Unlocking Finance for India's Textile Waste Management

An Analysis of the Pre-Consumer Textile Waste Sorting, Aggregation and Recycling Ecosystem

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Executive summary

India generates an estimated 7.07 million tonnes of textile waste annually, of which nearly 42 per cent is generated before products reach consumers, during spinning, weaving, knitting, processing, and garment manufacturing (MoT 2026). Unlike post-consumer waste, pre-consumer textile waste is relatively homogeneous and less contaminated, making it well suited to reuse and high-value recycling (Lau 2015; Fashion for Good 2022).

Pre-consumer textile waste is generated during production and manufacturing processes, including combing, carding, spinning, weaving, and garmenting, at various stages of the textile value chain (MoT 2026). It typically includes rejected or defective products, short fibres and dust, yarn and fabric scraps, fabric rejects, and apparel deadstock (Fashion for Good 2022). However, the transition from recovery to higher-value circularity remains constrained by systemic inefficiencies across the value chain (Lau 2015).

Strengthening the management of pre-consumer textile waste can improve resource efficiency, reduce dependence on virgin materials, and support **India's transition towards circular manufacturing**.

Report

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India's textile recycling sector is projected to reach a market value of USD 3.5 billion by 2030, with the potential to generate approximately one lakh green jobs by 2030 (MoT 2026).

Globally, approximately one lakh tonnes of textile waste is generated annually, although this estimate covers all textile waste rather than pre-consumer waste specifically (UNEP 2025). Only around 12–15 per cent of textile waste enters recycling systems, while less than 1 per cent is recycled into new clothing (Taneja et al. 2025). Global policy responses are increasingly focusing on producer responsibility, circular design, and markets for recycled content. Regulations such as the European Union's Ecodesign for Sustainable Products Regulation, alongside emerging producer responsibility frameworks, are accelerating the transition towards circular textile value chains (European Commission 2026). These developments highlight the importance of establishing enabling policy and market conditions alongside driving investments in the recycling ecosystem.

In India, however, the pre-consumer textile waste ecosystem remains fragmented. Collection and aggregation rely substantially on decentralised networks of brokers, traders, and informal intermediaries, while recycling infrastructure is concentrated in established clusters such as Panipat in Haryana, Tiruppur in Tamil Nadu and Amroha in Uttar Pradesh. The resulting fragmentation and multiple handovers of material increase logistics costs. This makes it difficult to track waste flows, material quality, and final destinations, limiting transparency and constraining higher-value circularity (Fashion For Good 2022; GIZ 2023; MoT 2026). Financial constraints further limit the growth of enterprises across the textile recovery and recycling value chain, particularly for small and growing businesses (SGBs) occupying the 'missing middle'[1] of enterprise finance (Hornberger et al. 2018).

Against this **backdrop, this study examines India's pre-consumer textile waste ecosystem across the aggregation, sorting, and recycling stages of the value chain. The analysis combines secondary research with primary research involving 12 entities across India, comprising field visits to five textile recovery facilities (TRFs) and surveys of seven recycling enterprises, innovators, and solution providers across India.** It also applies the Dalberg SGB Segmentation Framework to classify enterprises based on their market growth and scale potential, product or service innovation profile, and entrepreneur behavioural attributes. Based on this classification, it identifies financing pathways suitable for different enterprise types (Hornberger et al. 2018).

[1] The 'missing middle' refers to small and growing businesses that are typically too large for microfinance, but too small or risky for conventional bank lending or venture capital. The term and the SGB segmentation framework used in this study are adapted from Hornberger, Kusi, and Chau (2018).

Women workers sorting pre-consumer textile waste by colour in Panipat.

Image: CEEW

Key findings

India's textile sorting, aggregation, and recycling ecosystem faces six overarching barrier themes

The study engaged with five textile recovery facilities (TRFs) and seven textile recycling enterprises, innovators, and solution providers across India. Across the TRFs engaged in the study, common barriers included fragmented waste-sourcing systems, fully manual sorting and grading, and inadequate storage and infrastructure. TRFs also face irregular offtake and high transportation and operating costs, which constrain their profitability and ability to scale. These barriers also limit investment in technology and infrastructure.

Barriers across India's pre-consumer textile recycling ecosystem cluster into six themes. Technology (23 per cent) and finance (22 per cent) together account for nearly half of identified barriers, driven by challenges in separating fibre blends, manual sorting bottlenecks, high capital requirements and limited access to affordable and green finance. Infrastructure (16 per cent) and market (15 per cent) barriers follow, including limited shared facilities and infrastructure needed to support textile recycling at scale. Operational and policy/systemic barriers (13 per cent each) include high energy and logistics costs and absence of an enabling regulatory framework for textile circularity.

Financial barriers cut across these constraints. The surveyed enterprises highlighted high upfront capital requirements, working-capital shortages, volatile feedstock prices, and limited access to affordable bank credit and green finance. These financing constraints limit enterprises' ability to invest in infrastructure and machinery, adopt new technologies, expand operations, and respond to market opportunities. Addressing the six barriers therefore requires an enabling policy environment and coordinated support across policy, infrastructure, technology, market, finance, and operations.

The ecosystem is heterogeneous and requires differentiated financing pathways based on enterprise characteristics

The 12 entities surveyed vary substantially in scale, business model, technology, and market orientation, as well as in their degree of automation, machinery requirements, digitalisation, and product markets. This heterogeneity creates distinct financing needs. Design-led enterprises may require smaller-ticket capital and market-development support, while established mechanical recyclers require working capital, machinery finance, and credit enhancement. Technology-led ventures require patient risk capital to develop and commercialise new technologies. Conventional MSME classifications based primarily on turnover or enterprise size therefore do not adequately capture these differences.

The study applies the SGB Segmentation Framework to classify enterprises based on their market growth and scale potential, product or service innovation profile, and entrepreneur behavioural attributes, and link these characteristics to more appropriate financing pathways. This provides a basis for differentiated financing rather than a single financing solution for textile recycling enterprises, with financial instruments aligned with enterprise characteristics and growth trajectories rather than enterprise size alone.

Recommendations

India's transition towards a circular textile economy will require an enabling policy environment and differentiated financing pathways. Targeted ecosystem support from policymakers and private financial institutions can further accelerate investment and strengthen India's pre-consumer textile waste recycling ecosystem (MoT 2025a, MoT 2026).

The recommendations address six interconnected barrier themes across the textile sorting, aggregation, and recycling ecosystem: policy and systemic, infrastructure, technology, market, finance, and operations. The mapping below shows how individual recommendations respond to multiple barriers identified through consultations with TRFs, recycling businesses, innovators, and solution providers, highlighting the need for coordinated action across the ecosystem.

Figure ES1. Six recommendations mapped against interconnected barriers across the textile sorting, aggregation, and recycling ecosystem

Recommendations	Policy and systemic	Infrastructure	Technology	Market	Finance	Operation
Include textile waste within a regulatory framework	●	○	○	○	○	○
Adopt differentiated financing pathways for textile SGBs	○	○	○	○	●	○
Recognise textile waste management as a priority green manufacturing activity	●	●	●	○	○	○
Strengthen innovation ecosystems and accelerate technology commercialisation	○	○	●	○	○	●
Promote circular manufacturing through upstream design and resource-efficient operations	●	●	●	○	○	●
Build stronger markets for recycled textiles through policy and producer responsibility	●	○	○	●	○	○

● Directly addresses ○ Partly addresses

Source: Authors' analysis

The study recommends the following actions.

- **Include textile waste within the regulatory framework.** Unlike plastic waste, municipal solid waste, construction and demolition (C&D) waste, e-waste, biomedical waste, and hazardous waste, which are governed through dedicated management rules under the *Environment (Protection) Act, 1986*, textile waste currently lacks a comparable regulatory framework. Bringing textile waste within a dedicated regulatory framework could include provisions for producer responsibility and measures to encourage the use of recycled textile content, while clearly defining roles and responsibilities across the textile value chain.

- **Adopt differentiated financing pathways for textile SGBs.** Enterprises operating within India's pre-consumer textile waste ecosystem are heterogeneous and require different forms of capital depending on their growth potential, innovation profile, entrepreneur behaviour, and stage of development. The segmentation framework provides a useful approach to understanding these differences and aligning enterprises with financing instruments appropriate to their growth trajectories. Financial institutions, development finance institutions, state governments, and impact investors could therefore adopt differentiated financing pathways that address both enterprise-specific financing needs and the market gaps that constrain access to capital.

- **Recognise textile waste management as a priority green manufacturing activity.** The survey findings indicate that textile recyclers and TRFs currently access largely the same financial schemes as conventional textile manufacturers, despite generating additional environmental benefits through waste diversion, resource recovery, and reduced dependence on virgin materials. Several state governments have already introduced targeted support for recycling infrastructure and machinery, demonstrating the feasibility and scalability potential for differentiated incentives. At the national level, integrating textile recycling into existing Ministry of Textiles (MoT) and MSME financing programmes could help accelerate formalisation and encourage greater participation by SGBs in India's circular economy transition.

- **Strengthen innovation ecosystems and accelerate technology commercialisation**. The survey identifies technological limitations, including those related to fibre separation, blended-textile processing, contamination removal, and automation, as major constraints to scaling higher-value recycling solutions. Future interventions should strengthen collaborative research among industry, start-ups, research institutions, and technology centres to develop feasible solutions for fibre identification, automated sorting, fibre-to-fibre recycling, and digital traceability.

- **Promote circular manufacturing through upstream design and resource-efficient operations.** Unlocking finance should be complemented by efforts to strengthen the operational resilience and competitiveness of enterprises across the textile value chain. Survey responses highlight high utility costs, raw material price volatility, and operational inefficiencies as key barriers affecting profitability.

