). Industries located within city walls now have Zero liquid discharge.	Major industries have adopted renewable energy (solar rooftops).	Presence of an integrated garment textile park that brings together common environmental facilities, including waste management, proper waste water disposal	Garment export units use recycled fibre to increase the possible percentage on the client's demand. They are also working on sustainability aspects due to the increasing demand.

Table 2: Textile related Institutions

Hub	Mumbai	Delhi	Coimbatore
Description / Known for	Various textile institutions and textile ministry office	Various textile industry institutions and textile ministry	Various textile academia and industry institutions
Location	Maharashtra	Delhi	Tamil Nadu
Interaction with stakeholders in the cluster	SASMIRA, Pearl Academy, Fashion for Good, Su.Re, CMAI	Fashion for Good, ATDC, IIT Delhi,	SVP International School of Textiles & Management, South India Textile Research Association, Southern India Mills' Association



Ichalkaranji	Ludhiana	Panipat	Surat	Tirupur
Hub for cotton weaving, garment manufacturing industries and textile academic institution	Hub for woollen knitwear garment manufacturing industries	Hub for recyclers manufacturing pre-consumer and post-consumer recycled yarn	Hub for weaving and wet processing industries processing polyester woven fabrics	Hub for cotton and allied blend knitwear garment manufacturing industries
Maharashtra	Punjab	Haryana	Gujarat	Tamil Nadu
DKTE Society's Textile & Engineering Institute, Ken Enterprises,	Monte Carlo, Nahar Industrial Enterprise Ltd., Trident Fashions	Kakkar Spinning Mill, Mittal International, Raj Overseas, Jindal Cotspin Pvt Ltd	Shahlon Industries, Pratibha Group, J B Ecotex, Birla Cellulose, Birla Century, Welspun India	Exim Knits, Prachi Exports, Balu Exports, Sulochana Mills, AIC – NIFTEA
Garment manufacturers are employing homemakers residing in nearby areas. Many industries are producing recycled products.	They are using recycled fibre 100% in some low-value high demand products like ladies' leggings (hosiery), also some percentage in woollen but only for the international market, not local.	Recycling fibre and yarn from pre and post-consumer waste of pan-India and other countries.	Treated sewage water is used as a water source for the wet processing industry. Currently, there are two ZLD common effluent treatment plants.	The whole cluster is carbon positive in terms of energy generation. "Zero Liquid Discharge" garment cluster many industries practise rainwater harvesting.



Waste in Textile Value Chain

02





It is crucial first, to comprehend how the textile value chain functions as a linear economy to pivot the sector to a circular cycle. This chapter elaborates on how waste is created along the value chain.

Decoding Waste

The Textile & Apparel value chain includes all activities that provide or receive value from designing, manufacturing, distributing, retailing, and consuming a textile product (or providing the service that a textile product offers). It includes raw material extraction, supply, and activities involving the textile after its useful service life has ended. In this view, the value chain has been divided into six stages:

1. Fibre production/ Raw material Extraction
2. Yarn and Fabric production
3. Wet Processing

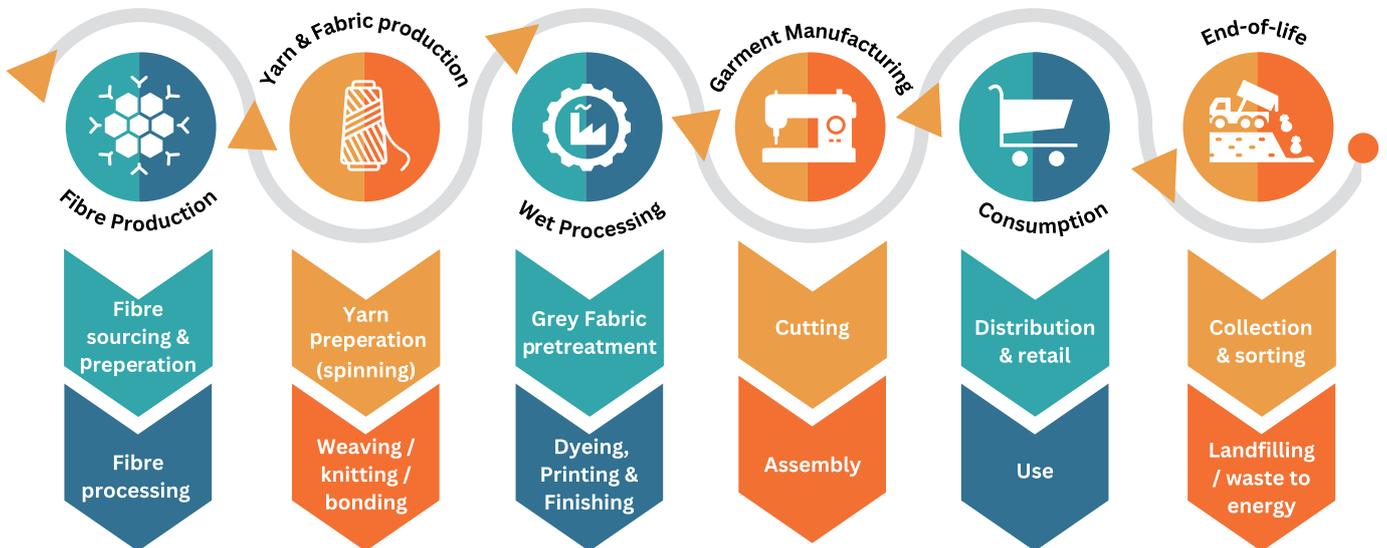
4. Garment manufacturing
5. Consumption
6. End-of-life

Producing fibre for fabric can include using and processing natural resources such as cotton, creating synthetic fibres such as polyester from crude oil, or a blend of these two.

Textile fibres can be broadly classified into two categories:

- Natural fibres
- Manufactured (man made) fibres

Figure 7: Textile Value Chain



Where are textile fibres used?

Textile fibres are used for:

1. Apparel textiles: Cotton, viscose, flax, wool, silk, polyester, polyamide, and acrylic fibres are used in making apparel.

2. Home textiles: Cotton, jute, polyester, polyamide and acrylic fibre are used in home textiles.

3. Industrial or Technical textiles: Cotton, jute, polyester, polyamide, glass, carbon, and ceramic fibre is widely used in technical or industrial textiles.



TECHNICAL TEXTILES

- **Medical and hygiene**
Bandages, plasters, orthopedic belts, etc.
- **Sports and recreation**
Tents and canopies, parachute cloth, life vests, etc.
- **Transportation**
Seats and upholstery in automotive, aviation and marine belting airbags, etc.
- **Construction**
Safety gear, ropes and cables, geotextiles, etc.
- **Agricultural**
Fishing and aquaculture nets, horticulture floriculture nets and mats etc.
- **Packaging**
Luggage, sack bags, wrapping bags, tea bags, etc.



APPAREL

- **Formal and Casual Wear**
Shirts and T-shirts, jeans, trousers, jerseys, dress and sarees, etc.
- **Uniforms**
- **Footwear**
- **Accessories**
Scarves, ties, hats, etc.
- **Sportswear**
Swimwear etc.
- **Undergarments**
Underwear, socks, hosiery, etc.



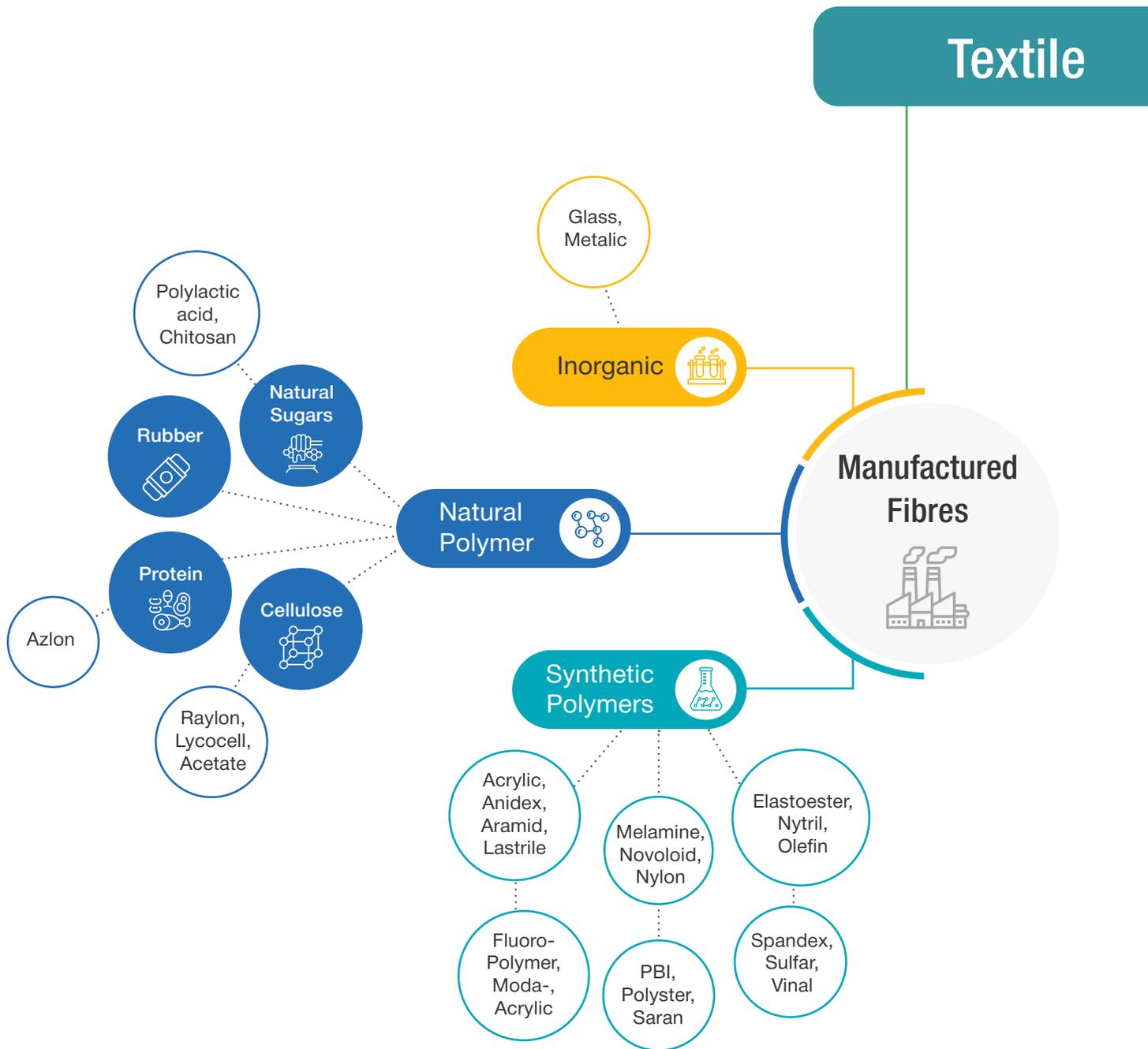
HOME TEXTILES

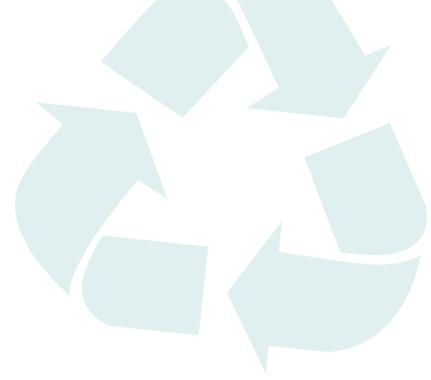
- **Kitchen**
Cleaning cloth, table cloth, tea bags, etc.
- **Bedroom**
Bed linen, blankets, rugs, carpets, curtains, mattresses, upholstery and covers, etc.
- **Bathroom**
Shower curtains, mats, towels, etc.

Adapted from: Sustainability and Circularity in the Textile Value Chain, UNEP 2020