- **Build stronger markets for recycled textiles through policy and producer responsibility mandates.** Circularity can be unlocked through predictable market demand and supportive regulatory frameworks. Survey respondents consistently highlighted uncertain market demand, fragmented supply chains, and inconsistent feedstock availability as major barriers to growth. National platforms such as Bharat Tex 2026 offer opportunities to strengthen industry collaboration, showcase circular innovations, and facilitate market linkages among brands, recyclers, investors, and technology providers. The MoT, the Ministry of Environment, Forest and Climate Change, textile brands, and industry associations should work together to strengthen markets for recycled textiles through producer responsibility mechanisms, quality standards, and demand-side interventions.

1. Introduction

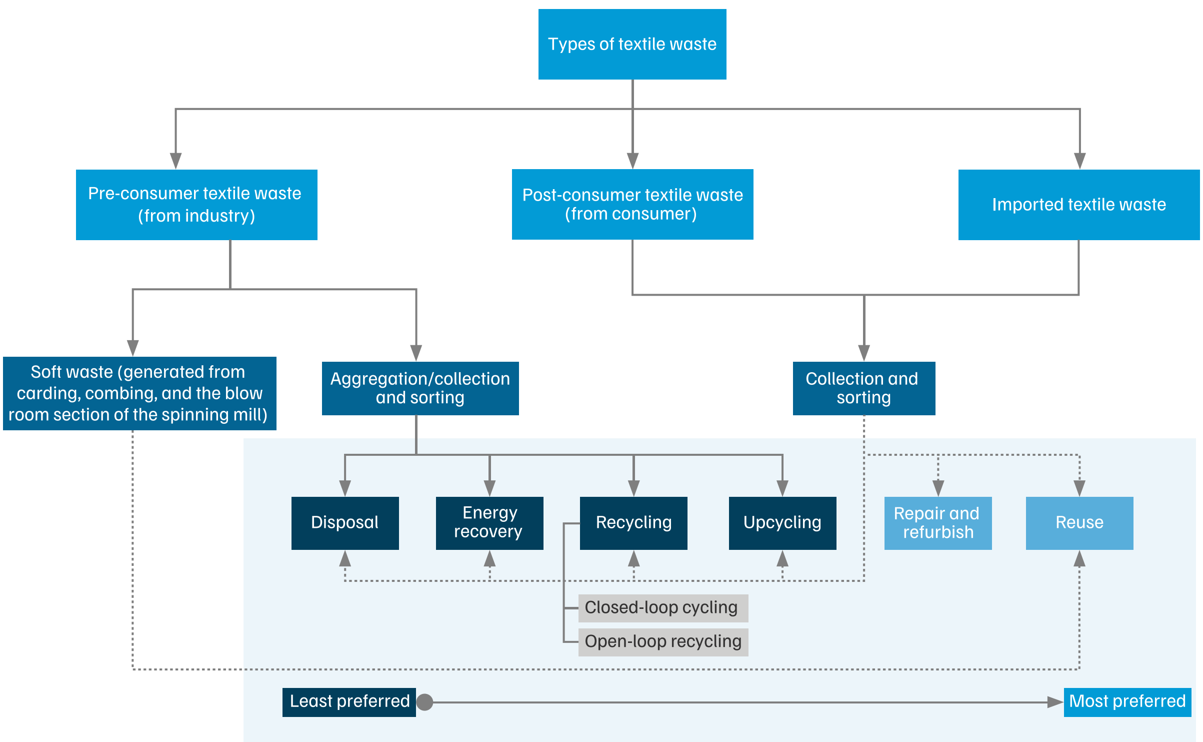
Globally, an estimated 92 million tonnes of textile waste is generated annually, the vast majority of which ends up in landfills or is dumped or burned in regions lacking adequate waste management infrastructure (UNEP 2025). Despite the significant environmental consequences, only 12–15 per cent of this waste reaches recycling facilities, and less than 1 per cent is successfully recycled into new clothing through closed-loop systems (Taneja et al. 2025).

Against this global backdrop, India is a major textile manufacturing hub. The country's textile industry was valued at USD 157 billion in 2021–22 and contributed approximately 2 per cent to national gross domestic product (GDP), 7 per cent to industrial output, and 10 per cent to total merchandise exports (MoT 2026). It is also a key driver of employment, supporting over 45 million people and contributing to rural livelihoods and export growth (PIB 2026). However, the rapid expansion of textile manufacturing and domestic consumption has also generated a substantial waste footprint, with India producing approximately 7.07 million tonnes per annum (TPA) of textile waste (MoT 2026). Of this, 42 per cent originates from pre-consumer sources such as manufacturing waste, while 58 per cent arises from post-consumer disposal (MoT 2026).

Textile waste can broadly be classified as soft waste and hard waste (Arafat and Uddin 2022). Soft waste, generated in the blow room and during carding and combing in spinning mills, falls under pre-consumer textile waste category and is often reused in rotor spinning to produce coarser yarns (Arafat and Uddin 2022). Hard waste comprises pre-consumer and post-consumer textile waste. Figure 1 presents the classification of textile waste and the preferred management pathways for different waste streams.

Among these categories, pre-consumer textile waste presents a significant opportunity for resource recovery and circularity. Its relatively high quality, consistency, and ease of recovery make it particularly suitable for reuse and recycling compared with post-consumer textile waste (Lau 2015). Pre-consumer textile waste is generated during production and manufacturing processes, including combing, carding, spinning, weaving, and garmenting, at various stages of the textile value chain (MoT 2026). It typically includes rejected or defective products, short fibres and dust, yarn and fabric scraps, fabric rejects, and apparel deadstock (Fashion for Good 2022). However, the transition from recovery to higher-value circularity remains constrained by systemic inefficiencies across the value chain (Lau 2015).

Figure 1. Classification and preferred management pathways for textile waste



Source: Authors' analysis

1.1 Strengthening the management of pre-consumer textile waste

India's textile value chain is a complex, multi-stage ecosystem with significant data gaps, particularly in downstream segments and across fibre types (MoT 2025b). Its fragmented infrastructure further constrains the transition from textile waste recovery to higher-value circularity.

The management of pre-consumer textile waste is largely informal (Intellecap 2022). Collection and aggregation rely predominantly on an unorganised, informal network of brokers, traders, and middlemen. These informal networks act as intermediaries that connect textile manufacturers with recyclers (GIZ 2023). However, despite their critical role, the decentralised system lacks transparency and traceability, limiting visibility into material flows and waste quality (GIZ 2023; Fashion For Good 2022).

Further, localised processing infrastructure is unevenly distributed. Waste generated across garmenting clusters is frequently aggregated and transported over long distances to centralised recycling hubs such as Panipat, increasing logistical costs and operational inefficiencies.

1.2 Addressing the environmental and economic risks of linear textile systems

The textile and apparel industry is an important pillar of international trade. However, low utilisation rates with high levels of throughput, and low recycling levels create substantial and growing pressure on resources. The current linear system drives much of this pressure (Ellen MacArthur Foundation 2017). By 2030, global apparel consumption is projected to rise by 63 per cent to 102 million tonnes (McKinsey & Company 2024).

Driven by increasing demand for fast fashion and high rates of clothing disposal, textile waste continues to grow at an alarming rate (Vera et al. 2024). Regulatory responses to this trend are also gathering pace globally. Under the European Union's *Ecodesign for Sustainable Products Regulation* (ESPR), large enterprises are banned from destroying unsold apparel, clothing accessories, and footwear from July 2026, with medium-sized enterprises to follow from 2030 (European Commission 2026). The ESPR framework also enables the Commission to adopt mandatory ecodesign requirements, including on durability and recyclability for textiles in future product-specific delegated acts.

France has moved further, building on its 2020 Anti-Waste Law for a Circular Economy (Loi AGEC) with a 2026 Anti-Fast Fashion Law, which took effect on 1 September 2026, introducing a per-item eco-tax alongside mandatory disclosure requirements (including manufacturing location and awareness messaging) for ultra-fast-fashion garments sold in the country. Together, these measures signal a shift from voluntary industry commitments to binding producer accountability, a direction that India's policy landscape may also increasingly need to consider.

The textile and apparel sector is globally recognised as a major source of pollution, with its greenhouse gas (GHG) emissions estimated to exceed those from shipping and international aviation combined (Lopes 2021). Improper management of textile waste can also result in landfilling, where decomposition may release hazardous chemicals and GHGs into the environment (Leal Filho et al. 2022).

In resource-constrained environments, the lack of formal collection systems can result in the open burning of discarded clothing (Paranjape and Athalye 2024). An estimated 10–20 million metric tonnes (Mt) of textile waste is burned annually across 137 countries. The incineration of polyester alone contributes an estimated 8.3–24.6 Mt of fossil carbon dioxide (CO_2) emissions, with South Asia accounting for 37 per cent of this total (Bayramova et al. 2026). Open burning of textile waste also contributes significantly to air pollution, releasing hazardous atmospheric pollutants, including PM2.5, PM10, polycyclic aromatic hydrocarbons (PAHs), and toxic heavy metals, disproportionately affecting vulnerable populations (Bayramova et al. 2026).

> Open burning of textile waste also contributes significantly to air pollution, releasing hazardous atmospheric pollutants, including PM2.5 and PM10.

1.3 Advancing textile recycling technologies for sustainable textile management

Pre-consumer textile waste management generally involves classifying textiles according to their physical condition and composition to determine their potential for reuse (Lanz et al. 2024). The management system is broadly structured around three stages: collection, classification, and treatment (Lanz et al. 2024).