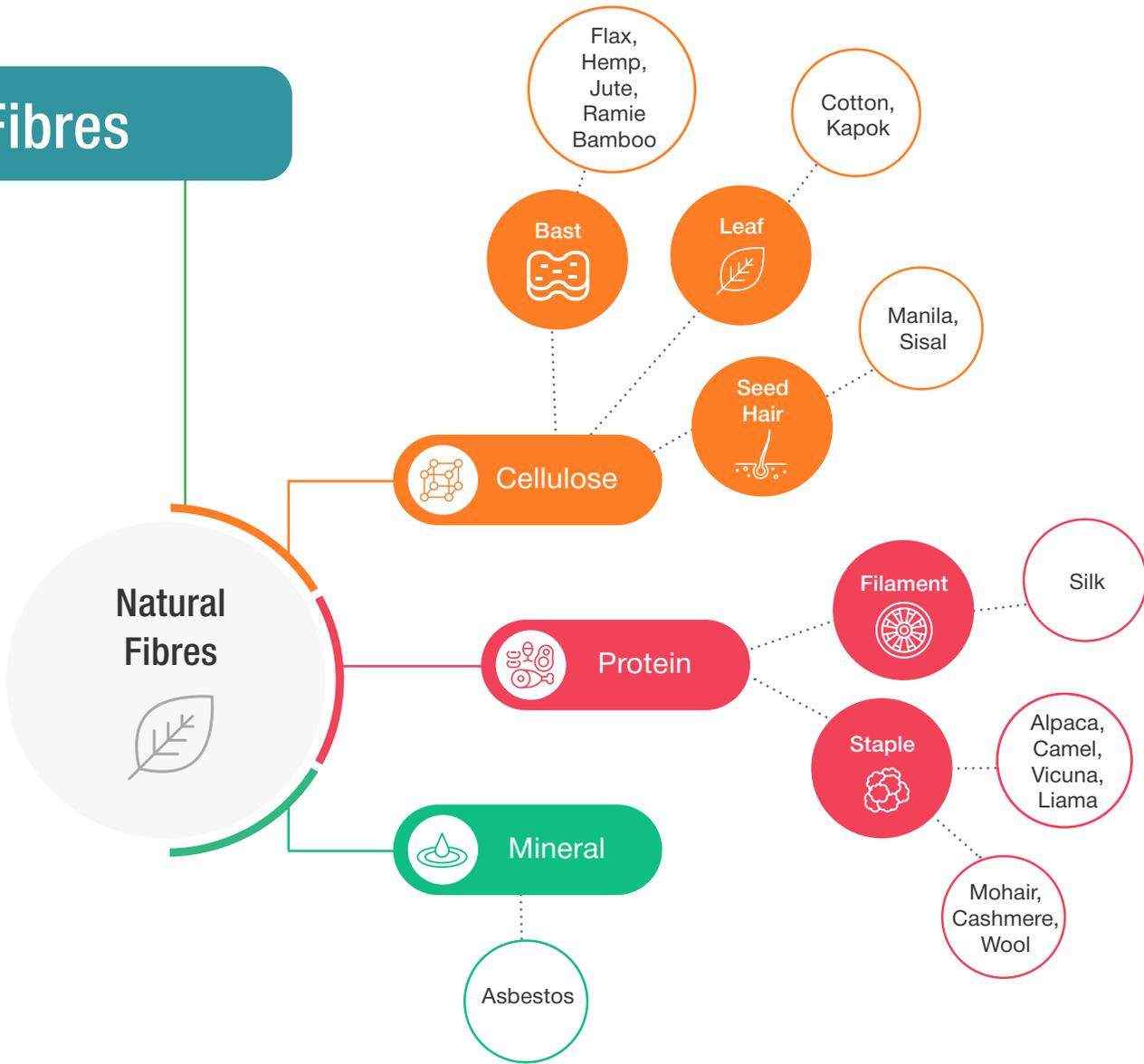


Figure 8: Classification of textile fibres





Fibres



Source: Facilitating a Circular Economy for Textiles Workshop Report, NIST

Environmental and Social impact due to textile production

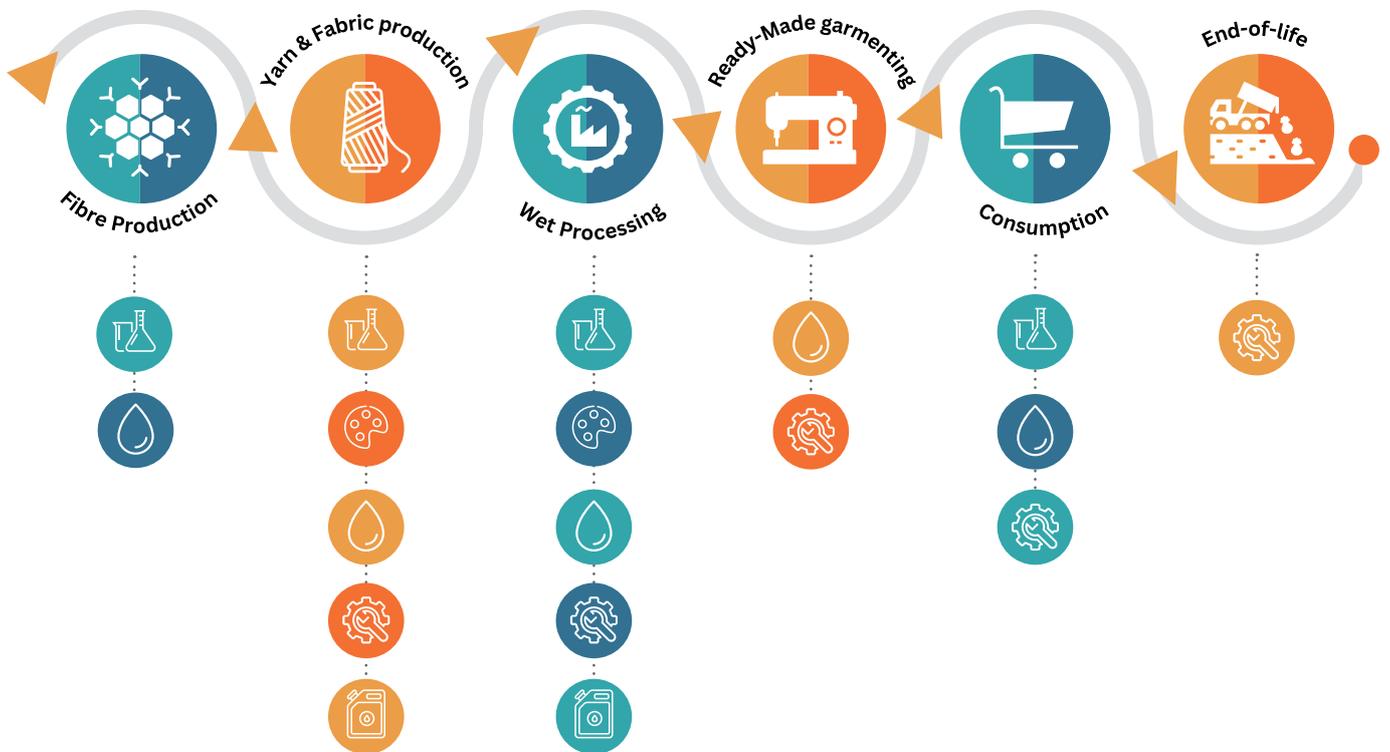
As described in the previous section, value addition occurs at each value chain level to transform fibres into garments and at each level, the raw materials listed below are consumed.

- Chemicals and Auxiliaries (lubricating agents, wetting agents, surfactants, etc.)

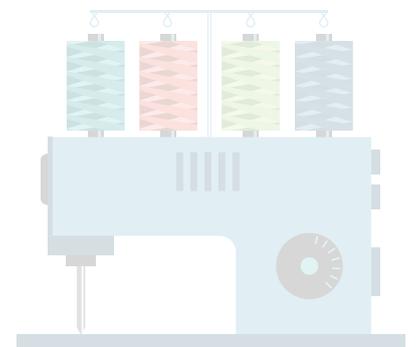
- Dyestuffs (reactive dyes, disperse dyes, pigments, etc.)
- Utilities (Electricity, Steam, thermic fluid oil, water, air, etc.)
- Fuel (Coal, Natural gas, firewood, etc.)

Significant consumption of these resources due to inefficient processes has a negative impact on the environment and the society.

Figure 9: Resource consumption across value chain



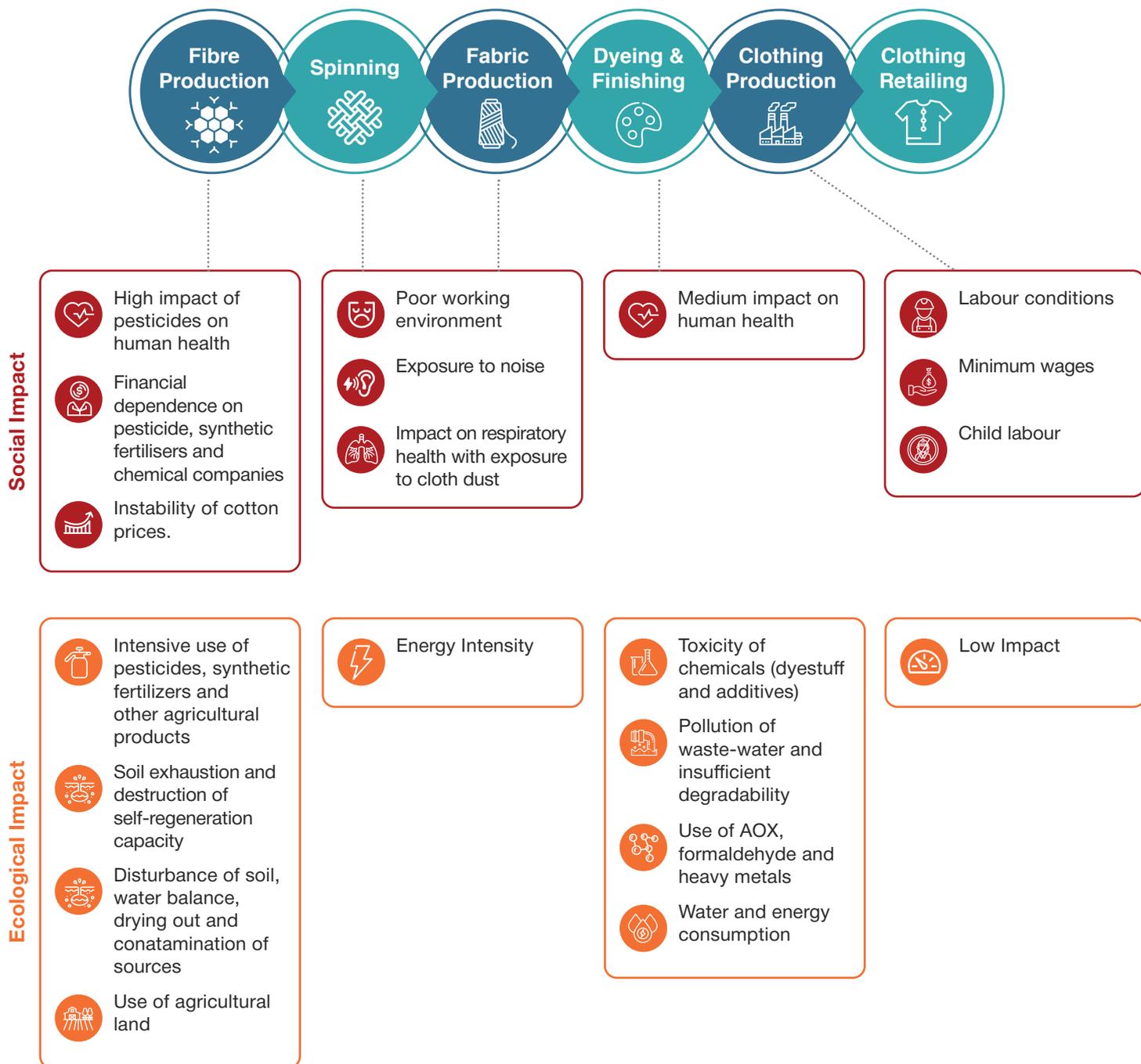
Legends:



The main environmental issues linked with the textile sector are generated by wastewater discharge into fresh water bodies. Other critical environmental problems include air pollutants, particularly

Volatile Organic Compounds (VOCs), excessive noise or odour, and workplace safety. The figure below depicts the social and environmental implications at each value chain level.

Figure 10: Environmental and social impact of textile production processes



Source: Environmental Analysis of Textile Value Chain: An Overview

An overview of the type of waste and emission generated within textile value chain is highlighted in the table below:

Table 3: Overview of Waste and emission generated across value chain

Process	Air Emission	Waste water	Solid wastes
Fibre preparation	Low	Low	Fibre waste and packaging waste
Yarn and Fabric Production			
Yarn spinning	Low	Low	Sized yarn, fibre waste, cleaning and processing waste
Slashing/sizing	VOCs	BOD & COD from size washing residues	Fibre lint, yarn waste, cleaning waste, size unused starch-based sized
Weaving	Low	Low	Yarn and fabric scraps, off-spec fabric, used oil.
Knitting	Low	Low	Yarn and fabric scraps, off-spec fabric
Tufting	Low	Low	Yarn, fabric scraps, off-spec fabric
Wet Processing			
Desizing	VOCs from glycol ethers	BOD from sizes lubricants, biocides, anti-static compounds	Fibre lint, yarn waste, cleaning and maintenance materials
Scouring	VOCs from glycol ethers and scouring solvents	Disinfectants, insecticide residues, caustic soda, detergents, oils, knitting lubricants, spin finishes, spent solvents	Low
Bleaching	VOCs	Hydrogen Peroxide, stabilizers, hypo chloride	Low; even if little, the impact could be considerable
Singeing	Small amounts of exhaust gases from the burners	Low	Low
Mercerizing	Low	Caustic soda	Low

Heat-setting	The volatilization of spin finish agents in synthetic fibre manufacture	Low	Low
Dyeing	Low	Metals, salt, surfactants, organic processing assistants, cationic materials, colour, sulfide, acidity / alkalinity, spent solvents	Low
Printing	Solvents, curing oven emissions, gases	Suspended solids, urea, solvents, colour, metals, foam	Low
Finishing	VOCs, formaldehyde vapors	Suspended solids, toxic materials, spot solvents	Fabric scraps and trimmings
Garment manufacturing			
Fabric laying & cutting	-	-	Fabric, lining and interlining scrap, packaging waste
Sewing	-	-	Yarn scrap, metal scrap, oil-soaked cloths
Garment Washing	-	Detergent in waste water, chemicals, dyes	Micro fibres
Ironing & Packaging	-	-	Carton scrap, plastic bags
Consumption			
Distribution and Retail	Vehicular emission	-	Packaging waste
Consumer use	-	Detergent in waste water	Used garments, Micro fibres
End of Life			
Collection & Sorting	-	-	Soiled clothes, small cut pieces, plastics, metals
Landfilling/ waste to energy	Carbon emission	-	Co-processing of textile waste



Textile Waste Classification

It is vital to categorize wastes produced across the chain. It is also important to determine the origin of waste to conceptualize its use and explore potential

solutions for increasing circular practices in the textile value chain.

The Baseline Assessment primarily focused on textile waste, as it represents a sizable source of solid waste and is classified as following.

Figure 11: Textile waste classification:



Pre-consumer waste is generated during manufacturing and tends to be the cleanest and easiest stream to recycle. Whereas post-consumer waste is generated after use and is the highest volume stream with blends of all fibre types and contaminants.

Pre-Consumer Waste

The waste generated during the manufacturing stages of the textile value chain can be classified into two major types:

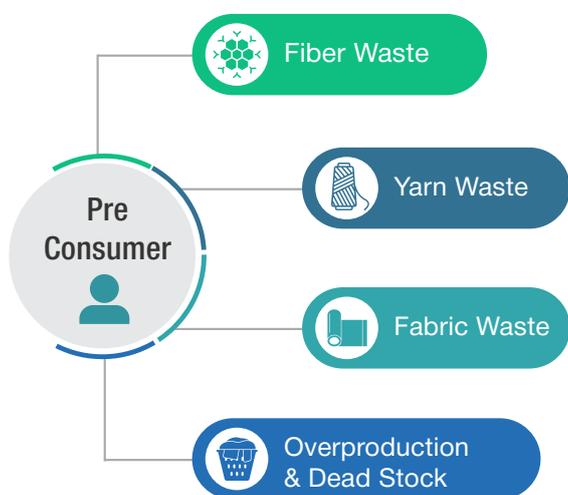
- **Soft waste** – In fibre form (From Spinning)
- **Hard waste**
 - ❖ Yarn form (From Weaving, Spinning, Yarn Dyeing)
 - ❖ Fabric form (Selvedge Cut, Chindi {From Weaving, Processing, Garmenting})

Soft waste - The waste in fibre form is called soft waste. The soft waste is generated from carding to the speed frame (Including all slivers). These soft wastes are reusable for producing low-quality yarn.

Hard waste - The waste includes yarn, selvedge, fabric, overproduction and deadstock waste, which is not reusable and is challenging to utilize based on complexity.

Overproduction and deadstock waste have high economic value and utility. It includes unsold garment

Figure 12: Pre-consumer textile waste



inventory and rejects discarded during quality checks, sampling, export surplus at the manufacturer’s end, unsold, rejected fabric rolls, or order cancellation.

Across the textile value chain, the complexity of waste increases, and the number of utilization options for the waste generated reduces.

Pre-consumer waste can also be further classified as pre- and post-dyed waste. Pre-dyed waste is usually in the initial stages of the chain and can be easily utilized compared to post-dyed waste.

Post-Consumer Waste

Textile waste is generated after the use of finished product by the end-consumer at the household or industrial level.