Treatment can include mechanical or chemical recycling, as well as incineration or landfill disposal, depending on the material and available infrastructure (Lanz et al. 2024; Paranjape and Athalye 2024).

Mechanical recycling produces shorter 'second-chance' fibres that can be used in insulation products, non-woven fabrics, and automotive components (Paranjape et al. 2024). It is commonly used for cotton and polyester, and processes are steadily improving in their ability to retain fibre quality (JBR PET 2025). Chemical recycling depolymerises waste textiles using chemical processes to produce monomers for new textiles or other materials. Biological recycling uses enzymes or microorganisms for similar material-recovery purposes instead of chemicals. This approach can enable higher-purity restoration and greater retention of fibre strength (Silva et al. 2026). Thermal recycling, including pyrolysis and gasification, recovers energy or fuels from textile waste (Pitak and Sholokhova 2025; Tang 2023).

The use of recycled fibres can reduce reliance on the resource-intensive extraction of virgin materials and, in turn, lower GHG emissions. Estimates indicate reductions in CO^2-equivalent emissions of 38 per cent for recycled viscose, 22 per cent for recycled polyester, and 3 per cent for recycled cotton (MoT 2026). At the same time, the cost of decarbonising the global fashion supply chain is estimated at USD 1 trillion, highlighting the scale of investment required to support the transition towards a more sustainable system (McKinsey & Company 2024).

1.4 Enabling a circular pre-consumer textile economy through policy, finance and data systems

Building on the identified gaps in infrastructure, traceability, and technology adoption, enabling a circular economy for pre-consumer textile waste in India requires action across policy, finance, and market systems. India's textile recycling sector is projected to reach a market value of USD 3.5 billion by 2030, driven by rising demand for sustainable fashion solutions, and has the potential to generate approximately one lakh new green jobs over the next five years (MoT 2026). Across the country, industries, start-ups, and other enterprises are adopting a range of practices to manage pre-consumer textile waste and promote circularity (Fashion For Good 2022).

Global and regional policies are increasingly designed to address the sustainability of the textile industry and are crucial for driving innovation in textile waste management (Tang 2023). In India, the Union Budget 2026–27 proposes support to modernise traditional textile clusters through investment in machinery and technology upgrades and the establishment of common testing and certification infrastructure (MoT 2026). However, no specific, comprehensive national regulations currently govern textile waste segregation, traceability, or recycling standards.

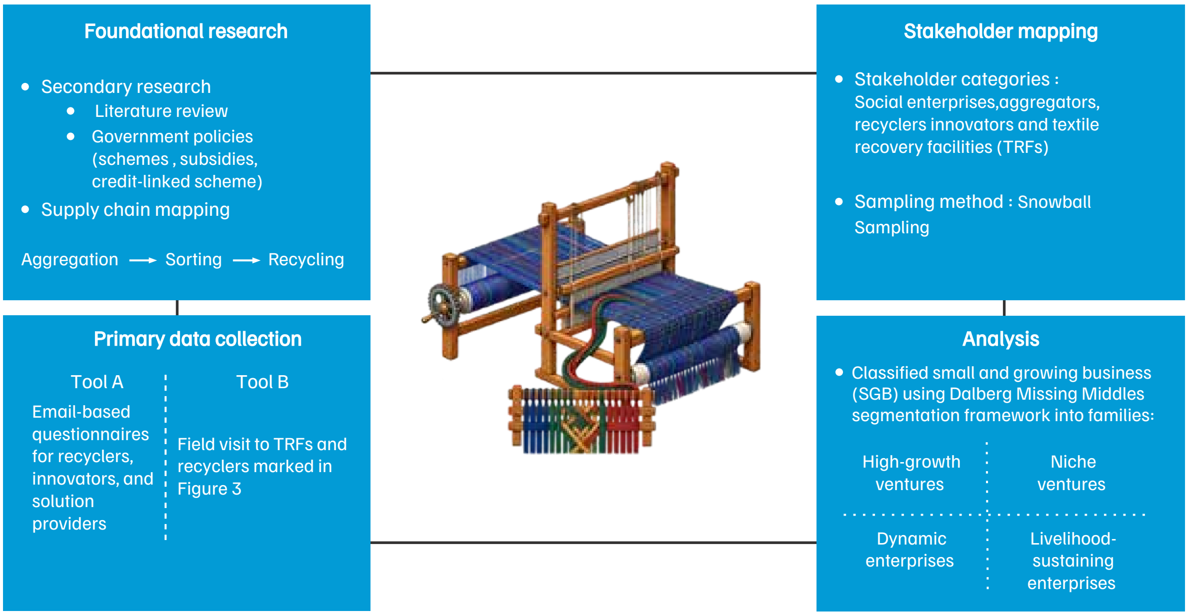
Financial and market barriers further limit the scaling of these solutions. Competing business priorities often outweigh sustainability initiatives, particularly when returns are uncertain or difficult to measure (McKinsey & Company 2024). Small and growing businesses (SGBs) drive innovation, job creation, and inclusive economic growth, yet face challenges in accessing finance (Hornberger et al. 2018). The Aspen Network of Development Entrepreneurs (ANDE) defines SGBs as formal or formalising enterprises with financing needs typically ranging from USD 20,000 to USD 2 million, occupying a segment that is too large for microfinance yet too small or early-stage for conventional bank lending or private equity (Hornberger et al. 2018). Addressing this financing gap requires a clearer understanding of the different types of enterprises operating within India's pre-consumer textile waste ecosystem and their distinct financing needs.

This study examines the aggregation, sorting, and recycling stages of the pre-consumer textile waste value chain. It first maps India's ecosystem, covering both textile recycling technologies and textile recovery facilities (TRFs). The study surveys seven textile recyclers, innovators, and solution providers and five TRFs across India. It applies a segmentation framework to evaluate these enterprises' profiles and assess their potential to scale and access suitable financing pathways. The study administered a semi-structured questionnaire to the surveyed entities to understand their operations. This was complemented by a review of the policies and financial schemes available to them. Together, these inputs help identify key enablers for strengthening and developing the ecosystem across India's diverse textile clusters.

2. Research methodology

In this study, we adopted a mixed-methods approach to examine pre-consumer textile waste management in India, combining secondary research, stakeholder mapping, primary data collection, and an enterprise segmentation framework. Figure 2 summarises the methodology.

Figure 2. Key methodological steps undertaken for this study



Source: Authors' compilation

Note: SGB: small and growing business; TRF: textile recovery facility

Secondary research

We conducted a comprehensive literature review to identify existing technologies, business models, solutions, and innovations for pre-consumer textile waste management across the textile waste supply chain. We reviewed journal articles, reports, case studies, and enterprise websites to understand the sector and existing practices.

We also undertook a policy analysis to establish a foundational understanding of government programmes, policies, financial schemes, and instruments, including incentives, subsidies, and credit-linked support programmes, available to textile businesses engaged in pre-consumer textile waste management.

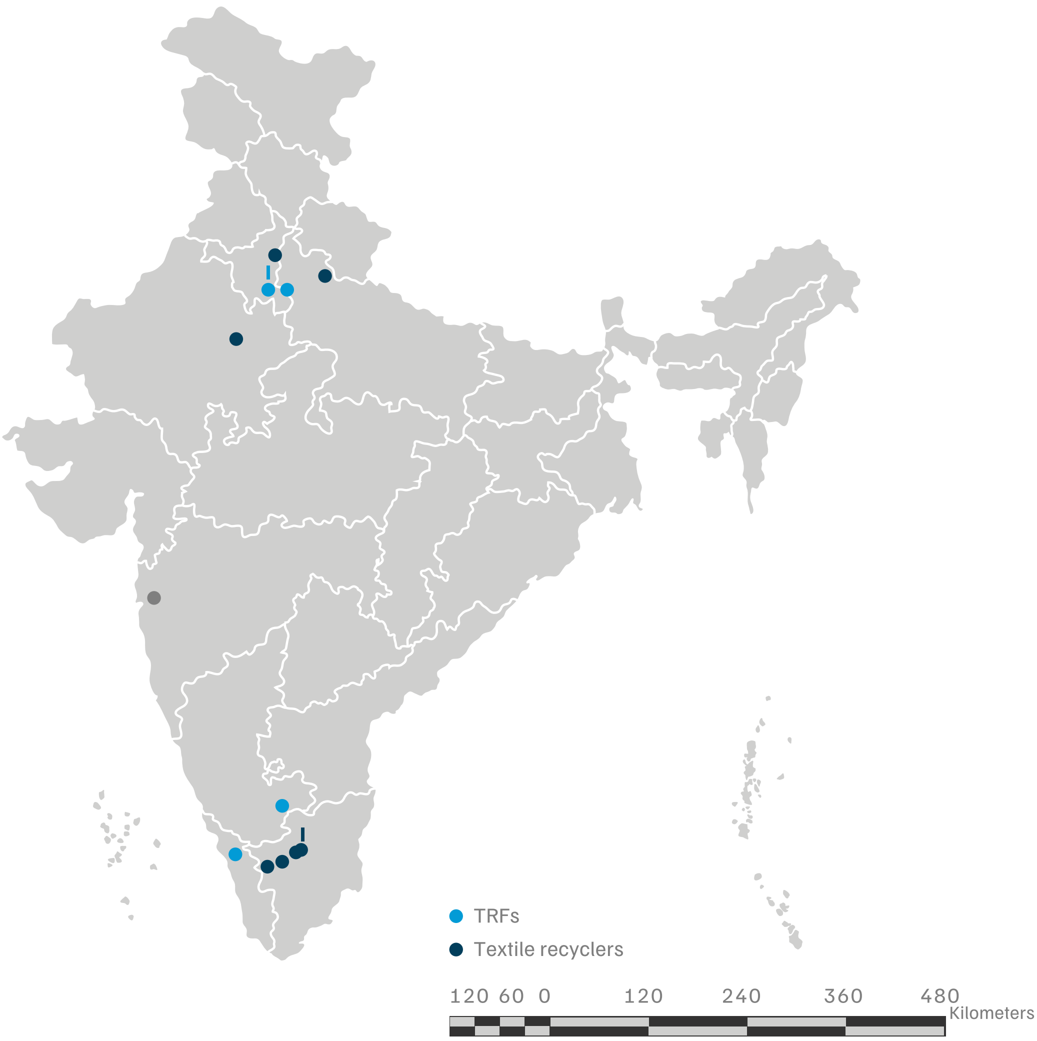
Stakeholder mapping

We mapped stakeholders in the pre-consumer textile waste management sector across India, including textile waste aggregators, recyclers, innovators, and TRFs. Engaging initial stakeholders helped us identify and connect with additional entities operating within the ecosystem through a snowball sampling approach. This process identified 12 entities that formed the basis for primary data collection.

CEEW team in conversation with a textile recovery facility (TRF) manager in Karnataka.

CEEW team in conversation with a TRF manager in Kerala.

Figure 3. Surveyed textile recovery and recycling facilities across India



Source: Authors' compilation

Note: TRF: textile recovery facility

Primary research

We conducted field visits to gain insights into the operational processes and material flows of the selected facilities. We gathered information using customised semi-structured questionnaires for TRFs and for recyclers, innovators, and solution providers (attached as Annexure 1). These visits allowed us to interact directly with recyclers, TRF managers, aggregators, and solution providers to understand practical challenges related to raw material availability, logistics, workforce, and market linkages. To maintain consistency and protect confidentiality, all 12 participating entities have been anonymised in this report. They are therefore referred to using generic identifiers such as TRF 1 and Recycler 1 throughout the report.

Data synthesis and analysis

After gathering insights from the recycling, recovery, and processing facilities, we validated the information with the respective facilities. We analysed the data using quantitative and qualitative methods to evaluate TRFs and recycling solution providers across different stages of pre-consumer textile waste management. We then developed a comprehensive overview of the technological, operational, financial, and market characteristics of the surveyed entities.

The study highlights the heterogeneity within this ecosystem, with enterprises of similar sizes and operating in the same sector exhibiting different growth trajectories, capital requirements, and financing barriers. To account for this heterogeneity, we applied an adapted Small and Growing Businesses *(SGB) Segmentation Framework* based on the Missing Middles framework developed by the Collaborative for Frontier Finance (CFF) and Dalberg to classify the enterprises (Hornberger et al. 2018).

We selected this framework because it moves beyond descriptive, size-based definitions, such as revenue and employee count, to segment enterprises along three dimensions: growth and scale potential; product or service innovation profile; and the entrepreneur's behavioural attributes, including risk tolerance, growth ambition, and openness to external capital. As the framework was developed for SGB finance in a general, largely global context, we recontextualised its financing recommendations for Indian textile recycling rather than applying them directly.

We segmented each surveyed entity into one of four families: high-growth ventures, niche ventures, dynamic enterprises, or livelihood-sustaining enterprises, based on the survey responses. We then identified Indian government financing schemes and private capital instruments that could serve as key enablers for diverse textile clusters. Finally, we mapped each enterprise segment to suitable financing mechanisms based on its risk profile, growth stage, and capital requirements (Annexure 2).

Research limitations

Despite the study's comprehensive nature, it has certain limitations. The research focused on pre-consumer textile waste management and did not examine post-consumer waste as a separate category. While several participating entities handle both pre- and post-consumer textile waste, the analysis focused specifically on their pre-consumer waste-related activities, where these could be distinguished during consultations and field visits.

Insights relating to common processes, such as collection, sorting, aggregation, storage, and recycling, were considered where they were applicable to pre-consumer textile waste. Where entities did not differentiate between the two waste streams in their operations, their inputs were used only to inform broader process-level or ecosystem-level observations and were not treated as evidence specific to pre-consumer waste. This distinction was maintained throughout the analysis to align the findings with the stated scope of the study.

The primary data draws on 12 entities that were willing and able to participate, providing an in-depth view of their operations rather than an exhaustive representation of India's pre-consumer textile waste ecosystem. The study prioritises the organised segment of the ecosystem, as it aims to unlock finance for organised textile enterprises. Informal enterprises, which may represent a significant share of the sector, fall outside the present scope and constitute an important area for future research.

> The study mapped stakeholders in the pre-consumer textile waste management sector across India, including textile waste aggregators, recyclers, innovators, and TRFs.

3. Key findings

This section moves from an assessment of current practices to targeted financing solutions. Sections 3.1 and 3.2 examine the status quo of aggregation, sorting, and recycling businesses, identifying challenges in managing pre-consumer textile waste across the value chain. Section 3.3 introduces an enterprise segmentation framework that translates these shared barrier categories into differentiated, actionable financing pathways.

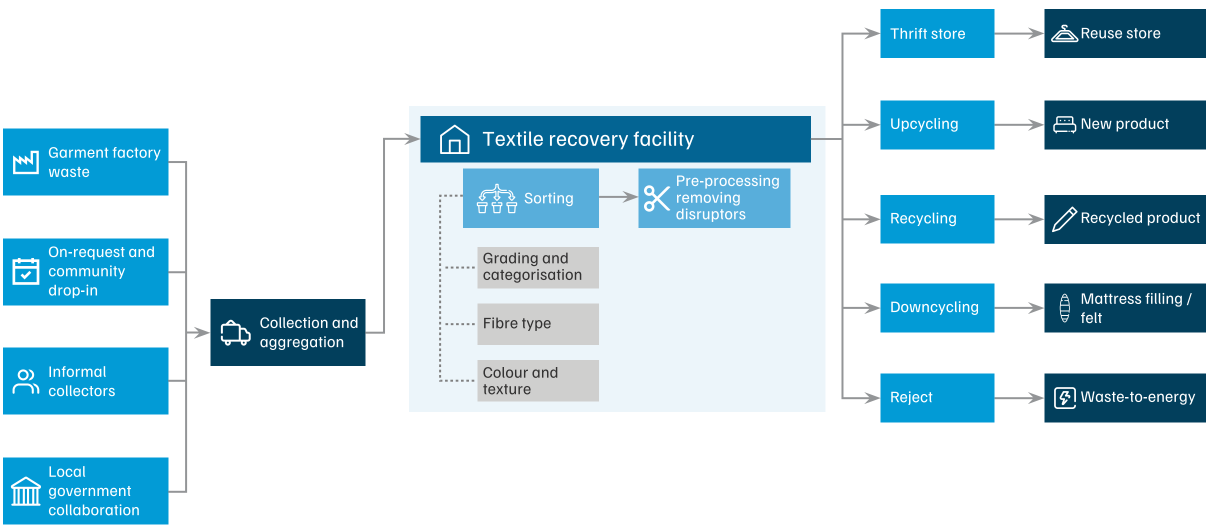
3.1 Emerging business models for textile recovery facilities

A TRF is a dedicated infrastructure hub for aggregating, sorting, and storing textile waste, including production offcuts, post-consumer clothing, and defective stock. It directs these materials to appropriate end destinations for reuse, recycling, upcycling, or energy recovery (Kamble 2025; RECEIC 2026). Textile recovery facilities are a relatively new concept in India. These facilities bridge the gap between collection and recycling by creating traceable and transparent pathways, as shown in Figure 4.

TRFs perform a common systems function within India's textile circular economy

The field assessment revealed that, despite differences in scale, geography, and operating models, TRFs perform a common systems function within India's textile circular economy. They serve as a critical interface between waste aggregation and downstream recovery. Collected textile waste is initially sorted manually, primarily through visual inspection, and categorised into grades to direct it towards the highest-value recovery pathway. In some cases, additional steps include sorting by colour and removing accessories and other impurities.

Figure 4. Textile recovery facilities enable resource recovery through sorting and pre-processing



Source: Authors' compilation

Table 1. Comparative analysis of textile recovery facilities across India

Parameter	TRF 1	TRF 2	TRF 3	TRF 4	TRF 5
Location	Uttar Pradesh	Maharashtra	Karnataka	Haryana	Kerala
Year established	2022	2024	2022	2022	2022
Land area	2000 sq ft	4000 sq ft	6000 sq ft	Not specified	Not specified
Type of textile waste handled	Post-consumer, tailoring offcuts	Pre-consumer, post-consumer	Pre-consumer, post-consumer	Pre-consumer, post-consumer	Post-consumer
Processing capacity	No fixed tonnage targets	~2 TPD	~0.5 TPD	Not specified	~2.5 TPD
Primary source of textile waste	Households and boutiques/ tailoring offcuts	Textile industries, households, and hotels	Textile manufacturing industries, and households	Households, hotels, textile manufacturing industries, and garment exporters	Households and resource recovery facilities
Collection method	On-request collection from households, scheduled collection, drop-off to the TRF	Local informal waste collectors dropping waste at the TRF; scheduled collection from textile manufacturing industries; drop-off to the TRF	On-request collection from households; scheduled collection; drop-off to the TRF	On-request collection from households and hotels; drop-off to the TRF; scheduled collection from textile manufacturing industries	Collaboration with local government bodies and *Haritha Karma Sena* (Kerala's civic waste system); drop-off to the TRF
Monthly logistics cost	INR 2000 (This entity operates as a research and systems-development facility)	Not available	INR 40,000–50,000	Not available	INR 45,000
Highest-margin stream	Upcycling	Rewearables	Reuse material	Reuse material	Rewearables
Full-time workers	5	10	12	14	16
Storage duration	3–4 months	15 days	1–2 months	1–2 months	Indeterminate

Source: Authors' compilation

Sourcing of textile waste

Textile recovery systems have evolved around local institutional ecosystems rather than a standardised collection model. The surveyed TRFs demonstrated diverse approaches to sourcing textile waste, shaped by local actors and waste-generation patterns. TRF 2 in Maharashtra engages the local informal waste-collection community to collect post-consumer textiles from households. TRF 5 in Kerala integrates textile recovery into Kerala's municipal solid waste management system through the *Haritha Karma Sena* (Kerala's civic waste system) and resource recovery facilities in Kochi and Kozhikode.