Figure 13: Post consumer textile waste

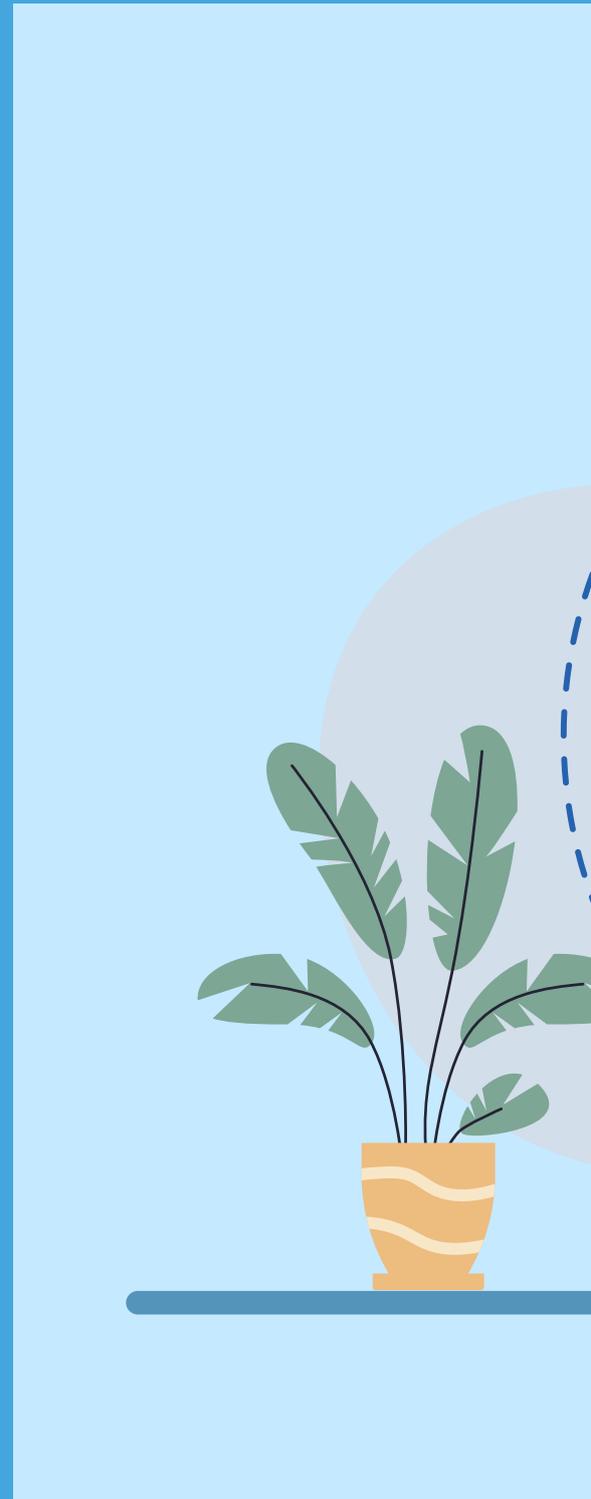


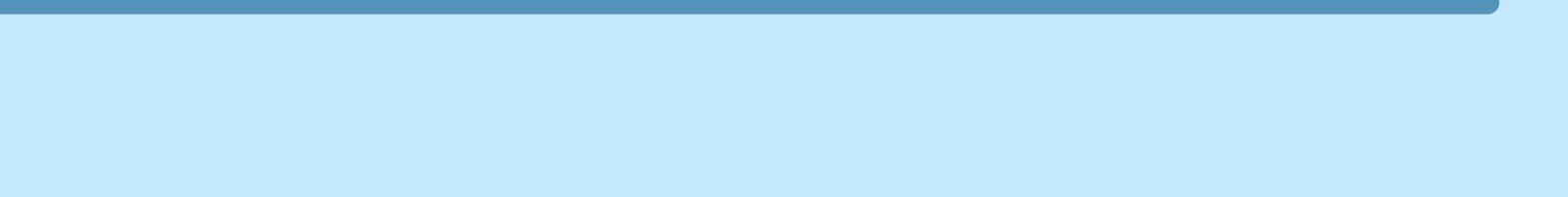
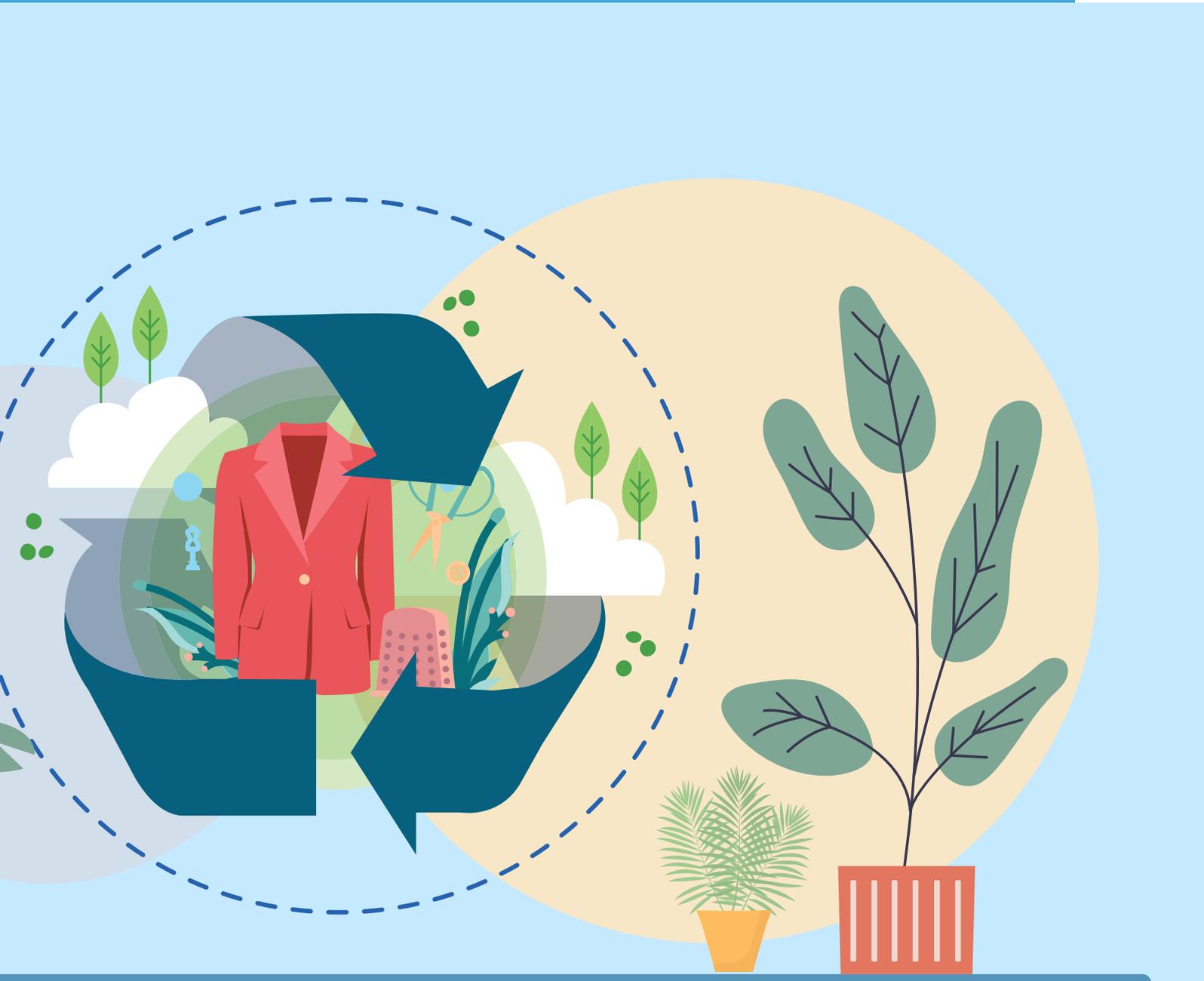
Reclaimable: Used garments and other home textiles still in good shape are donated to NGOs or collected by brands, collected through take-back programs, and circulated in the value chain.

Non-Reclaimable: Household waste includes significantly discoloured or damaged fabrics, resulting from excessive or prolonged usage of textile articles, for example commercial and industrial waste includes used PPE kits or rags for cleaning machines.

Circularity: Present Scenario

03





Textile circularity in India is still in the early stages of development. While there is a growing awareness of sustainable practices in the textile industry, there are still challenges to be addressed in order to implement circularity in the textile value chain.

The lack of infrastructure and technology are two major challenges that limit progression of circularity in the sector. In addition, the industry has limited Government support for undertaking circularity. Moreover, the consumers are also not inclined towards buying sustainable products.

Efforts are underway to address these challenges and promote textile circularity in India; companies such as Birla Cellulose, Reliance Industries, PurFI, Kishco and many others are working on textile recycling and repurposing.

Organizations such as 'Fashion for Good', 'Textile Exchange', 'Circular Apparel Innovation Factory (CAIF)', and industry partnerships such as Su.Re are promoting Aditya Birla Fashion and Retail Ltd., Arvind, Welspun, Reliance, Pratibha Syntex, Shahi Exports, etc., to set circularity goals and are collaborating with internal and external stakeholders to achieve them.

During the assessment, overall readiness of the Textile & Apparel ecosystem stakeholders was analyzed, which included both direct (involved in a specific stage of the value chain) and indirect actors, such as Government regulators, non-governmental organizations (NGOs), innovators, educational and research institutes.

Findings on the circularity practices are further segmented based on stakeholder involved and summarized as following:

Initiatives by the Academia

Research and academics play an essential role in fostering circular textile technologies, discovering new textile materials, and guiding the next generation of textile professionals. The Baseline Assessment began with academic stakeholders, as it is the starting point for the entire ecosystem.

The following is a partial and non-exhaustive list of institutions providing circularity courses that have been visited during the baseline assessment. Existing challenges faced while bringing circularity in the sector have also been documented during discussions with them.

- NIFT, in collaboration with UNEP, has introduced the **Fashion Innovation and Sustainable Design for Circularity**, a Postgraduate Diploma Program.
- NID has established the “**Innovation Center for Natural Fiber**”, focusing on capacity building in natural fibre development and utilization through design, engineering and technology innovation.
- SVPITM, Coimbatore, has conducted a “Sustainable Development in Textile Value Chain” training programme.
- IIT Delhi practices sustainability and circular practices through their incubator programme.
- Sasmira's Institute of Design and Textiles (SIDT) and The Academy for Sustainability (TAS) have launched a series of educational workforce development programs, including certificate and diploma programmes on the Fundamentals of Sustainability, Fashion Sustainability, ESG, Circularity, Sustainable Design, Corporate Social Responsibility, and Sustainability Reporting for the Fashion and Textile Industry.

Circularity focus: Circular design, innovation research, capacity building, circular business models





Figure 14: Cotton fibre fluffs from beam



Figure 15: Airjet machine



Figure 16: Powerloom machine



Figure 17: Selvage waste

Deciphering the Textile Value Chain

Spinning & Weaving

Stakeholders in the fibre and yarn production value chain contributed to mapping associated fibre and yarn waste in the pre-consumer processes. Waste is used as a raw material for various applications, with or without pre-processing, indicating the prevalence of circularity practices in the sector.

Being a product with a low profit margin, cotton fibre is often spun by large-scale units with sophisticated

systems to achieve optimum efficiency. Weaving majorly involves following characteristics of loom machinery:

- Handloom - no selvage waste is generated.
- Power loom – no selvage waste is generated.
- Rapier– selvage waste is generated on both sides of the fabric.
- Airjet – selvage waste generated on one side.
- Waterjet – due to water usage, wet selvage waste is generated.

Circularity: Present Scenario

During consultations, the following facts were evident and were recorded regarding the current state of circularity and associated challenges to further upscale:

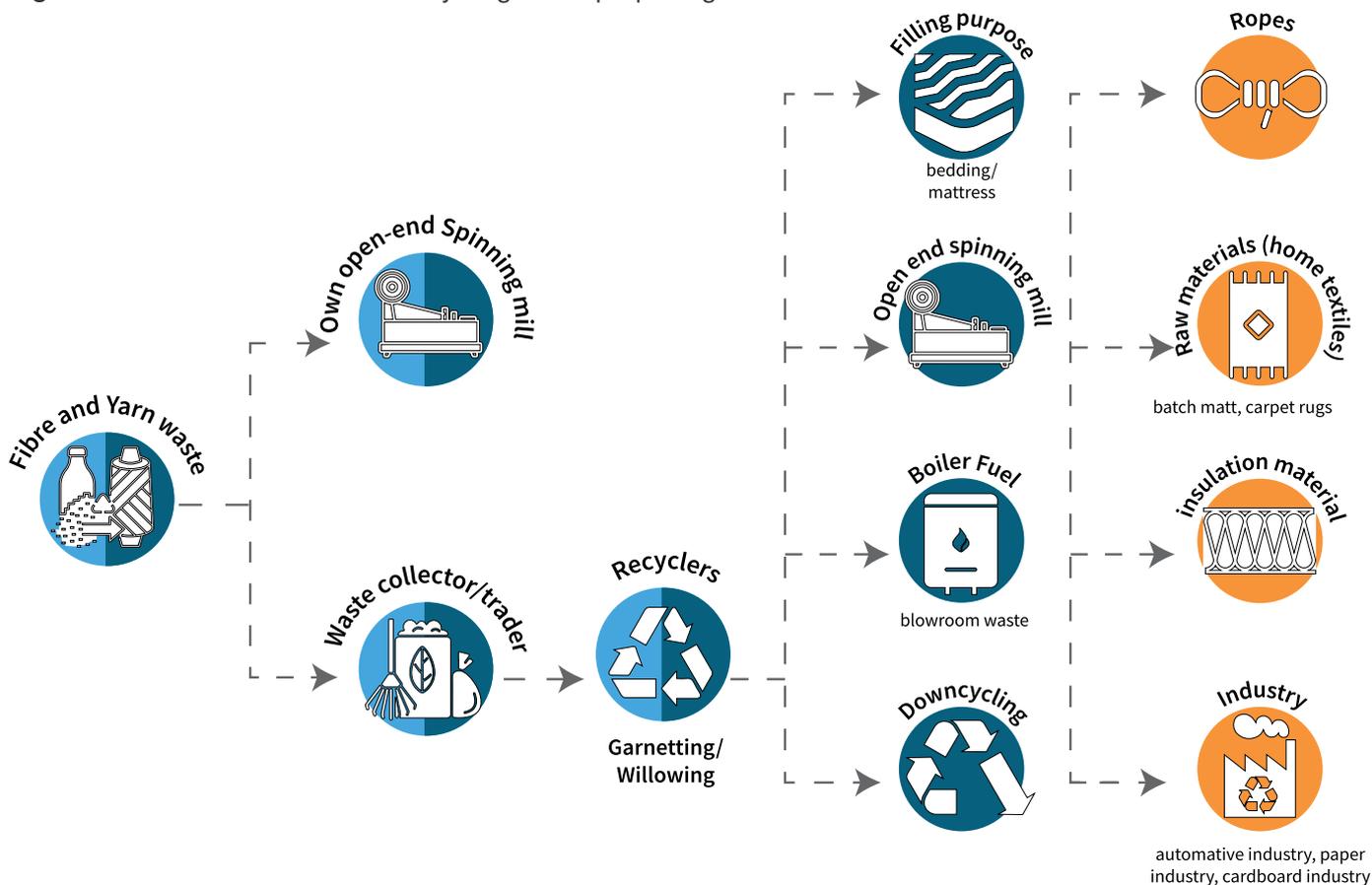
- When dyed yarns are woven, coloured selvage waste is produced, which reduces their recyclability.
- Sized fabric is sold depending on fabric weight, increasing the use of sizes, for instance, yarn of inferior quality with a higher size usage weighs the same as yarn of excellent quality with a lower size usage. It also increases the amount of water used to pre-treatment final fabrics.
- Due to Government-provided electricity subsidies, it was observed that many MSMEs in Maharashtra have continued power looms usage. Due to rising energy costs, they cannot switch to shuttle-less looms that are more efficient and produce finer counts.