TRF 4 in Haryana sources pre-consumer textile waste from garment manufacturing industries through scheduled industrial collections and collects textile waste from residential units and hotels on request. TRF 1 in Uttar Pradesh and TRF 3 in Karnataka use both on-request and scheduled collection systems. Some of these TRFs also periodically conduct textile waste collection drives in residential areas and malls.

Image: CEEW

Manual sorting of textile waste by colour and pattern at a textile recovery facility (TRF) in Maharashtra.

Sorting and grading

All surveyed TRFs use fully manual sorting based on the condition and reusability of materials, grade, fabric type, and colour before considering recycling or disposal. TRF 3 has also deployed near-infrared (NIR) spectroscopy to identify fibre composition. Grading systems are largely similar across the facilities and typically comprise four to six categories: Grades 1 and 2 comprise rewearable or resalable garments; Grades 3 and 4 comprise recyclable textile waste, including materials suitable for upcycling; Grade 5 comprises textile waste sent for downcycling, such as into rugs and carpets; and Grade 6 comprises rejects.

TRF 1, TRF 2, and TRF 3 use more comprehensive grading systems (Grades 1–6), whereas TRF 2 and TRF 5 use narrower grading systems (Grades 1–4), focusing on rewear, repair, and upcycling. At TRF 5, approximately 30–40 per cent of incoming textiles are classified as rewearable and redirected to *Kuppayam* ('apparel' in Malayalam), a community thrift store established by the organisation, where cleaned and sorted garments are sold at subsidised prices to local residents.

At TRF 3 and TRF 4, some discarded garments retained their original retail tags. This indicates that a share of textile waste enters the waste stream while still wearable rather than at the end of its usable life. This may be associated with fast-fashion business models (Fashion for Good 2022). These findings underscore the importance of prioritising reuse and redistribution before recycling within the textile waste hierarchy.

Facility operators reported that experienced workers could often distinguish materials with accuracy and speed during routine operations. The findings suggest that technology currently complements, rather than replaces, skilled workers.

Image: CEEW

Community thrift store established by a textile recovery facility (TRF) in Kerala, where cleaned and sorted garments are sold at subsidised prices to local residents.

Inadequate infrastructure and innovation

The greatest value in textile recovery lies in extending product life before material recycling. However, downstream recycling infrastructure remains a weak link in the textile recovery value chain. While TRFs sort and grade textile waste effectively, viable end-use pathways remain limited for several material streams. TRF 3 and TRF 5 reported that significant quantities of sorted polyester-rich and blended textiles had to be diverted to co-processing or incineration due to limited recycling options (Arun et al. 2025; Enviu 2025). Another sorting challenge is removing non-textile disruptors, such as zippers, buttons, chains, and other accessories, which increases workforce requirements, processing time, and operational costs.

Socio-economic and environmental impact of TRFs

TRFs generate significant environmental and socio-economic value beyond material recovery. In addition to diverting textiles from disposal, all surveyed facilities create employment opportunities for local communities through manual sorting, grading, and handling activities. The facilities also maintain inventory records, traceability systems, safety protocols, and compliance mechanisms to improve transparency within textile value chains. These findings indicate that TRFs are not merely waste management infrastructure but emerging circular economy enterprises that simultaneously contribute to resource recovery, local livelihoods, and the formalisation of textile waste management.

Scalability challenges for TRFs

The field assessment indicates that these decentralised and fragmented TRFs face interconnected challenges that constrain their ability to scale. The TRFs have limited storage infrastructure and face mismatches between demand and supply. Market barriers include limited demand, irregular offtake, and uncertain prices for recycled textile outputs (Enviu 2025). Technology barriers include challenges associated with blended fibres and polyester-rich waste streams, disruptors that reduce processing efficiency, and the limited availability of high-value local recycling solutions (Choudhury et al. 2024). Operational challenges include high transportation costs borne by TRFs and inconsistent feedstock availability.

These challenges span the aggregation and collection stages of the value chain and limit TRFs' ability to scale as viable business models. Rising operating costs weigh on profitability and limit investment in technology and infrastructure (Fashion for Good 2022). Formalising textile waste collection systems and integrating aggregation centres are therefore important steps towards addressing these constraints.

Image: CEEW

Storage of textile waste at a textile recovery facility (TRF) in Kerala, highlighting limited storage infrastructure.

3.2 Barriers to scaling sustainable pre-consumer textile waste management

To promote circularity and minimise the environmental impacts of waste generation in the textile sector, adopting sustainable practices such as reuse and recycling is vital. Based on the primary data, we identified three distinct solution typologies: mechanical recycling, textile-to-paper, and upcycling by design. The study analyses seven pre-consumer textile waste management enterprises across various textile clusters in India.

These seven entities rely primarily on manual or semi-automated sorting processes. A comparative analysis of these seven enterprises, comprising recyclers, solution providers, and innovators, for the circularity of pre-consumer textile waste is presented in Table 2.

Image: CEEW

Sample of bleached, colour-sorted pre-consumer textile waste prepared for recycling into fibres, observed during a field visit in Haryana

Table 2. Comparative analysis of the solution providers for the circularity of pre-consumer textile waste

Entity	R1	R2	R3	R4	R5	R6	R7
Cluster	Erode, Tamil Nadu	Tiruppur, Tamil Nadu	Erode, Tamil Nadu	Amroha, Uttar Pradesh	Jaipur, Rajasthan	Coimbatore, Tamil Nadu	Panipat, Haryana
Solution typology	Memos and niche products (upcycling by design)	Textile-to-paper	Textile-to-paper	Mechanical recycling to fibre	Mechanical recycling to fibre	Upcycling + re-spinning	Circular apparel manufacturing + recycling
Total monthly volume of pre-consumer textile waste collected/ handled (in tonnes)	1	60	10	500	100	45	800
Feedstock cost (INR/kg)	INR 20	INR 60	INR 83	Not specified	INR 5	INR 8–12	INR 25
Selling price (INR/kg) of the products	INR 250–1,000/piece (composite products, slippers, panels)	INR 180/ kg (paper packaging)	Not disclosed (garment/ paper output)	INR 10–20/kg (fibre for sofas, cushions, quilts)	INR 17/kg (recycled non-woven fibre)	INR 150/kg (pellets, fluff, upcycled goods)	Not disclosed (garments + recycled fibre)
Conversion efficiency	>95%	>95%	70–80%	70–80%	<60%	<60%	>95%
Recycled content in output	26–99% recycled; no virgin synthetic	76–99% recycled	100% recycled	76–99% recycled; 1–10% natural virgin	100% recycled	26–50% recycled	11–25% recycled; 51–75% natural virgin
Total FTEs	4	70	10	10	40	55	250
Percentage of workforce categories	60–80% semi-skilled/manual	10–20% manual; 40-60% technical/ skilled	>80% semi-skilled/manual	60–80% semi-skilled/manual	>80% technical/ skilled	>80% semi-skilled/manual	<10% semi-skilled/ manual; 60-80% technical/ skilled
Machinery origin	Indigenous + custom-built	Indigenous	Custom-built	Indigenous + imported	Imported	Indigenous	Imported
Digitalisation level	Manual / paper-based	Manual / paper-based	Integrated ERP	Platform-enabled marketplace	Basic digital (Excel)	Integrated ERP	Platform-enabled traceability
Enterprise scale (in INR)	Micro (≤2.5 cr)	Small (≤25 cr)	Micro (≤2.5 cr)	Small (≤25 cr)	Micro (≤2.5 cr)	Micro (≤2.5 cr)	Medium (≤125 cr)

Source: Authors' compilation

Note: ERP: enterprise resource planning; FTE: full-time equivalent

The survey of seven recyclers, innovators, and solution providers identified 29 barriers affecting the growth of enterprises engaged in pre-consumer textile waste management (Details provided in Annexure 3). Based on the responses, these barriers were grouped into six broad themes: market, technical, operational, policy and systemic, infrastructure, and finance. While the type and severity of barriers varied across enterprises by business model and stage of growth, many of the challenges were found to be interconnected. Figure 5 provides an overview of these barriers and shows how they collectively influence enterprise growth and the transition towards a circular textile economy. The findings also reveal several patterns that directly shape the surveyed enterprises' financing needs.

- **Value capture runs counter to volume.** The highest-throughput enterprises (Recycler 7: 800 tonnes/month; Recycler 4: 500 tonnes/month) realise the lowest unit values (Recycler 4 at INR 10–20/kg), whereas the lowest-volume enterprise (Recycler 1: 1 tonne/month) commands the highest unit value (INR 250–1,000/piece). This reflects a structural divide between design-led upcycling, which can capture higher margins but is difficult to scale by volume. On the other hand, bulk mechanical recycling, which can achieve scale but operates on thin, commodity-like margins.

- **Conversion losses and feedstock price variation shape commercial viability.** Enterprises pursuing closed-loop processes (Recycler 5 and Recycler 6, both fibre-to-fibre or re-spinning) report the lowest conversion efficiencies (below 60 per cent), while upcycling, textile-to-paper, and apparel manufacturing enterprises exceed 70 per cent. Enterprises undertaking more demanding circular processes therefore face greater material losses, reinforcing the case for targeted technology and viability-gap support. Feedstock costs vary more than fifteen-fold across the sample, from INR 5/kg to INR 83/kg, and, combined with conversion efficiency, substantially influence commercial viability.

- **Recycled content varies widely.** Several enterprises classified as recyclers use a majority share of virgin material in their outputs. For example, Recycler 4 uses 76–99 per cent virgin synthetic material, while Recycler 7 uses 51–75 per cent virgin natural material. Separately, all seven recycling enterprises assessed operate through open-loop pathways, where recovered textile material is used to produce different products or materials rather than returning to the original textile application.

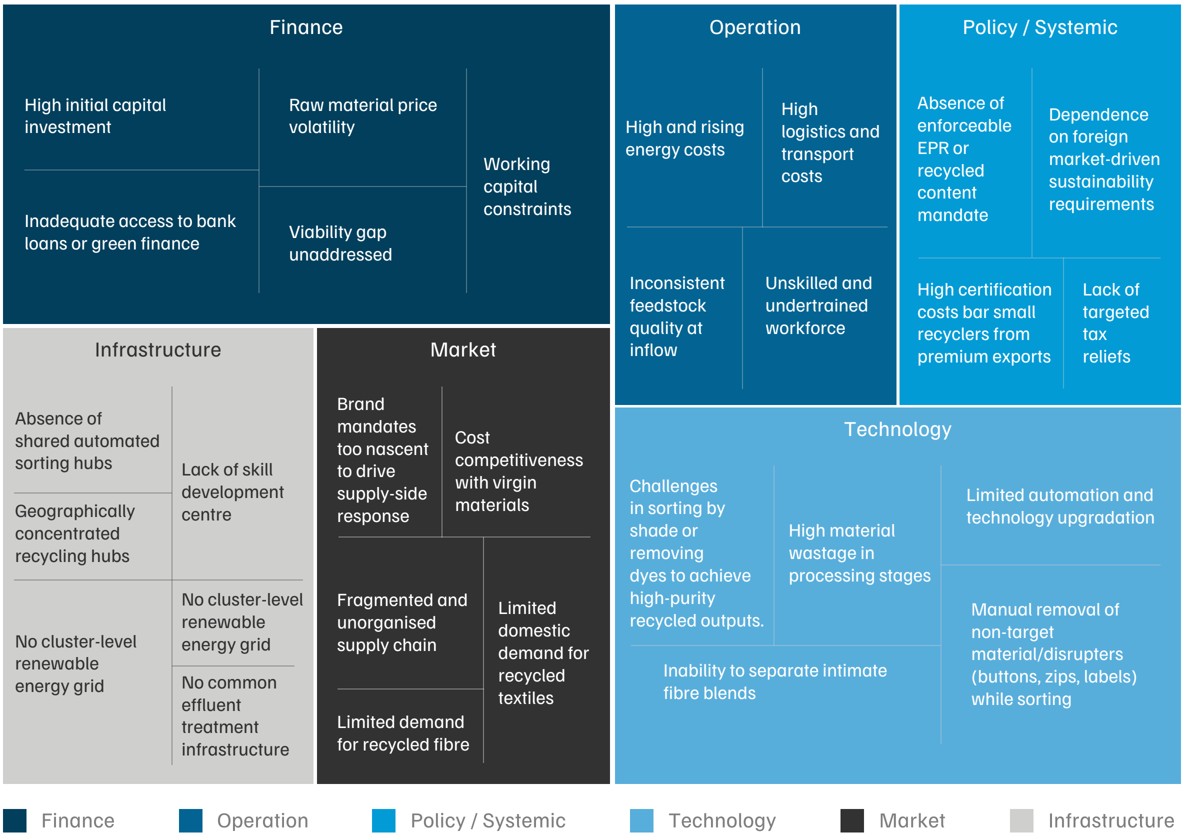
Market barriers

Market barriers arise from the limited development of markets for recycled textiles in India. The study finds that recycled textile products often struggle to compete with virgin materials, while demand for recycled fibres and products remains limited. The supply chain is also fragmented, with inconsistent availability of textile waste and multiple intermediaries increasing procurement costs. Although several global brands have announced recycled-content commitments, these mandates are still in the early stages and have not generated sufficient demand for recycled materials, particularly among small and medium-sized enterprises. Together, these challenges result in uncertain market demand, irregular sales, and limited incentives for enterprises to invest in expanding recycling operations (Malpani et al. 2023; MoT 2026).

Technology barriers

Technology barriers arise from the limitations of current recycling technologies and processing systems in handling the complexity of textile waste. The study finds that blended fibres remain difficult to separate using existing mechanical recycling technologies, while chemical recycling is technically viable but remains at a nascent stage in India (Kansabanik 2026). Enterprises also reported significant material losses during processing, partly because achieving high-purity recycled fibres requires extensive manual sorting by fibre type, colour, and shade. Material that cannot be sufficiently separated or does not meet the required quality specifications may be excluded from the recycling process, contributing to processing losses. The removal of disruptors such as buttons, zippers, and labels further increases processing time and workforce costs. Limited access to automation and technology upgradation also restricts productivity and scalability. Existing research similarly identifies manual sorting and technology gaps as major barriers to improving material recovery and producing high-quality recycled fibres (Malpani et al. 2023; Hari and Mitra 2022).

Figure 5. Major barriers to textile waste management, categorised across different themes



Source: Authors' compilation

Note: EPR: extended producer responsibility

Operational barriers

Operational barriers affect the day-to-day functioning and efficiency of textile recycling enterprises. The study finds that rising energy and transportation costs are major operational expenses, particularly where textile waste sources and recycling facilities are located in different regions. Enterprises also reported inconsistent quality of incoming textile waste, requiring further sorting and pre-processing before recycling. In addition, shortages of skilled workers for sorting and machine operation affect product quality and overall output. Together, these operational challenges increase processing costs, reduce efficiency, and make it difficult for enterprises to scale their operations (Malpani et al. 2023).

Image: CEEW

Manual cutting of pre-consumer textile waste for upcycling into paper products in Erode, Tamil Nadu.

Policy and systemic barriers

Policy and systemic barriers reflect the absence of an enabling regulatory framework for textile circularity. Enterprises reported limited market certainty and weak demand signals for recycled textile products. These challenges are compounded by high certification costs, the growing sustainability, certification, and traceability requirements of international buyers, and the lack of targeted fiscal incentives, making it difficult for recycling enterprises, particularly micro, small and medium enterprises (MSMEs), to compete with virgin materials on equal terms (MoT 2026; Taneja et al. 2025).

Infrastructure barriers

Infrastructure barriers arise from the lack of shared facilities and ecosystem infrastructure needed to support textile recycling at scale. Survey respondents highlighted the absence of centralised facilities such as automated sorting hubs, common testing laboratories, renewable energy infrastructure, centralised effluent treatment plants, and skill development centres. Such facilities are difficult and costly for individual enterprises to establish independently. Respondents also noted that recycling infrastructure remains concentrated in a few established clusters, such as Panipat, Tiruppur, and Amroha, limiting access to specialised facilities for enterprises operating elsewhere. As a result, pre-consumer textile waste often has to be transported over long distances for processing, increasing logistics costs and contributing to regional disparities in the development of India's textile recycling ecosystem (FMC 2026; MoT 2026).

Financial barriers

Financial barriers emerged as a significant and cross-cutting constraint across the surveyed enterprises, affecting their ability to establish, operate, and scale recycling businesses. This assessment is based on the frequency and consistency with which financial constraints were raised during primary consultations, rather than a formal ranking of barriers. Enterprises highlighted several challenges, including high initial capital requirements for technology, differences in feedstock costs, working capital shortages, limited access to affordable bank credit and green finance, and the absence of mechanisms to bridge viability gaps during the early stages of business growth.

While these enterprises often require patient capital to invest in machinery, technology, and infrastructure, many struggle to access appropriate financing. This financing gap limits investments in technology upgradation, automation, infrastructure, and market expansion, constraining enterprises' ability to scale circular solutions despite growing policy and market interest in textile recycling (Hornberger et al. 2018; Intellecap 2022; H and Shinde 2023; SIDBI 2025). As India advances its textile circularity agenda through initiatives such as the *National Technical Textiles Mission* (NTTM), emerging textile waste management policies, and industry platforms such as Bharat Tex, improving access to appropriate finance will be critical to enabling circular enterprises to grow and contribute to the Ministry of Textiles' (MoT) broader goals of resource efficiency and sustainable manufacturing (MoT 2025a; MoT 2025b; MoT 2026).

Overall, the survey findings show that enterprises face a range of market, technical, operational, policy, infrastructure, and financial barriers that collectively affect the growth of textile recycling businesses. Alongside addressing broader ecosystem challenges, improving access to appropriate finance will be critical to enabling enterprises to invest in technology, infrastructure, and business expansion. However, financing needs are not uniform across enterprises. Differences in business models, growth ambitions, and capital requirements mean that a technology-led start-up requires different financial support from an established recycler or a TRF. This highlights the need for differentiated financing pathways rather than a one-size-fits-all approach.