Wet Processing

Wet processing is one of the most water- and energy-intensive processes after fabric production. It also contributes to high resource consumption and low process efficiencies. With a circularity perspective, wet processing units have a different set of challenges compared to other processes of the value chain, as listed below:

- Small- to large-scale textile industries in India undertake the majority of job work. The fabric is acquired from various suppliers, including major brands, small market participants, and others. The product is processed according to their specifications, without any regulations or standards, and mostly based on the product's economic value rather than its impact on the environment and society.

Figure 18: Fibre and Yarn waste recycling and repurposing



Circularity Focus areas: Energy consumption, yarn and fibre waste





- The manufactured fabrics serve both local and international markets. Multiple types of raw fibres are processed simultaneously by a wet processing unit depending on varying needs of vendors. They use various chemicals based on fabric compatibility, increasing the complexity of waste generated and its traceability to bring into the circular cycle. Few wet processing units have their own brand in the market and, thus, can optimize their manufacturing processes, reduce resource consumption of associated environmental impacts and make their products traceable.
- It further reflected that there is no national quality benchmarking system and benchmarking data for variables such as quantity and quality of chemicals and auxiliaries used, water usage per kilogram of fabric, etc. It contributes to the complex mix of materials that limit recycling and reusability.
- Coal and firewood are the primary fuel sources for steam generation, while renewable sources are not utilized commercially for thermal energy generation to reduce carbon footprint.
- Large textile clusters engaged in wet processing have common effluent treatment facilities. However, each cluster has a slightly different technique for treating wastewater. At the same time, some textile hubs have begun reusing treated wastewater for textile processing and adopting circular water usage and management practices.

Circularity Focus areas: Chemical and water usage, energy consumption, air pollution, hazardous solid waste.

Garment Manufacturing

The apparel industry is emerging as an important and is one of the primary processes with the potential for circularity practices in the value chain.

Cotton solids, natural and man-made fibre blends, and printed textiles constitute a major portion of total waste generated in the process. These units are further implementing circularity techniques, examples and the difficulties associated with scaling them up have been outlined below:

- Cutting waste is typically sold as “mixed waste” since it is not separated by content, size, or colour at the production level. If it is done, there will be better applicability to bring into recycled yarn production. However, few manufacturers separate white-cutting waste from mixed waste due to high demand for these products and can negotiate a better price.
- There is a semi-organized process for recycling of cutting waste. The cutting waste is segregated hierarchly into small, medium and large at its source.
 - ❖ Small cut waste is sorted according to colour and used to produce recycled fibres with a count up to Ne 30. Finer fibre is blended with virgin fibres to make recycled apparel, while the coarser yarn is sent as raw material for home textiles. Meanwhile, short staple fibres that cannot be made into yarns are sold to allied industries such as pulp and paper, automotive, etc.
 - ❖ Medium cut waste is sold to secondary garment manufacturers to make kidswear and other smaller size apparel.



Figure 19: Fabric Laying



Figure 20: Fabric Cutting



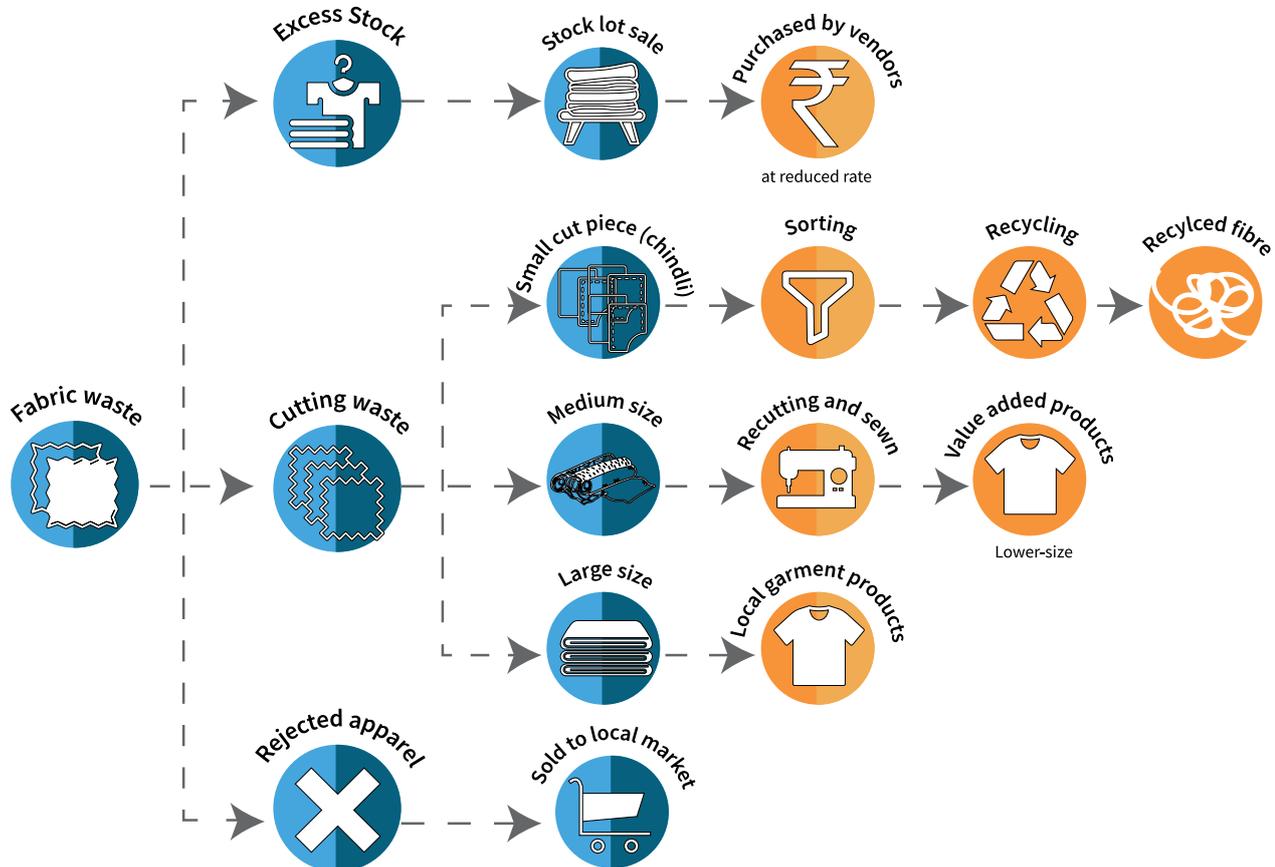
Figure 21: Garment Sewing



Figure 22: Garment Washing

- ❖ Large cut waste is sold to vendors who manufacture garments for rural areas as economical products.
- Various types of apparel waste generated during the process and current recycling and disposal mode are being mapped and presented in the figure below:
- Waste collectors collect cutting waste from production facilities and sort it colour-wise at their warehouse. It is then transported to
 - India’s major recycling and downcycling plants through middlemen/traders to produce recycled fibre. This fibre is of low quality and lower count and is limited to manufacturing knitted fabric with a certain blend with virgin material.
 - There is a need to promote automated cutting with AutoCAD rather than practicing manual cutting to increase efficiency from 80% to more than 90%.
 - The major woven and denim apparel manufacturers

Figure 23: Fabric waste recycling and repurposing



in Bengaluru and nearby areas have incorporated ZLD to recycle wastewater generated from garment washing.

- The acquisition and management of numerous certificates, such as OEKO TEX, GOTS, BSCI, SLCP, GRS, Bluesign, ZDHC, and others, promote circularity in a limited manner. At the same time, C2C certification is expensive and possesses two circularity aspects of technical and biological cycles.

Circularity focus: Sorting (segregation by colour & blend), Recycling, waste water

Weaving Circularity into Businesses

Brand's Approach

The following observations were made during interviews with people from various brand departments, including designers, product managers, and sourcing managers.

- New generations, such as Gen Z and Gen Alpha,

are interested in sustainability. They further have the purchasing ability to pay a premium price for eco-friendly clothing. However, this is not the case for people in other generations, as the general public has little understanding of sustainability. As a result, when the product is launched in the market, there will be very few buyers due to price and quality issues such as hand feel and piling of recycled fibres.

- To bring Circular Economy, brands are changing their packaging to limit their use of plastics.
- India is one of the leading brand in collaboration with integrated mill and dyestuff manufacturer developed apparel, made from natural dye stuffs, with inclination towards cradle to grave circularity concept.
- Various polyester-based sports wear are now created from PET-recovered polyester, although large-scale textile-to-textile recycling is still in developing stage.

Circularity Focus Points: Consumer awareness, circular apparel design, circular business models, traceability, ecosystem modelling for recycling

The below-mentioned chart indicates the flow of apparel in the consumer segment.

Figure 24: Post Consumer waste Usage

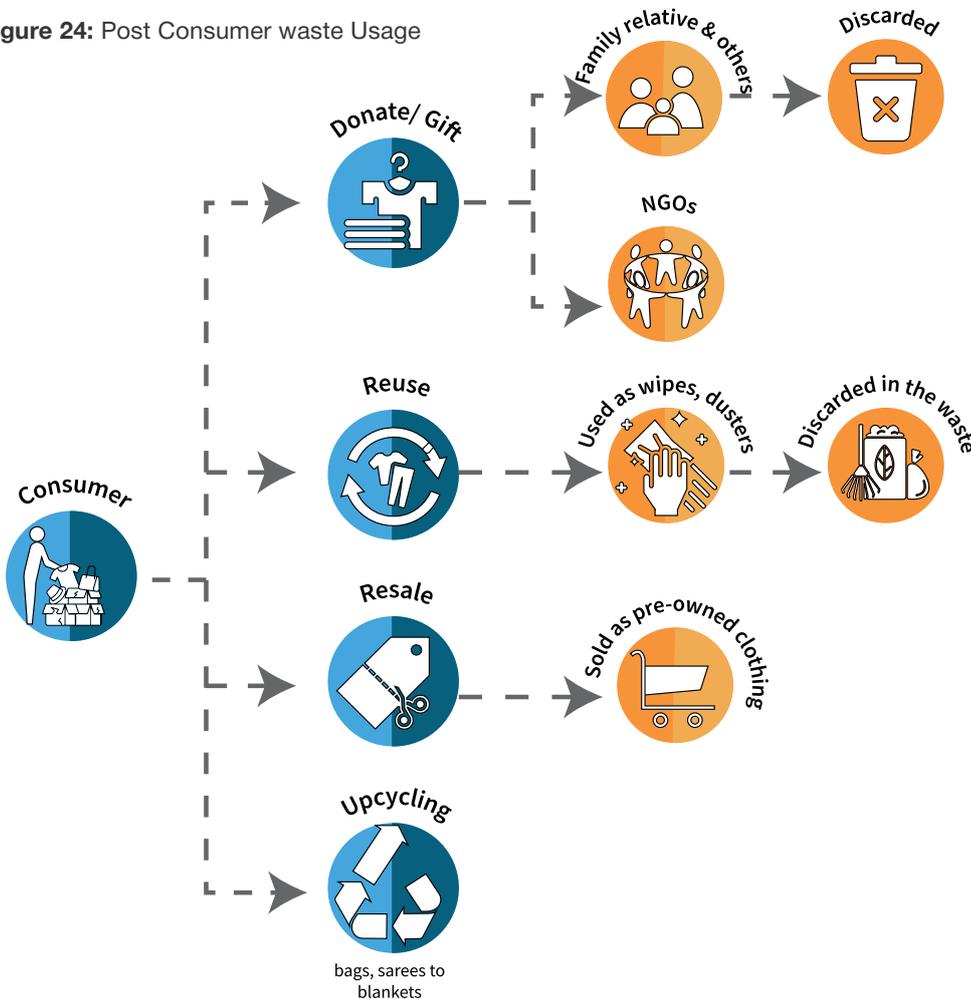
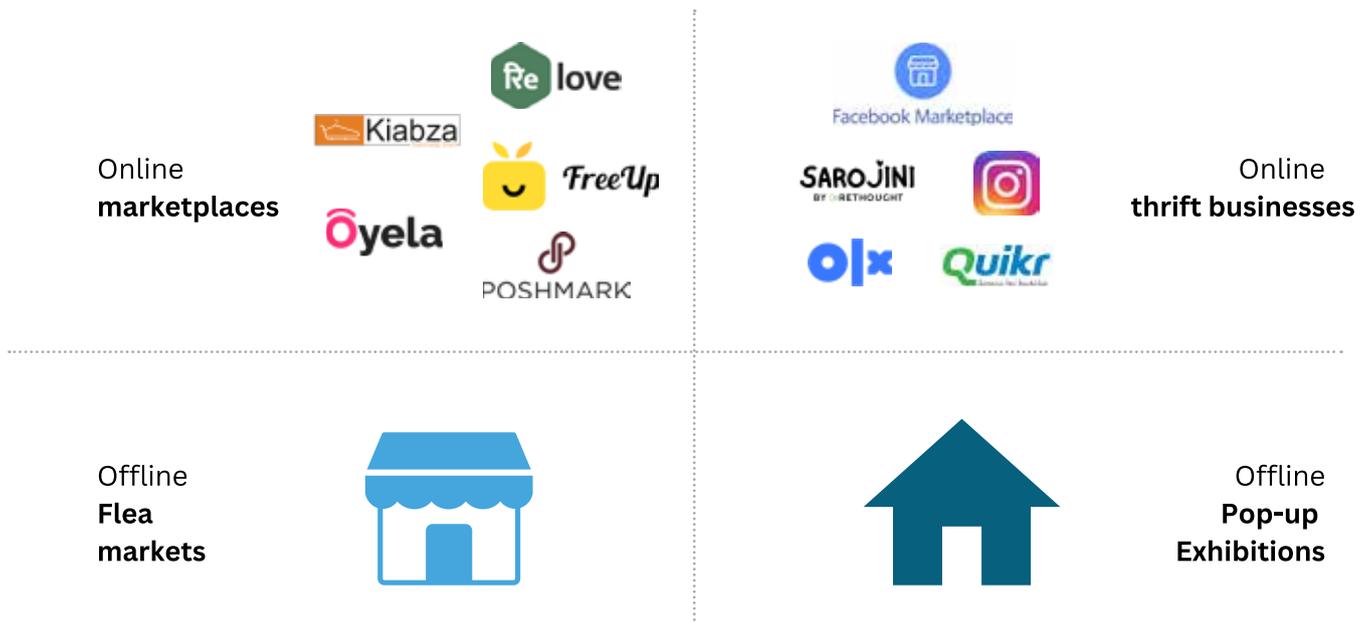


Figure 25: Second-hand apparel scenario



Connecting the dots with Consumers

In India, textile recycling is a traditional craft. An online survey found that most people in India wear their clothes until they are worn out or extend the lifecycle of the garments by either donating or gifting to others.

Still, majority of Indians discard their clothing by donating. These clothes are often passed down in the family, extended family members, helpers at home or donated to NGOs.

In case the clothing is not in good condition, it is reused for household purposes such as wipes and swabs or independent recycling.

The clothes are also repurposed to create mattresses or other textile items, such as handbags for domestic use. However, its popularity is declining and is now only found in rural areas.

The younger generation has adopted the trend of purchasing used clothing. The figure above displays the various online and offline channels used to purchase second-hand apparel (SHA). It is available

at flea markets such as Raghurib Nagar in Delhi and K.R. Market in Bengaluru. The other alternative channel developed in India is the resale of pre-owned clothing using online apps of companies and brands. Poshmark, Kiabza, Indiamart, other online marketplaces, and Instagram is a rapidly growing the business-to-consumer (B2C) platform.

Waste Management Practices

Pre-consumer waste collection

The pre-consumer waste is categorized as: pre-dyed and post-dyed waste. Collection and segregation of this waste is mainly done through traders responsible for collecting fabric waste from garmenting units. Based on the type and quality of waste, it is further categorized as follows:

Pre-dyed waste

The collected mixed waste is usually segregated at the warehouse based on its quality. The waste is sold to stakeholders, including traders in recycling hubs, regional willowers, and recyclers, depending on the highest price offered. The waste is not immediately sold. Instead, traders hold onto it until they think



Figure 26: Cotton fibre waste (Soft Waste)



Figure 27: Dyed selvage waste (Hard Waste)



Figure 28: Polyester weaving waste

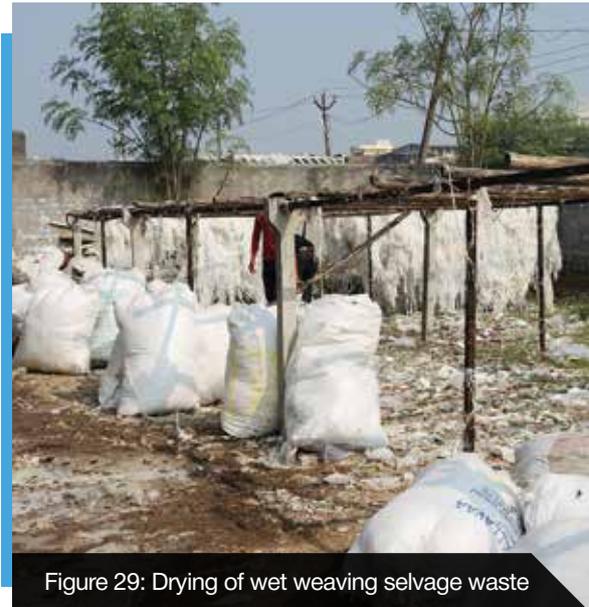


Figure 29: Drying of wet weaving selvage waste

there is a market demand for it and can get a reasonable price.

There is no sorting or pre-processing of waste at units, although the traders are doing it. For example, waterjet selvage waste is usually dried by the waste collector at the warehouse.

Post-dyed waste

Contrary to pre-dyed waste, post-dyed waste is generated more in quantity, thus posing a higher

resource requirement in segregation. Below are a few other reasons for waste generation:

- Across the value chain, there are usually two to three tiers of sorters and aggregators. The purpose of the last level aggregator is not only to sort the waste but also to hold it until there is sufficient demand.

Post-consumer waste collection

Post-consumer waste is collected through various channels, such as NGOs and charitable organizations,





Figure 30: Cutting waste segregation



Figure 31: Sorting of medium size cut waste



Figure 32: Large size cut pieces



Figure 33: Shredded cut waste transportation

the most common of which are donation drives and brand-specific take-back programmes.

Children and people needing clothing in shelter homes use the clothing donated by the NGOs, and some clothing goes for rehabilitation and relief work in regions affected by natural disasters.

The clothing's recycling potential is influenced by

its quality, degree of usage, physical condition, and inclusion of accessories such as buttons, emblems, labels, etc. Usually, most artificial recycled fibres come from sources other than clothing, such as PET bottles and pre-consumer waste.

Circularity focal points: Awareness, Advocacy, Traceability

Recycling Practices

- During the visit to Panipat, one of India's major recycling centres, it was seen that obsolete technologies are being used for recycling and re-production processes.
- Clothes are sorted by colour and material, while the fibres are shredded and ripped down via unravelling, grinding, defibration, and cutting. Since the fibres are shortened, they become weaker and damaged during the sorting process. Its functionality and quality degrade, forcing producers to add virgin and high-quality fibres.
- Open-ended recycled yarns with a Ne count of 0s-30s are prevalent in the industry, whereas only a few recyclers produce ring-spun recycled yarns.
- Currently, GRS certification offers access to the formal economy for recycled textiles. The existing technological barrier permits 30% recycled fibres to be substituted for natural fibres. Impurities in the input material further diminish the grade of recycled fibres.
- Due to mechanical recycling limitations, fiber characteristics deteriorate, however better recycling value can be perceived from knitted (100 % cotton solid colors) as compared to woven.
- The recycled yarn is down cycled based on their coarseness and used in manufacturing of products such as insulating materials, industrial cleaning

cloth, bath mats, industry wipes, or oil-absorbent mats, etc.

- Currently, recycled yarn has limited use only in knitted and denim fabric at present.
- Birla Cellulose has developed a chemical recycling process out of pre-consumer cotton waste for creating GRS certified liva reviva, a recycled viscose fibre.

Circularity focal points: Technology upgradation, traceability

Open-end Spinning

It was discovered that open-end spinning industries are located in major recycling hubs of India and source pre- and post-consumer waste through waste collectors/ middlemen spread across different clusters of India.

Natural fibres such as cotton fabrics are primarily recovered through mechanical recycling and are spun into coarser yarn using open-end spinning.

As the bales are cut open, the mutilated garments are sorted colour-wise and stripped of all accessories, such as labels, buttons, zippers, press studs, leather

Figure 34: OE spinning PFD



1. Raw Material

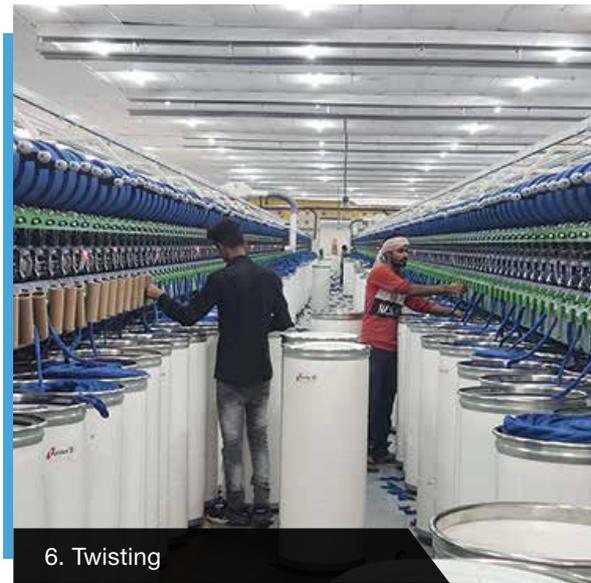


2. Disassembly



3. Sorting

Figure 24: OE spinning PFD



patches and trimmings, shoulder pads and linings, etc., mostly by women labourers.

These garments are then shredded into fibres and soaked overnight to ease their passage through the machinery and prevent the buildup of static electricity. The filaments are carded and then spun into a new yarn.

The feedstock for recyclers includes imported textile waste, brand-driven collection initiatives, and apparel acquired through donations.

Downcycling

Short-staple recycled fibres that cannot be used for manufacturing yarn are downcycled. They are used as raw materials in allied sectors such as paper and automotive.

Small-micro enterprises also directly purchase selvage and yarn waste from traders to create floor mats, ropes, and other products.





Figure 37: Handloom for weaving selvedge waste



Figure 38: Floor mat made from handloom



Figure 39: Ropes made from yarn waste

Disposal (Landfilling & Incineration)

Several sources of textile waste to landfills or incinerators have been identified during the assessment.

- Soiled waste from household and industry.
- Non-usable waste from textile traders and recyclers going to incineration.

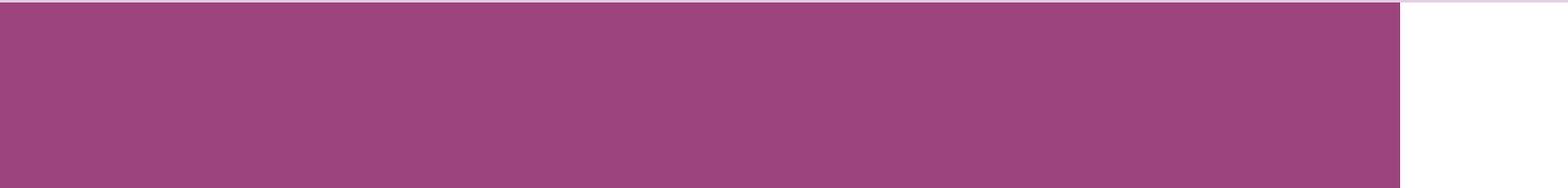


Figure 40: Textile waste disposal in Surat outskirts

Making Circularity a Reality: The Way Forward

04





Several practices in the Textile & Apparel value chain, in some way, contribute to the circular economy. However, significant challenges and gaps continue to hinder implementing, formalizing and scaling and these novel circular practices.

Scaling circularity: Understanding Challenges

The challenges identified during the assessment have been organized into six categories. These six categories are also action areas for achieving circularity in the Textile & Apparel industry.

1. Waste Management
2. Infrastructure
3. Value Chain Stakeholder Education and Awareness
4. Government Policy
5. Research and Development
6. Consumer Engagement

Waste Management

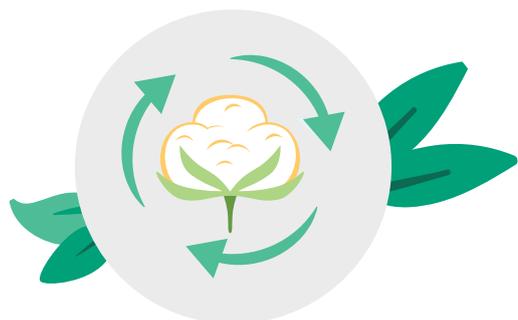
- Industries are not keen to invest in sustainable technologies.
- The use of varied techniques and technologies for producing changing and client demand complicate monitoring of production processes. It is resulting in excess raw materials usage and the generation of more waste.
- There are no unified textile waste collection guidelines or standards for pre-and post-consumer waste. For example, materials must not be soiled or contaminated to retain recyclability.
- The textile industry's complex and pan-Indian presence makes it difficult to trace the origin of materials and results in a complex and expensive

logistical system, due to absence of local recycling hubs.

- No harmonized sorting standards or criteria are available in country, leading to difficulty in establishing automated sorting technologies for used-apparel that could contribute significantly and affordably to large-scale recycling systems. However, manual sorting, which is labor-intensive and expensive, creates limitation in upscaling post-consumer waste recycling.
- It is expensive for small- and medium-sized enterprises (SMEs) to implement circular practices because they lack the capital to invest in advanced technology and processes.
- Polyester and other synthetic fibres are not biodegradable and their recycling is still in nascent stages.
- In some cases, there is no clear indication of the precise composition of the fibres on the garment's label, and in some cases, it is unavailable post usage. This restricts the traceability and recycling potential for post-consumer garments.

Building a Robust Infrastructure

- The online survey (Annexure 1) suggests that at the end-of-life phase of a product, a completely new industry is required for collection of post-consumer waste and redesigns/re-produce.
- There is a lack of adequate infrastructure to support implementation of sustainable and circular production techniques and practices.
- The use of obsolete technology, and difficulty of separating different types of fibres pose obstacles to textile recycling and reuse.
- A significant lack of waste management infrastructure for waste collection and processing systems makes it challenging for the sector to recycle and reuse materials successfully.
- There is insufficient demand from consumers for circular products. Therefore, the brand's initiatives



to promote such products is challenging. Several brands have stated that it is critical to identify easily implementable circular practices.

- Numerous trials are required at each stage of the value chain to launch a circular product effectively. The current supply chain ecosystem is unable to execute such concepts on a larger scale.
- Modern textile recycling facilities require complex technology and an enormous installation area. Hence only a few players are in operation due to the high initial investment.

Educating & Creating Awareness for Value Chain Stakeholders

- The current apparel design criteria exclude End-of-Life disposal implications and recycling during its lifecycle.
- Many MSMEs lack the technical ability and knowledge to apply circular processes properly. They may not wholly comprehend the benefits of these practices and how to use them in an efficient and cost-effective manner.
- Suppliers find it challenging in collaboration with buyers and handholding to achieve their long-term circularity goals. It is hard for them to find a balance between economic production and circular practices.

Getting support from the Government

- Existing regulations only support sustainability components to a limited degree, while circularity is not yet addressed.
- Available guidelines (if any) are not comprehensive for resource management and waste reduction.
- There is lack of incentives such as tax breaks, subsidies, or other forms of assistance linked to implementing circularity practices
- There is absence of comprehensive guidelines to assist the textile industry in reducing hazardous chemical usage.



Investing in Research and Development

- The textile industry is a traditional and conservative business, resistant to adapting to new technologies and techniques. Only a few key players invest in R&D to produce alternative sustainable materials.
- It is challenging to find circular packaging alternatives for the Textile & Apparel industry because packaging manufacturers do less research and development of such products.
- Few sustainable textile dyestuffs, chemicals, and auxiliaries are available in the market and are expensive. There is limited R&D undertaken to help boost industry acceptance of these chemicals at an affordable price.

Generating Consumer Awareness

- Consumers have limited awareness of the environmental impact of apparel production and do not consider circularity as a key factor while making a purchase.
- Not all consumers will pay premium prices for circular products and presume recycled products as inferior.
- Due to lack of ultimate disposal methods for non-usable textile articles, these end up in landfills as municipal waste rather than recycled.

Approaching Circularity on 6 Priority Action Areas

The circularity focal points were identified by observing current circularity practices across the value chain (Refer to Chapter 3).