3.3 Segmentation-based financing pathways for pre-consumer textile waste enterprises

The analysis in Sections 3.1 and 3.2 shows that financial barriers are a common challenge across TRFs and textile recycling enterprises. As discussed in Section 1.4, all 12 surveyed entities meet the definition of small and growing businesses (SGBs) and were therefore assessed using the SGB segmentation framework. These enterprises often face difficulties accessing finance despite their potential to drive innovation, employment, and circularity. However, SGBs are not a homogeneous group. The surveyed enterprises differ in their growth ambitions, innovation capabilities, and capital requirements, resulting in distinct financing needs. As previously discussed, financing approaches suitable for one enterprise may therefore not be appropriate for another.

To better understand these differences and identify financing pathways aligned with enterprise characteristics, the surveyed recyclers and TRFs were assessed using the *SGB Segmentation Framework* (Hornberger et al. 2018). The framework classifies enterprises based on three dimensions: (i) growth and scale potential, (ii) product or service innovation profile, and (iii) entrepreneur behaviour profile (Hornberger et al. 2018).

Unlike conventional MSME classifications based primarily on turnover or employment, the framework recognises that enterprises of a similar size may have fundamentally different financing requirements depending on their growth ambitions, innovation orientation, and willingness to pursue external capital. This distinction is particularly relevant to India's pre-consumer textile waste ecosystem, where enterprises range from traditional fibre processors and paper manufacturers to technology-enabled circular economy start-ups and design-led material innovators. Figure 6 positions the surveyed pre-consumer textile waste enterprises within the *SGB Segmentation Framework* using the three assessment dimensions adopted in this study: market growth and scale potential, product or service innovation profile, and entrepreneur behavioural attributes.

In this study, we evaluated each surveyed enterprise across the framework's three dimensions using information collected through the primary survey and field visits. Market growth and scale potential was assessed based on indicators including enterprise size and turnover, buyer markets, recent market expansion, growth ambitions, and the enterprise's ability to respond to increased demand. Product or service innovation profile was assessed based on the introduction of new products, services, business models, technologies, machinery, or processes.

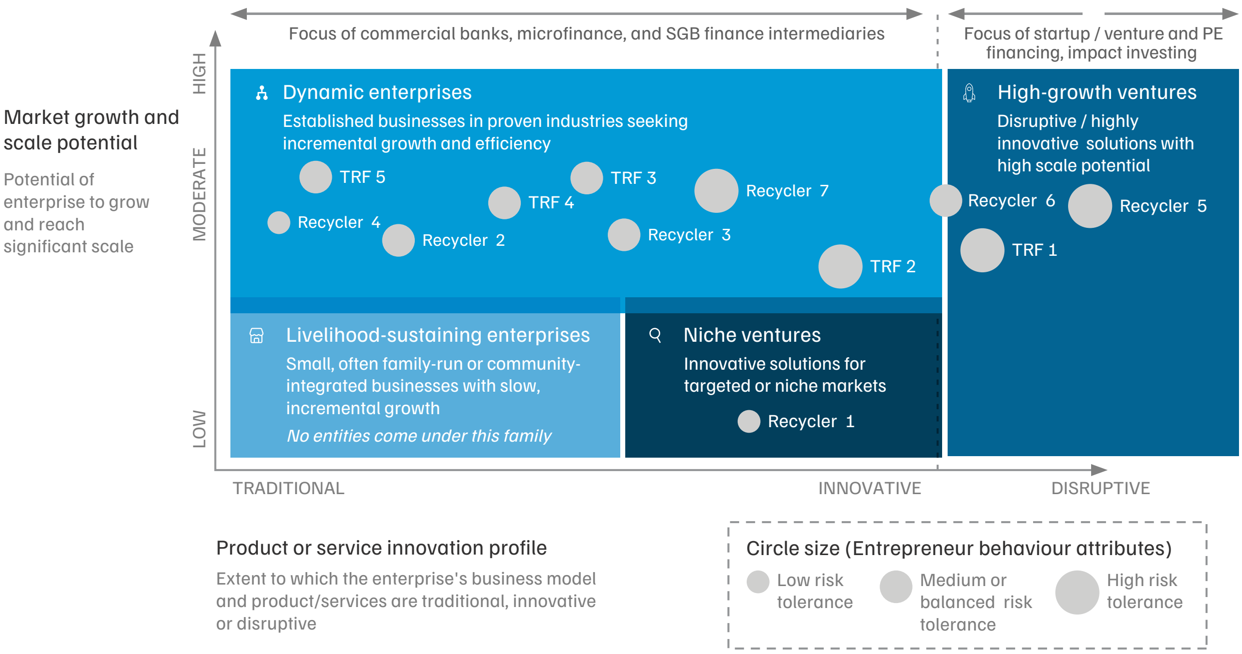
Entrepreneur behavioural attributes were assessed based on the enterprise's approach to business decisions, response to operational challenges, willingness to pursue uncertain opportunities, approach to borrowing and financing, and willingness to develop new capabilities. Rather than treating the four enterprise families as rigid categories, we classified enterprises by the predominant characteristics reflected across these dimensions.

While the framework identifies four enterprise segments, none of the 12 surveyed enterprises was classified as a livelihood-sustaining enterprise. This reflects the composition of the study sample, which focused on formal recycling enterprises, innovators, solution providers, and TRFs identified through stakeholder mapping within India's pre-consumer textile waste ecosystem.

The horizontal axis reflects the degree of innovation in an enterprise's core business model, ranging from traditional mechanical recycling processes to innovative and disruptive circular solutions. The vertical axis represents market and scale potential, capturing an enterprise's ability and ambition to expand into larger markets and achieve commercial scale. Circle size represents the entrepreneur behavioural attributes. This was assessed using survey responses on risk attitude, problem-solving approach, growth and scale ambition, openness to external finance, and willingness to pursue new business opportunities.

Responses across these attributes were reviewed together to determine a predominant entrepreneur behavioural profile, which was then represented through three relative circle sizes: low, medium, and

Figure 6. Positioning of surveyed enterprises using the *SGB Segmentation Framework*



Source: Adapted from Hornberger, Kusi, and Veronica Chau. 2018

Note: PE: private equity; SGB: small and growing business; TRF: textile recovery facility high. As these characteristics do not fall into distinct categories, the boundaries between the four enterprise families should be interpreted as indicative rather than absolute, with some enterprises exhibiting characteristics that overlap across adjacent segments.

The distribution of the 12 assessed entities highlights the diversity of business models within India's pre-consumer textile waste ecosystem. TRF 1, Recycler 5, and Recycler 6 are classified as high-growth ventures, reflecting stronger innovation profiles and higher market growth and scale potential. Recycler 6 is positioned closer to the dynamic enterprise segment, reflecting some overlap in characteristics across the two segments. Recycler 1 is classified as a niche venture, reflecting an innovative business model focused on a specialised market. The remaining entities, including TRF 2, TRF 3, TRF 4, TRF 5, Recycler 2, Recycler 3, Recycler 4, and Recycler 7, fall within the dynamic enterprise segment, reflecting established business models with moderate growth potential and incremental innovation.

Circle size reflects entrepreneur behavioural attributes, including risk tolerance, growth orientation, openness to external finance, and willingness to pursue new business opportunities. TRF 1, TRF 2, Recycler 5, and Recycler 7 have larger circles, indicating stronger growth-oriented behavioural attributes. TRF 3, TRF 4, TRF 5, Recycler 2, Recycler 3, and Recycler 6 have medium-sized circles, reflecting moderate or balanced behavioural attributes. While Recycler 1 and Recycler 4 have smaller circles, indicating lower risk tolerance.

The positioning of entities near the boundaries between adjacent families illustrates that enterprise characteristics may not fit neatly within a single category and can evolve over time. The segmentation in Figure 6 provides a basis for identifying financing pathways that are more closely aligned with enterprise characteristics.

While the framework identifies the types of finance most appropriate for each enterprise family, this study contextualises those recommendations for India by mapping each SGB family to (i) relevant Indian public financing instruments and schemes and (ii) complementary private capital options. Table 3 presents indicative financing pathways, demonstrating how enterprise segmentation can translate into context-specific financing options for India's pre-consumer textile waste ecosystem. Annexure 4 provides a detailed explanation of the relevant Indian government schemes.

Image: CEEW

CEEW researchers at the textile recovery facility in Kerala.