Circularity focal points are critical areas in the value chain, where circular practices can be focused in product design, energy consumption, production

Figure 41: Stakeholders to address circularity focus points by working on action areas

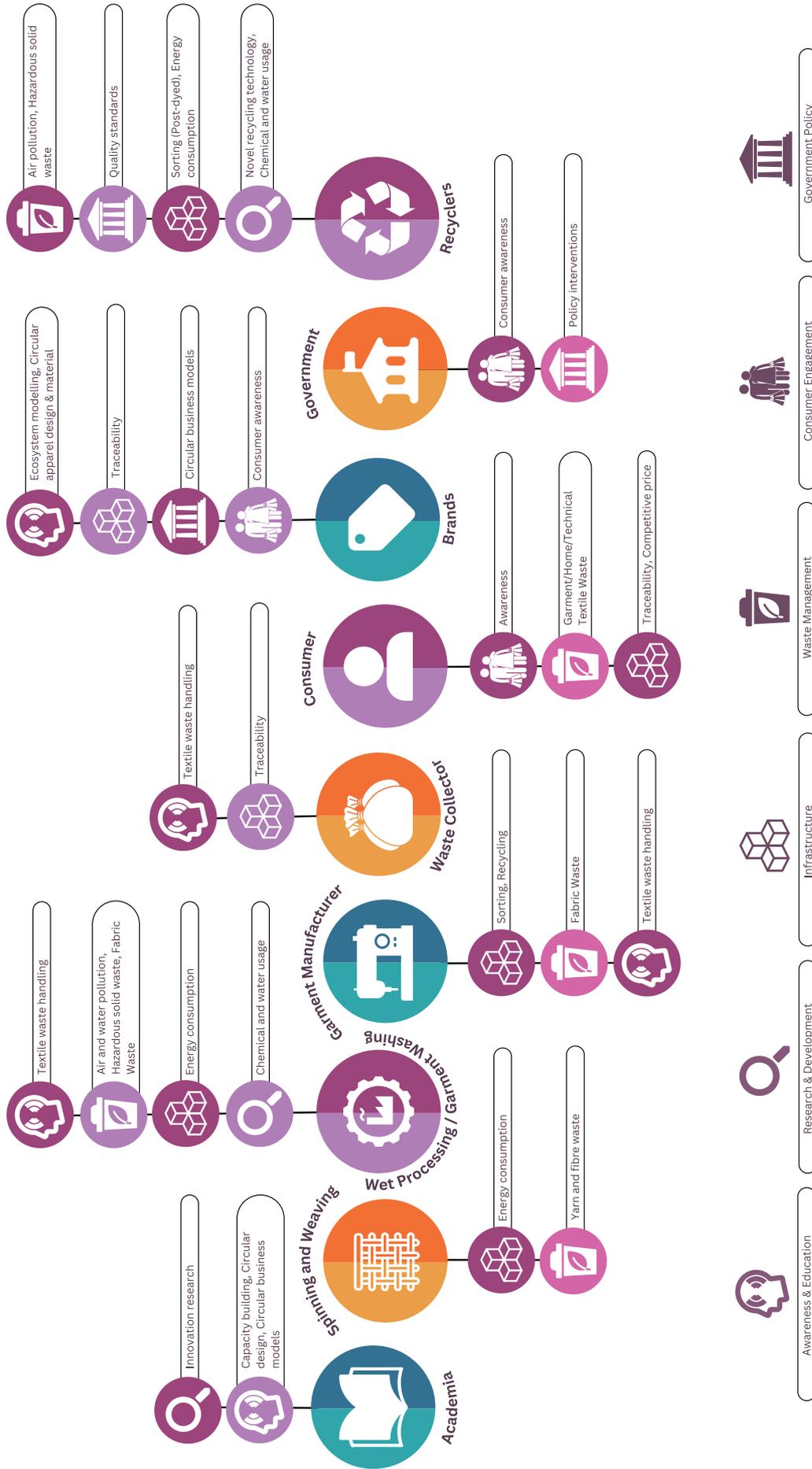


Figure 42: 6Rs strategy



processes, etc. By focusing on these areas, each stage of the value chain and the ecosystem can work towards achieving a more circular economy.

Stakeholder-specific circularity focus points identified have been linked to six priority action areas (refer previous section) for implementing circularity in the Textile & Apparel sector.

The six priority action areas have been further elaborated, with detailed tasks and measures for achieving circularity.

Action Area 1: Waste Management

A waste management strategy can help to reduce waste generation and increase recycling efforts. The figure above depicts the 6Rs strategy for textile waste management: Refuse, Reduce, Reuse, Remanufacture, Recycle, and Regenerate (decompose).

This is a comprehensive waste management strategy to achieve circularity and sustainability in the Textile sector. By decreasing waste and pollution, saving

resources, and promoting economic viability, the 6Rs methodology can lead the Indian textile sector towards a sustainable and circular future.

1. Redesign

The shift to a circular textile sector requires fundamental reformations across the entire lifecycle of textile apparel products, including the upstream design modifications to ensure that clothing can be properly recycled and mended. It may necessitate a shift away from mixed fibres (such as poly-cotton) and toward the prevalence of clothes made from mono-fibres (e.g., pure cotton, hemp, bamboo etc.). For a product to be completely biodegradable within biological cycles, it must be designed in line with circular economy principles. Hazardous chemicals, among others, must be avoided, wherever feasible.

2. Reduce

Reduce entails decreasing resource use and waste generation in textile production, usage, and disposal. It can be accomplished by minimizing the quantity of water, energy, and chemicals used in manufacturing clothes and the amount of waste produced by

industrial operations. It can be achieved by using efficient processes, advanced technologies and better operating practices.

3. Reuse

This involves reusing textiles rather than discarding them. It can be achieved by repairing, refurbishing, or reusing textiles and utilizing durable materials. It involves the concept of “Resale,” in which individuals who are discarding their clothing sell it to marketplaces, where it is resold as pre-owned clothing or second-hand clothing (SHA).

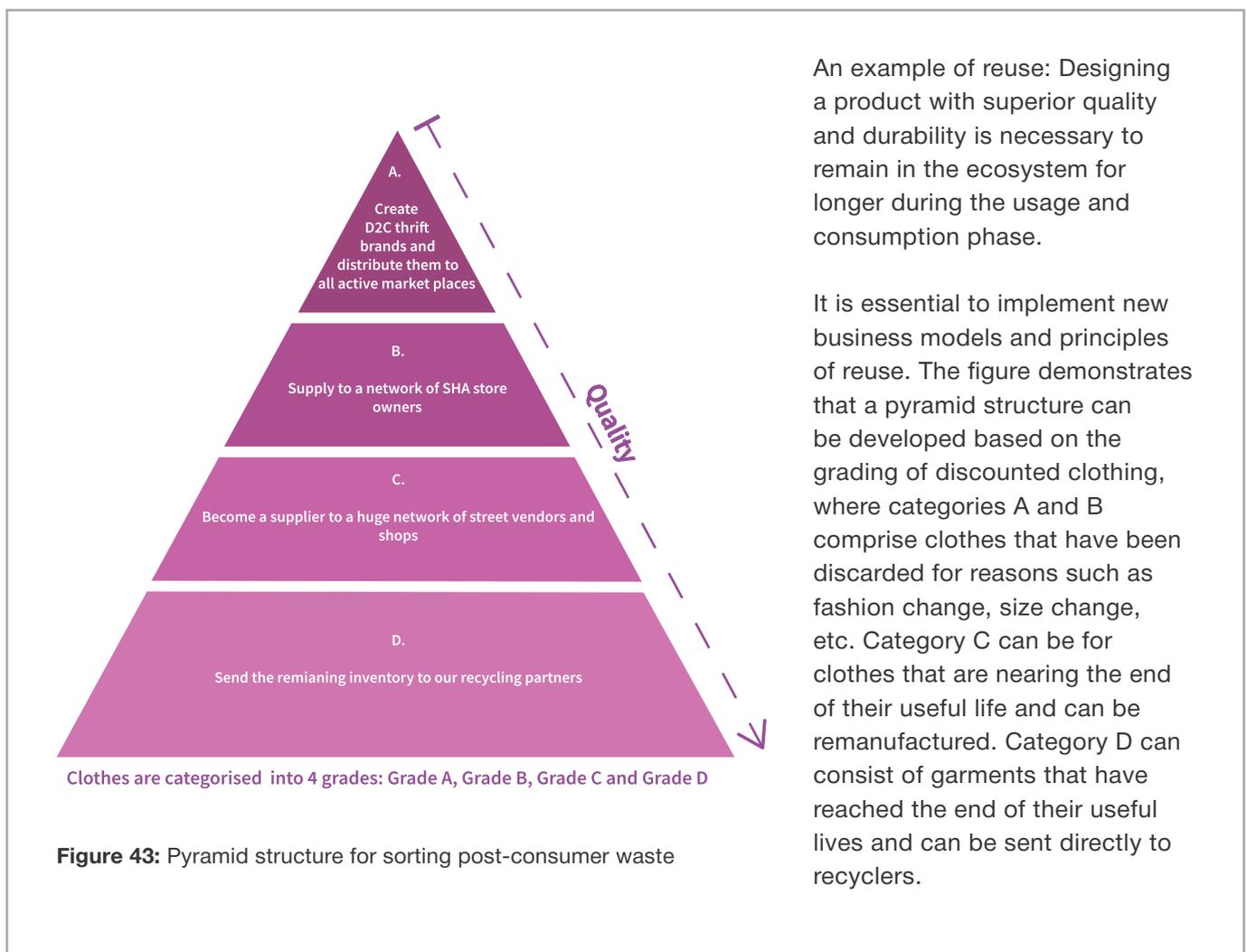
4. Remanufacture

Remanufacturing is an efficient method for extending the life of clothing. This process involves disassembling worn clothing, recovering valuable components from it, and then redesigning and

reassembling parts to create a new clothing or accessory of equivalent or greater quality. During the process, remanufactured merchandise may lose its original identity or functionality. For instance, a pair of pants may be remanufactured into a coat or a skirt.

Remanufacturing is more cost-effective and resource-efficient than recycling, since it avoids energy and chemical-intensive and polluting treatment processes. An Important aspect during the remanufacturing process is the ability to disassemble a garment quickly. The design approach can facilitate easy disassembly by adding innovative stitch types or bonding technology. Fabrics must be durable and of acceptable quality to utilize in remanufacturing.

Case Study



An example of reuse: Designing a product with superior quality and durability is necessary to remain in the ecosystem for longer during the usage and consumption phase.

It is essential to implement new business models and principles of reuse. The figure demonstrates that a pyramid structure can be developed based on the grading of discounted clothing, where categories A and B comprise clothes that have been discarded for reasons such as fashion change, size change, etc. Category C can be for clothes that are nearing the end of their useful life and can be remanufactured. Category D can consist of garments that have reached the end of their useful lives and can be sent directly to recyclers.

Some process-level barriers impede the growth of the remanufacturing company, such as sourcing sufficient raw material, high process throughput time, and skill requirements for disassembly and redesigning. However, these obstacles can be overcome at designing its disassembly and remanufacturing process.

5. Recycle

This includes recycling old textiles to create new fibres. It is performed by mechanical or chemical recycling processes that convert used textiles into useful new fibres.

The current recycling sector mostly engages in downcycling, which remakes products of lower value from the original fabric. Downcycling inhibits a circular approach and only postpones product disposal in landfills.

One of the most important approaches to developing a circular fashion system is textile-to-textile recycling in the Textile & Apparel sector. This includes the development and widespread acceptance of novel

sorting and recycling technologies that separates fibres without damaging the underlying material’s quality. In this context, many innovations are in pilot stage and are striving to enter the mainstream market to expand commercially.

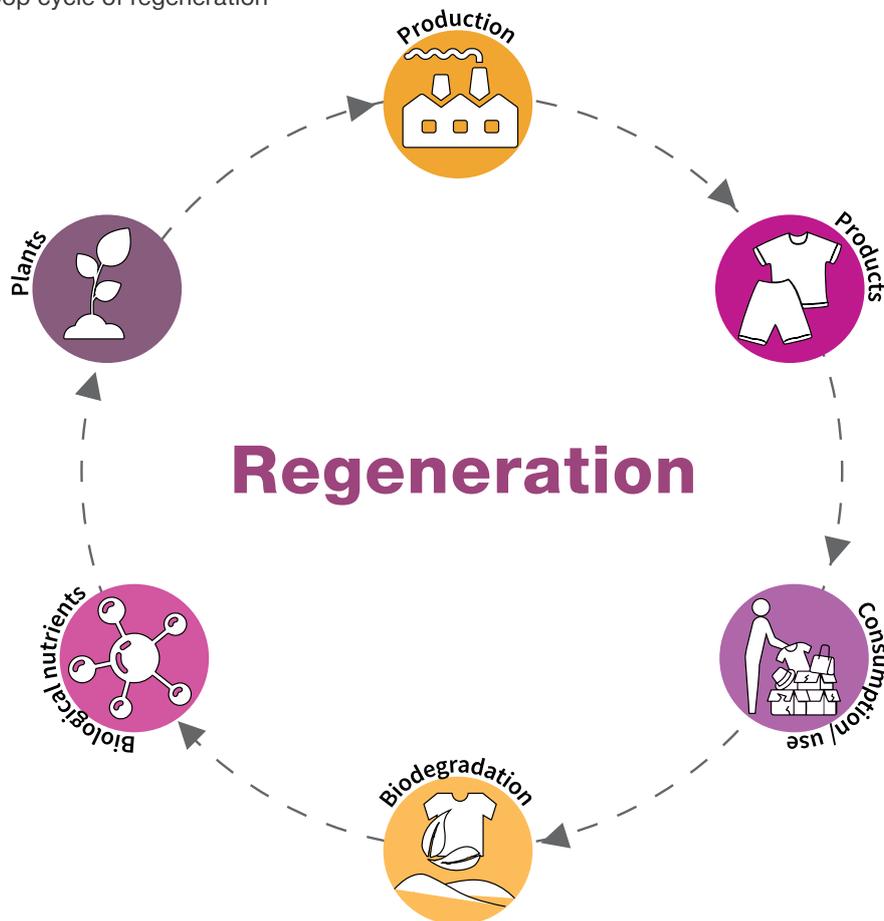
A product design that allows easy recycling back into clothing is a must to improve clothes-to-clothing recycling. Traceability throughout the product life cycle on information of fibre composition is essential to promote recyclability.

6. Regenerate

All post-use fabrics can enter the recycling value chain. This fabric should be returned to nature after decomposing.

As shown in the diagram, a greater emphasis must be placed on ensuring that the apparel is made biodegradable by regenerative techniques. Wherever no viable alternatives exist, textile waste must be disposed off scientifically and care must be taken to minimize emissions and air pollution during the process.

Figure 44: Closed loop cycle of regeneration



Action Area 2: Infrastructure

Textile recycling is essential for a circular economy, because it facilitates materials reuse, waste reduction, and resource conservation. Developing a robust textile recycling ecosystem in India, which substantially contributes to the economy and employs many people, can provide considerable advantages to the sector, environment, and society.

A number of organizations collect used clothes, including nonprofits, commercial waste collectors, social entrepreneurs, and municipalities. Entities with divergent interests run most reuse and recycling businesses and are not involved in the forward supply chain stakeholder networks.

Industry must enhance and accelerate reverse logistics and supply chain capabilities by integrating digital technology in resource tracking and tracing. Shortening and simplifying the reverse cycle is essential to save money and time. Incentives in cash or discounts on future purchases can be implemented to encourage individuals and boost the collection rate of old apparel.

Action Area 3: Value Chain Stakeholder Awareness and Education

Raising awareness and educating stakeholders, including government officials, industry, consumers, brands and suppliers, on the benefits of textile circularity and how it can be implemented is a critical first step.

Traditional Indian textile education must be reformed to embrace core components of circular economy. A strong sustainability focus in the design, technology

and chemistry curriculum can be a powerful tool for making a significant impact. Furthermore, because eco-design entails meaningful engagement between designers, manufacturers, and research institutions, knowledge and understanding about sustainability among them is crucial while building a circular product.

It is critical to delegate awareness, knowledge, tools, and training to all supply chain stakeholders to ensure long-term success in the circular economy implementation and stimulate innovation.

Action Area 4: Government Policy

The Indian Government may significantly encourage textile circularity by establishing guidelines to promote sustainable practices, such as extended producer responsibility (EPR) and product take-back programmes.

Implementation of amended or newer policies can foster circular business models. There is a need of policy instruments that address material use, product design, production, distribution, consumption, and waste management to achieve circularity. The Government has been identified as a key stakeholder capable of accelerating the transition towards a circular economy through effective policy implementation. The Government can promote programmes by supporting green manufacturing techniques and motivate companies to select suppliers based on their sustainability performance. The textile labelling program, such as the Eco mark, a Bureau of Indian Standards accreditation mark for eco-friendly product can set stringent standards for environmentally friendly textile products and acts as a guide for purchasing.

Currently, customers are not encouraged to send unwanted clothing for reuse or recycling, and government initiatives in this area are limited. Extended Producer Responsibility principles, which hold organizations liable for post-consumer waste, can be implemented with the assistance of policy initiatives.

The provision of startup capital grants for circular business models working in the fields of collection, repair, and recycling, and the reduction of taxes on specific recycled items, are two additional methods





for fostering the development of new circular business models.

Action Area 5: Research and Development

Investing in new technologies and processes supporting textile circularity, such as mechanical and chemical recycling, can reduce waste and promote sustainable production practices.

Material and technology innovations are crucial for transition from a linear to a circular economy. Creating a new sustainable material that might reduce the use of cotton and polyester fibres is essential. There are already attempts to generate cellulose-based fibres from agricultural waste, such as banana, pineapple, and orange fibres. Recycled fibres may offer a low-impact alternative to virgin fibres, but cost-effective technology for recycling various fibre types and composite products has not yet been developed commercially.

Technical innovation is vital to limit the negative effects of the production process and reduce resource usage, this may include waterless dye processes, digital printing technologies, zero-liquid discharge etc. For recycling, there is also a requirement for modern equipment that can assess the material composition and facilitate large-scale sorting.

Action Area 6: Consumer Engagement

Consumer behavior plays vital role in usage of circular products. There must be significant effort to alter consumption patterns toward sharing, extended usage, and reusing. New ideas, such as sharing platforms, may require significant marketing, public awareness campaigns, and retailer dedication to attract customers.

Engaging and educating customers on the significance of textile circularity and how they can contribute, like purchasing products made of recycled fibres or repairing and reusing textiles, can help create a demand for more sustainable products. Providing buyers with a cost-saving benefit is one way of boosting consumer engagement in the circular economy. While shopping, consumers can be notified about convenient ways of extending product life, such as repair and exchange.

For example, few brands offer repair and recycling services and give discounts on a new pair of clothes when the used pair is returned. The old cloth is washed, repaired, and resold as a second-hand apparel, encouraging consumers to extend a product's life.

Circular fashion is often challenging to explain to consumers because its meaning is more complex than recycling etc.



Making Textile Circularity a Way of Life

The Baseline Assessment suggested that there is significant lack of awareness and knowledge in the circularity domain. Although, many industries have been already practicing certain parts of circular practices, at times without even being aware of it. For example, recycling of textile waste to produce fibre, upcycling and repurposing are some of the practices being followed.

However, the industry does not relate it to circularity and thereby, leaves gaps in implementing circularity within the value chain.

Thus, it is imperative that the industries are made aware of sequential steps within the circular textile value chain, so that the industry can identify and address the gaps to complete the circular cycle. The findings of the present assessment helped in revealing the gaps associated in implementation of the circularity approaches in the sector.

It is therefore, highly desirable that, to demonstrate the intended circular economy approach in India's Textile & Apparel sector, training and capacity building of the stakeholders within entire value chain is carried out. At the same time, it is also required for the management to know and accept the benefits of circularity both ecological and economical.

It is also observed that many a circularity practices may not be cost effective especially for textile MSME segment, while schemes for financial support and incentives are expected, It is also necessary to bring out novel and innovative solutions for adopting circularity. In this context an innovation challenge has been conceptualized wherein, innovators and startups are invited to

share their innovations and newer approaches that can support industries in undertaking the circularity approaches.

A few select innovations will be tried and implemented within ABFRL value chain and case study from successful outcomes will be disseminated across the industries in India.

In parallel, to increase the awareness and acceptability of circular approaches nationwide, training and capacity development campaign will be carried out. This would target the top and middle management as well as supply chain vendors. In order to continue dissemination of knowledge within the industry clusters, it is also decided to develop a pool of trainers. This activity under the aegis of the project will continue to render knowledge for times to come.

Eventually, the experience and learnings of the project will be transformed into a circularity manifesto, which will serve as a guide for implementing and scaling up circular economy approaches in the Textile & Apparel value chain in India.



Annexures

Annexure 1 – Social Media Poll Results

An online poll was conducted where about 1500 people were reached and 80 responses were received to assess customer interest and perception in circularity.

The poll was conducted on social digital media viz. Facebook and Instagram and the polls results are shown below.

Figure 32 and Figure 33 shows that majority participants in the poll were between the ages of 18 and 50 years old.

Figure 32: Gender Ratio of participants

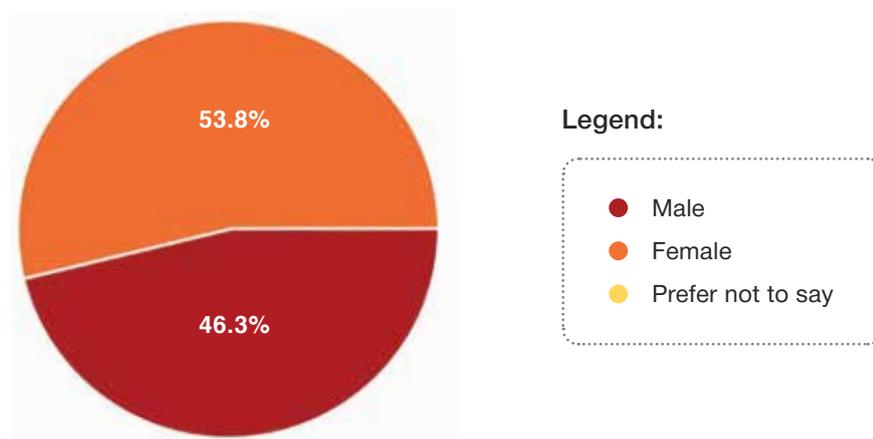
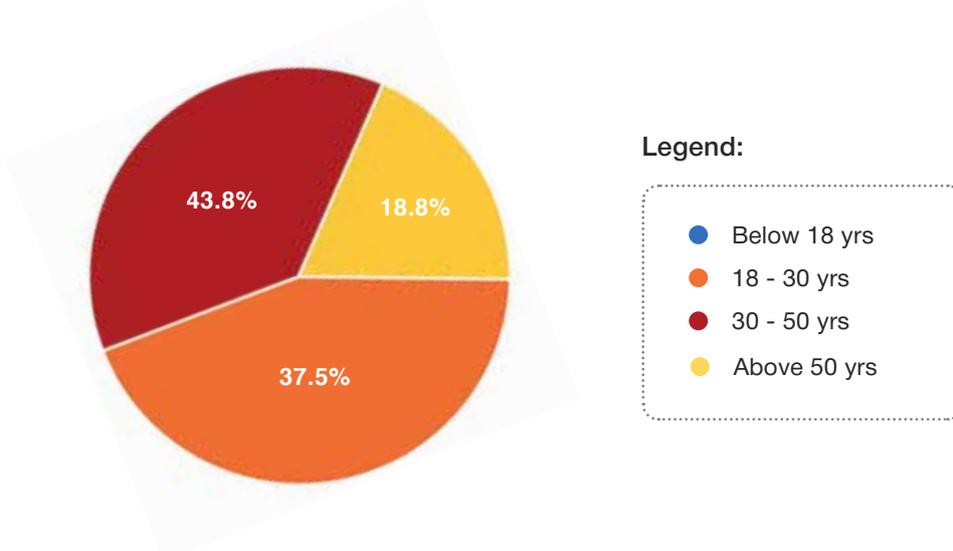


Figure 33: Age group of the participants



Shopping Characteristics

Figure 34 and Figure 35 illustrates customer purchase behaviour, which includes desired fabric and wear type.

Cotton is the most favoured fabric among consumers who mostly purchase casual wear, according to the poll. It indicates that consumers may not be aware that cotton is one of the most water-intensive crops with enormous environmental implications. Moreover, it also shows that they are unaware of other sustainable substitute fibres for cotton such as bamboo, hemp, etc.

Figure 34: Fabric preferred

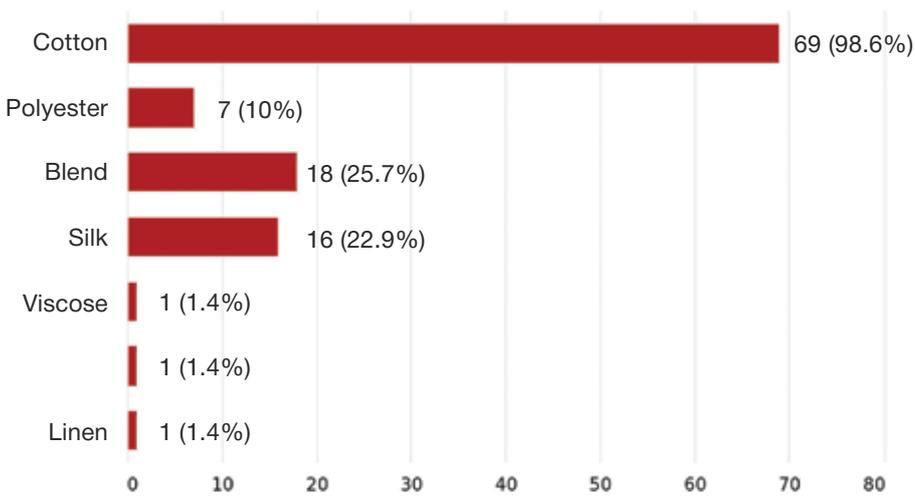
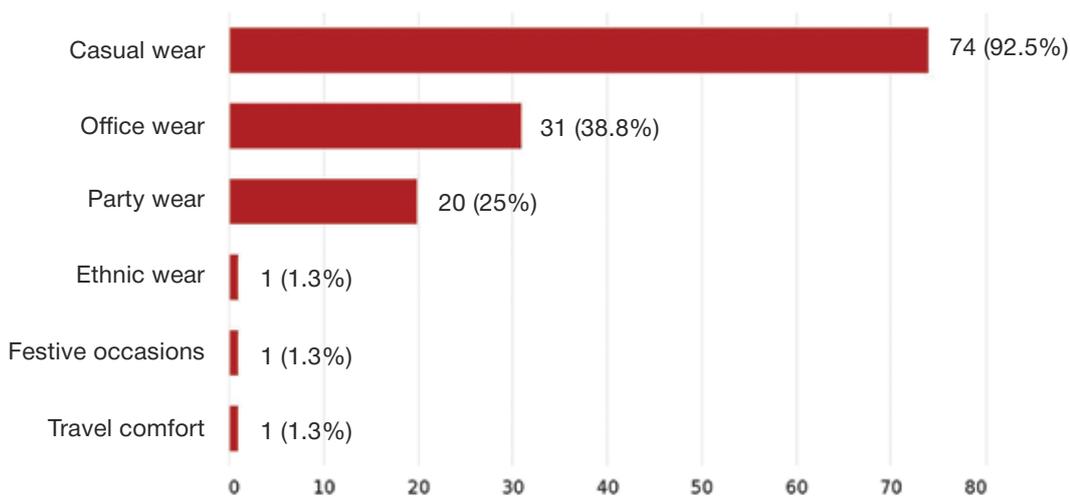


Figure 35: Cloth category preferred for purchase



Textile Circularity

Figures 36 and 37 illustrate customer readiness for circular fashion, wherein a poll asked whether consumers are eager to wear clothes made from recycled fibres and are willing to pay a premium for them.

The poll reveals that the majority of consumers are keen to purchase clothing made from recycled materials, but nearly half of those surveyed are hesitant to pay a premium price for them. It indicates that for the circular apparel concept to reach a large audience, it must be made affordable.

Figure 36: Willingness to wear recycled fibre clothes

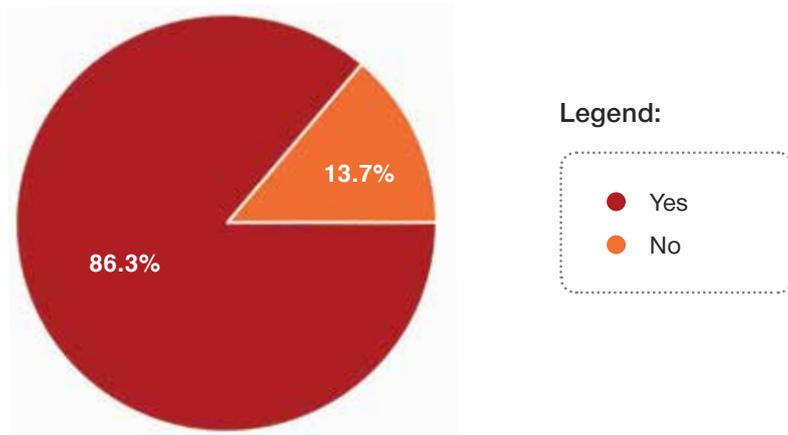
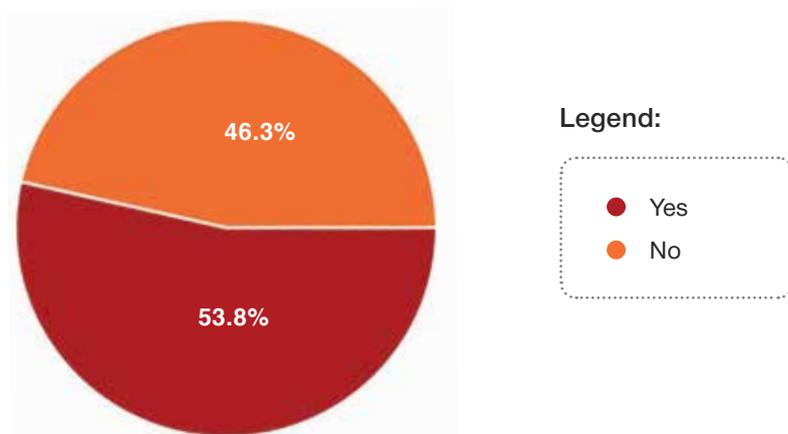


Figure 37: Willingness to pay premium price for circular clothes



Consumer Usage pattern

Figure 38 and Figure 39 reveals how long consumers have kept their apparel and how and why they discard it.