Table 3. Financing pathways for surveyed textile recycling enterprises and textile recovery facilities based on the *SGB Segmentation Framework*

SGB family	Indicative Indian public financing instruments and schemes	Private capital access
High-growth ventures	*UNEP-Intex India Project* (UNEP 2026) SME Growth Fund (INR 10,000 cr) (MoF 2026) State start-up policies (e.g., *Maharashtra Startup and Innovation Policy 2025)* (Government of Maharashtra 2025)	Patient capital/Evergreen funds Revenue share/Redeemable equity instruments Impact investors Blended finance: concessional SIDBI debt + development grant Climate venture capital (VC) funds Family offices
Niche ventures	SFURTI: cluster + artisan support (up to INR 5 cr) (MoMSME 2021) PMEGP: margin money subsidy (mfg. up to INR 25 lakh or USD 26,000) (MoMSME 2026) *Design Clinic Scheme:* design expertise for MSMEs (MoMSME n.d.) CGTMSE: collateral-free credit up to INR 10 cr (CGTMSE 2025) State-level schemes (e.g. Tamil Nadu state schemes such as NEEDS and UYEGP) (Government of Tamil Nadu n.d.)	Angel investor networks (Global Business Angels Network (GBAN) , local) Recoverable grants and pay-for-success notes Crowdfunding platforms (Kickstarter, Milaap) Accelerators/Incubators (ANDE network)
Dynamic enterprises	CGTMSE: collateral-free credit up to INR 10 cr (CGTMSE 2025) *Interest Subvention Scheme* (2% on loans up to INR 1 cr) MSE-CDP: common facility centre for shared capex (MoMSME n.d.) SIDBI risk sharing facility (SIDBI n.d.) PADMA/HEEP (Haryana cluster infrastructure grants) (Government of Haryana 2023) TReDS: invoice discounting for faster working capital (RBI 2020)	Specialised SME debt funds (GroFin, Business Partners Intl.) Mezzanine / revenue-share instruments SIDBI-linked impact funds Trade finance from offtake partners

SGB family	Indicative Indian public financing instruments and schemes	Private capital access
Livelihood-sustaining enterprises	PM MUDRA: Up to INR 20 lakh collateral-free for Tarun plus loan category (MoF 2025) PMEGP 2nd loan: upgradation up to INR 1 cr (MoMSME 2023) PM Vishwakarma: 5% concessional credit up to INR 1 lakh (artisan tailors) (CCEA 2023) CM-YUVA/MLUPY (UP and Rajasthan state interest subsidies) (Government of Uttar Pradesh n.d.)	Microfinance institutions (MFIs) for working capital Digital lending platforms (Liwwa model) Guarantee-backed lending via SIDBI RSF Self-help group finance Cooperative finance NBFC working capital

Source: Authors' analysis

Note: CGTMSE: Credit Guarantee Fund Trust for Micro and Small Enterprises; CM-YUVA: Chief Minister Youth Upliftment and Vocational Advancement; HEEP: Haryana Enterprise and Employment Policy; MLUPY: Mukhyamantri Laghu Udyog Protsahan Yojana; MSE-CDP: Micro and Small Enterprises Cluster Development Programme; MUDRA: Micro Units Development and Refinance Agency; NBFC: non-banking financial company; PADMA: Programme to Accelerate Development for MSME Advancement; PMEGP: Prime Minister's Employment Generation Programme; SFURTI: Scheme of Fund for Regeneration of Traditional Industries; SIDBI: Small Industries Development Bank of India; TReDS: Trade Receivables Discounting System; UYEGP: Unemployed Youth Employment Generation Programme

Note: The schemes and financing instruments presented are indicative rather than exhaustive. Eligibility depends on enterprise characteristics, legal status, stage of growth, location, and prevailing scheme guidelines. The mapping is intended to demonstrate the relative suitability of financing pathways for each SGB family rather than prescribe exclusive financing options.

4. Conclusion and recommendations

India's pre-consumer textile waste ecosystem presents a significant opportunity to advance circular economy objectives, strengthen domestic resource efficiency, and create employment. However, the study finds that enterprises across the value chain continue to face persistent financial, infrastructural, technical, and market barriers that constrain their ability to scale higher-value circular solutions.

Importantly, these challenges are not uniform. Enterprises with different business models, innovation profiles, and growth trajectories require differentiated financing pathways rather than one-size-fits-all support. Aligning enterprise characteristics with appropriate public financing instruments and private capital mechanisms can provide a practical framework for unlocking investment in India's growing textile circularity ecosystem.

As India moves towards greater resource efficiency and circular manufacturing, enabling SGBs through targeted financing and supportive policy measures will be essential to transforming textile waste from an environmental liability into an economic opportunity.

Include textile waste within the regulatory framework under the *Environment (Protection) Act, 1986*, similar to other major waste streams.

Unlike plastic waste, municipal solid waste, construction and demolition (C&D) waste, e-waste, biomedical waste, and hazardous waste, which are governed through dedicated management rules under the *Environment (Protection) Act, 1986*, textile waste currently lacks a comparable regulatory framework. Survey respondents indicated that this policy gap contributes to fragmented collection systems, inconsistent demand for recycled textiles, and limited investment certainty for recycling enterprises.

Bringing textile waste within a dedicated regulatory framework could include provisions for producer responsibility and measures to encourage the use of recycled textile content, while clearly defining roles and responsibilities across the textile value chain. Such an approach could provide greater policy certainty, strengthen collection and recycling systems, and create a more enabling environment for investment and the growth of a circular textile economy in India.

Adopt differentiated financing pathways for textile SGBs.

Enterprises operating within India's pre-consumer textile waste ecosystem are heterogeneous and require different forms of capital depending on their growth potential, innovation profile, entrepreneur behaviour, and stage of development. The *SGB Segmentation Framework* provides a useful approach to understanding these differences and aligning enterprises with financing instruments appropriate to their growth trajectories (Hornberger et al. 2018). Beyond enterprise size, financing needs vary according to where enterprises are in their growth journey, the level of innovation they pursue, their openness to external capital, and the scale of investment required to achieve commercial growth.

The findings suggest that high-growth ventures, dynamic enterprises, and niche ventures face distinct financing requirements and gaps. High-growth ventures often require patient risk capital and longer investment horizons to support technology development, commercialisation, and scale-up. Dynamic enterprises, which represent the majority of surveyed enterprises, require growth-oriented debt, working capital, and credit-enhancement mechanisms, but often face the 'missing middle' challenge: they are considered too risky for conventional lenders yet insufficiently scalable for venture investors (Hornberger et al. 2018). Niche ventures often require smaller-ticket finance, grants, and market-development support to scale specialised products and services. These differences highlight the limitations of one-size-fits-all financing approaches.

Financial institutions, development finance institutions, state governments, and impact investors could therefore adopt differentiated financing pathways that address both enterprise-specific financing needs and the market gaps that constrain access to capital. The financing pathways identified in this study provide one such framework by linking enterprise segments with relevant public schemes, private capital instruments, and financing mechanisms. This approach could improve capital allocation, reduce financing mismatches, and support the growth of diverse circular business models across India's textile waste ecosystem.

Recognise textile waste management as a priority green manufacturing activity.

The survey findings indicate that textile recyclers and TRFs currently access largely the same financial schemes as conventional textile manufacturers, despite generating additional environmental benefits through waste diversion, resource recovery, and reduced dependence on virgin materials. Introducing dedicated financial incentives for recycling enterprises, including preferential credit, capital subsidies, enhanced credit guarantees, concessional finance, and green investment windows, could improve project viability while encouraging greater private investment in circular manufacturing.

Several state governments have already introduced targeted support for recycling infrastructure and machinery, demonstrating the feasibility and scalability potential for differentiated incentives (Government of Maharashtra 2025; Government of Tamil Nadu 2025). At the national level, integrating textile recycling into existing MoT and MSME financing programmes could help accelerate formalisation and encourage greater participation by SGBs in India's circular economy transition.

Strengthen innovation ecosystems and accelerate technology commercialisation.

The survey identifies technological limitations, including those related to fibre separation, blended-textile processing, contamination removal, and automation, as major constraints to scaling higher-value recycling solutions. While India's NTTM has established a foundation for research and innovation, it must place greater emphasis on commercialising technologies accessible to SGBs (MoT 2025a; NTTM 2024).

Future interventions should strengthen collaborative research among industry, start-ups, research institutions, and technology centres to develop feasible solutions for fibre identification, automated sorting, fibre-to-fibre recycling, and digital traceability. High-growth ventures identified through the *SGB Segmentation Framework* could serve as innovation partners in demonstrating emerging technologies, while dynamic enterprises could be supported in adopting commercially proven technologies through technology upgradation and modernisation programmes. Strengthening this innovation ecosystem could improve productivity, reduce processing costs, and enhance the competitiveness of recycled textile products.

Promote circular manufacturing through upstream design and resource-efficient operations.

Unlocking finance should be complemented by efforts to strengthen the operational resilience and competitiveness of enterprises across the textile value chain. Survey responses highlight high utility costs, raw material price volatility, and operational inefficiencies as key barriers affecting profitability. The study also found considerable variation in operational practices, with no standard operating procedures for sorting, handling, and storing textile waste. Storage durations varied significantly depending on buyer demand, highlighting the need for more efficient and predictable supply chains.

Drawing on operational experience from TRFs, standardised process guidelines and operating procedures could help improve efficiency, material quality, and consistency across enterprises. Circularity should also be embedded upstream through product design by encouraging recyclable and mono-material products, reducing material complexity, and designing for recyclability. Enterprises should simultaneously be supported in adopting resource- and energy-efficient manufacturing practices, including energy-efficient machinery, renewable energy integration, water recycling, and waste minimisation.

While these interventions are relevant across all enterprise families, dynamic enterprises and niche ventures are particularly well positioned to improve competitiveness through operational efficiency and sustainable production practices (Singh and Wasdani 2016; MoT 2026). Linking financial incentives to measurable improvements in resource efficiency could strengthen both environmental performance and long-term business viability.

Build stronger markets for recycled textiles through policy and producer responsibility.

Circularity can be unlocked through predictable market demand and supportive regulatory frameworks. Survey respondents consistently highlighted uncertain market demand, fragmented supply chains, and inconsistent feedstock availability as major barriers to growth. As India moves towards introducing an EPR framework for textiles, there is an opportunity to integrate financing mechanisms that support recyclers, TRFs, and circular business models alongside producer compliance obligations. These measures could be complemented by national quality standards for recycled materials, digital traceability systems, and stronger producer–recycler partnerships to improve investor confidence and market transparency (MoT 2025a, MoT 2026).

National platforms such as Bharat Tex 2026 also offer opportunities to strengthen industry collaboration, showcase circular innovations, and facilitate market linkages among brands, recyclers, investors, and technology providers (Bharat Tex 2026). The MoT, the Ministry of Environment, Forest and Climate Change, textile brands, and industry associations should work together to strengthen markets for recycled textiles through producer responsibility mechanisms, quality standards, and demand-side interventions.

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