According to the aforementioned figures, the majority of people in India wear their clothes till they are worn out. It can be determined that worn-out clothing is reused for multiple reasons, whereas clothing discarded due to a change in size is donated.

Figure 38: Apparel Usage pattern

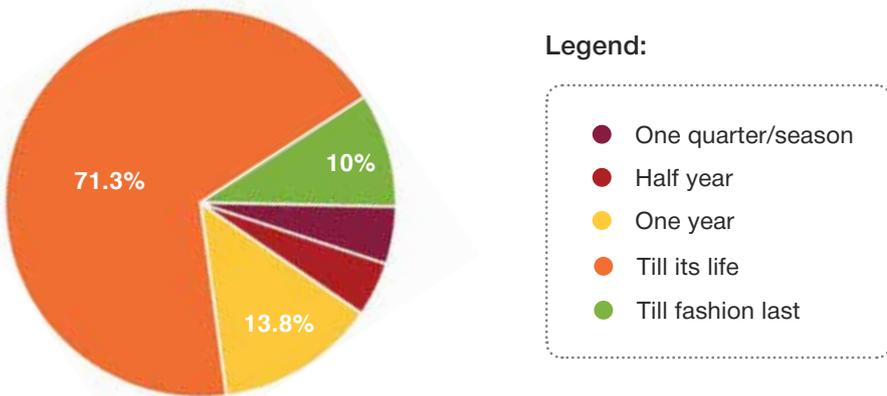


Figure 39: Reason for discarding clothes

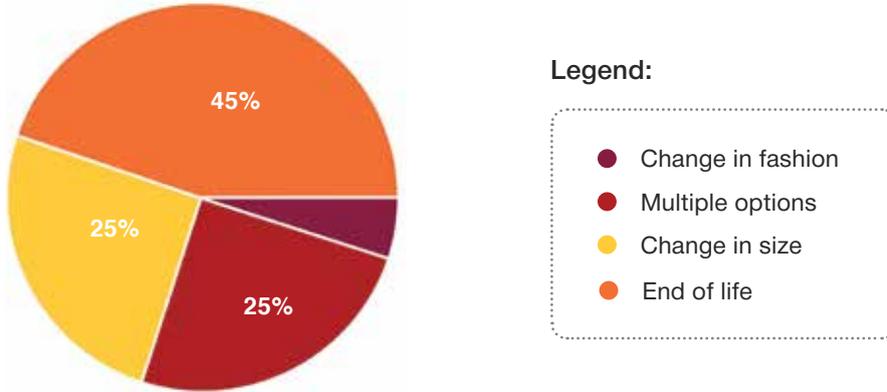
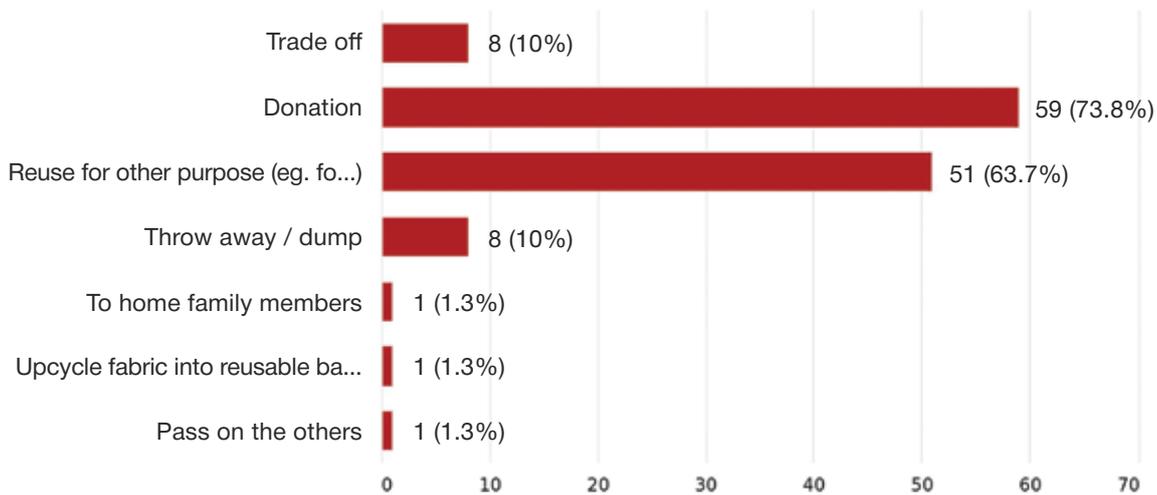


Figure 40: Mode of discarding clothes



Annexure 2 – Stakeholder Questionnaire Format

Academia

S. No.	Parameters	Data / Information	Tick
1	Basic Details		
1.1	Name of the Institute		
1.2	Contact details		
1.3	Address		
2	Curriculum on Circularity in Textile		
2.1	Does your curriculum includes circularity approaches	Yes	
		No	
2.2	What aspects of circularity are covered in your curriculum	Durability and longevity (Please indicate the coverage)	
		Resource use, waste prevention and diversion (Please indicate the coverage)	
		Reuse, remanufacturing and recyclability	
		Use of safe, renewable and recycled inputs	
		Other circular design principles	
2.3	Any plans for developing curriculum based on circularity aspects in designing	Yes	
		No	
2.4	Any research & development projects being offered by institute on implementing circularity concepts in design and development of textile products	Yes	
		No	
2.5	Any specific course being offered on developing products through upcycling of textile waste	Yes	
		No	

Textile Value Chain Stakeholders

S. No.	Parameters	Data / Information	Tick
1	Basic Details		
1.1	Registered name of mill/process house		
1.2	Address		
1.3	Products		
1.4	Category of industry	Small	
		Medium	
		Large	
2	Raw Material & Production		
2.1	Total production (Tons/meter) per annum		
2.2	Fabric processed / used	Cotton	
		Man-made	
		Blend	
2.3	Source of raw material	Local	
		Distant	
2.4	Product destination	Local	
		Distant	
3	Energy		
3.1	Source of energy / fuel used	Solid (coal/biomass)	
		Liquid (diesel/FO)	
		Gaseous (LPG/CNG)	
3.2	Renewable energy utilised	On site/Off site	
		Third party purchase	

4	Water		
4.1	Source of raw water	Ground water	
		Supply (SIDC/MC)	
4.2	Recycling / Reuse of water	Water recycling/reuse in process	
		Water recycling/reuse in other applications	
		ZLD	
5	Packaging		
5.1	Packaging material used	Plastic	
		Paper / corrugated box	
		Other	
5.2	Recycling / Reuse of packaging material	Single use	
		Reverse logistics (recovery)	
		Recyclable material	
		Virgin material	
6	Chemicals		
6.1	Chemical recovery / replacement (including auxiliary)	Chemical recovery / reuse	
		Chemical substitution	
		Eco-friendly chemicals	
6.2	Chemical type	Non-hazardous	
		Hazardous	
7	Logistics		
7.1	Type of logistics used	Road	
		Railway	
		Waterway	
		Air	

7.2	Any sustainable logistic practice	Clean fuel (CNG/EV)	
		Reverse / two way logistics	
8	Traceability		
8.1	Mechanism to identify sustainability / circularity	Certification	
		Third party verification	
		Client requirements	
9	Waste		
9.1	Waste management	Recycling	
		Co-processing	
		Reuse	
		Alternate product	
10	Circularity Context		
10.1	Has your company set targets for circularity?	No	
		Qualitative target only	
		SMART targets for:	
		Service-based business models	
		Business models that increase textile use	
		Design for durability and longevity	
		Design for recyclability and disassembly	
		Post-consumer textile collection Use of safe chemistry	
		Recycled content	
		Renewable materials produced using regenerative practices	
		Other circularity-related targets (please specify)	

10.2	What does your company's circularity strategy cover?	No strategy Please provide details.	
		In development	
		Strategy covers:	
		Reuse	
		Design for disassembly	
		Extended life	
		Technical cyclability	
		Biological cyclability	
		Material health	
		Textile collection and sorting	
		Use of recycled materials	
		Resource efficiency, waste prevention and diversion	
		Other important aspects of circularity	
10.3	Who holds overall accountability for the delivery of the company's circularity integration into business operations?	Not currently covered	
		Middle management	
		Senior management/directors	
		Chief Executive Officer (or equivalent)	
		Board member(s)	
		Other	
10.4	Does your company invest in circularity?	No	
		Yes, we invest in our internal operations and capacity building	
		Yes, we invest in our supply chain operations	
		Yes, we invest in circularity innovation and technology	

		Yes, we invest in stakeholder collaboration	
		Yes, we make some of our investment outcomes open source	
10.5	Does your company regularly report on its circularity activities and progress?	No	
		We have published our commitment to circularity	
		We have published our circularity strategy	
		We regularly report our circularity activities	
		We regularly report our circularity progress	
10.6	Does your company work on preventing and reducing pre-consumer waste?	No	
		Yes, through demand forecasting and/or through on-demand production	
		Yes, by engaging with suppliers to address waste	
		Please specify the level of the supply chain you are engaging with on pre-consumer waste and your activities	
		Other waste prevention or reduction measures	
11	Social Context		
11.1	Contribution to workers	Freedom of association and collective bargaining	
		Child labour prohibition	
		Fair salary	
		Standard working hours	
		No forced labour	
		Equal opportunities/discrimination	
		Health and safety	
		Social benefits/social security	

11.2	Contribution to consumers	Health and safety	
		Feedback mechanism	
		Consumer privacy	
		Transparency	
		End of life responsibility	
11.3	Contribution to local community	Access to material resources	
		Access to immaterial resources	
		Delocalization and migration	
		Cultural heritage	
		Safe and healthy living conditions	
		Respect of indigenous rights	
		Community engagement	
		Local employment	
11.4	Contribution to society	Public commitments to sustainability issues	
		Contribution to economic development	
		Technology development	
		Corruption abatement	
11.5	Contribution to value chain actors (not including consumers)	Fair competition	
		Promoting social responsibility	
		Supplier relationships	

Consumers

Parameters	Data / Information	Tick
Basic Details		
Name of the customer		
Contact number (if willing)		
Gender	Male	
	Female	
Shopping Characteristics		
Shopping criteria	As per need	
	Change in fashion	
What is average shopping frequency	Once in a week	
	Twice in a month	
	Once in a month	
	Once in a quarter	
	Half yearly	
	Yearly	
	On special occasions	
	On the go or unplanned	
Consumer Usage Practice		
Average usage of product	One month	
	One quarter	
	Half a year	
	One Year	
	Till its life	
	Till fashion lasts	

Criteria to discard cloths	Change in fashion	
	Multiple options	
	End of life	
Mode of discard	Trade off	
	Donation	
	Reuse	
	Throw away / dump	
Promoting Circularity in Textile		
Are you willing to use cloths from recycled fibers	Yes	
	No	
Are you willing to use cloths made of less natural resources	Yes	
	No	
Are you willing to donate your old cloths at retail stores or collection centres if available for recycling / upcycling	Yes	
	No	
Are you willing to purchase products made of less resources or recycled fibre but higher in price	Yes	
	No	
Are you willing to purchase products without tags and other packaging materials	Yes	
	No	

Recyclers/Waste Collectors

S. No.	Parameters	Data / Information	Tick
1	Basic Details		
1.1	Name of the Agency / Dealer		
1.2	Contact details		
1.3	Address		
1.4	Category	Waste collector	
		Waste segregator / pre-processor	
		Waste supplier / processor	
2	Textile Waste Management		
2.1	Source of textile waste	Collection from residential areas	
		Collection from commercial areas	
		Collection from market / shops	
		Collection from waste dumps	
		Collection from textile mills / manufacturer / processors etc.	
2.2	Condition of textile waste	Clean	
		Segregated (as per fibre)	
		Mixed (as per fibre and application)	
		Soiled and contaminated	
		Size (Big/small/mixed)	
		Quantity (small/big)	

2.3	Any pre-processing done	Sorting	
		Segregation	
		Cleaning	
2.4	End use of waste	Sold	
		Upcycling	
		Burned	
		Discarded	
		Secondary product	

Project Brief

GIZ India and ABFRL collaborated in 2021 as part of the DeveloPPP program. This program is implemented by GIZ on behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ) to promote public-private partnerships where business and development policy potential come together.

This is an industry-first initiative to promote Circularity in the Indian textile and apparel industry. The objective of the project is to identify the current state of circularity in India. The central idea is to contribute to reducing waste, controlling pollution, and implementing responsible production and consumption patterns in the textile and apparel

industry (SDG 12 Impact). The approach is centred around strengthening the capacities of the Indian textile and apparel industry to implement circular approaches. The focus lies on reducing the usage of harmful substances, recycling textiles and garments, reusing old clothes, and making use of alternative materials and renewable energy. This initiative intends to introduce circular business practices through demonstration projects by ABFRL and develop voluntary circular business guidelines and build a 'manifesto' for the sector in India. This program will strengthen and institutionalize an industry-level platform for consultation, knowledge exchange, innovation, and collaboration.

Disclaimer

The Baseline Assessment Report has been prepared based on the information available at the time of its publication. This report is intended to provide a general overview of the textile circularity status in India. Additionally, interpretations of the data and information provided in this report are subjective and depend on the perspectives and expertise of the authors and stakeholders involved. It may be noted that the textile industry is constantly evolving, and the data used in this report may not fully represent the industry's current state. Hence, the findings and recommendations in this report may become redundant at some point due to various external factors such as market conditions, government policies, and technological advancements.

Scope and Focus

The report focuses on the state of circularity in the Indian textile industry as of 2022-23. The findings and recommendations are based on data collected from a sample size of stakeholders located across India and may not fully capture the industry's dynamics. The report does not cover every aspect of circularity, and specific details and circumstances might not be reflected in it.

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While utmost care has been taken to ensure the accuracy and reliability of the information presented in this report, it is subject to the inherent limitations of data collection and analysis. The data obtained from interviews, surveys, and other sources may be subject to recall bias or inaccuracies. Any estimates, projections,

or assumptions made in the report are based on available data and methodologies employed, and variations may arise due to changes in circumstances or additional information becoming available.

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