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Circular Fashion in the Apparel and Textile Industry A Systematic Review of Innovations and Challenges

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ARTICLE INFO	ABSTRACT
Received: April 24, 2026	The situation of the fashion industries linear “take make dispose” model has caused an environmental crisis involving overuse of water, large GHG emissions (4 to 10% of global GHGs), resource depletion, and massive textile waste (92 million tonnes per year). Synthetic fibres account for 35% of ocean microplastic and conventional manufacturing processes uses ecosystem and explores finite resources. Circular fashion offers a revolutionizing alternative that focuses on design to last, resource efficiency and closed loop recycling, and new business models such as resale and rental. The second paradigm is oriented towards environmental protection, decreasing resource consumption, emission and waste, and also opens economic opportunities, with the second-hand market growing to the size of 350 billion dollars by 2050. In line with these pivotal Sustainable Development Goals, circular fashion provides a systematic answer to the growth of the industry and the parliamentary boundaries that need joint action from everyone interested in the sector to send towards a waste-free future.
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Introduction

The fashion industry has long been known for its creativity and ability to express oneself, but recently, it has drawn the attention of many due to its lack of sustainability in environmental matters, resource depletion and climate change. The need for a transition to a circular fashion system, where the focus is on transitioning towards a more sustainable economy with waste reduction and regenerative practices is more urgent than ever before. The aim of this review paper is to look at the challenges of the present fashion system, understand the principles and advantages of circular fashion, and to understand how it fits into the global frameworks of sustainability such as the Paris Agreement and the United Nations Sustainable Development goals (SDGs).

The Environment in Fashion – A Global Perspective

The Fashion industry environmental footprint is enormous and divers in terms of heavy consumption of water, pollution and greenhouse gas emissions, generation of waste etc.

Water Consumption and Pollution

One of the biggest consumers of water in the industry is the farming of cotton and the dyeing of textiles for the making of one cotton t-shirt, about 2700 liters of water (equal to a person's drinking water for an entire year) are consumed (WWF the impact of cotton T-shirts). Furthermore, untreated discharge of textile effluents containing toxic chemicals into water bodies is responsible for 20% of the global industrial wastewater, and the process of textile dyeing and finishing is a major source of these effluents (World Bank, pollution in Fashion, 2019). The near disappearance of Aral Sea is a case in point of the harmful effects of sustainable water used in cotton.

Greenhouse Gas Emission

One of the biggest environmental aspects of the fashion industry is its Green House Gases emission. There is a current consensus of 4-10% of global greenhouse gas (GHG) emissions from this sector. It is a huge number which is more than the total carbon emissions of international air transport and shipping combined (UNEP,2023; Eden MacArthur foundation,2017). This large emission profile is due to several reasons throughout the value chain, especially synthetic fibers production. Polyester, representing about 60% of all textile fibers, are produced from fossil fuel and are manufactured using energy intensive methods, which generate a lot of carbon dioxide (CO₂) emissions. Moreover, the speed of fast fashion business models has significantly expanded production volumes and also reduced the product life cycles leading to a 40% rise in fashion-related emission since 2000-2018. Climate impacts are exacerbated by the industry's globalized value chains that are dependent on coal powered manufacturing and primary production countries. If it remains unwrapped, the forecast is that emission from the fashion industry might reach 26 % of the carbon budget by 2050, therefore significant decarbonization needs to be achieved through circular strategy – an absolute must for climate mitigation.

Resource Depletion and Land use

The constant demand of raw materials in the Fashion industry puts a significant strain on global raw materials and land systems. Every year, about 342 million barrels of petroleum are used to produce synthetic fibers and a large plantation area is used to produce natural fibers (Ellen MacArthur foundation, 2017). Conventional cotton, which accounts for 2.4% of the world's arable land, is a good example of this resource problem: 20,000 liters of water are needed to produce one kilo of cotton, and it is highly dependent on chemical effects (canopies 2023). The growth of viscose is also linked to deforestation, as it is estimated that 150 million trees are felled each year to produce viscose fibre, predominantly from Asian forests and those in danger of extinction (pesticide Action Network UK, 2018). These extractive practices harm the soil quality by using pesticides and monocropping, and have a negative impact on the productivity of agriculture over time. Furthermore, with the increasing demand for land use in the industry, it clashes directly with food production and conservation of ecosystems, especially in developing nations where textiles contribute to the local economy. It is clear that this is an unsustainable use of resources and there is a pressing need for circular solutions that break the link between fashion production and virgin materials and land use.

Waste Generation and Low Recycling Rates

With the linear fashion economy, there was a lot of waste throughout the product life cycle, and the existing economic system is hopelessly ineffective in dealing with the flow of materials. Recent research estimates that about 92 million tonnes of textile waste are added to landfills or incinerated in a year, which is the equivalent of a garbage truck of clothing being thrown away every minute (Ellen MacArthur foundation 2017). This material is recovered only for <1% of the material is used for recycling in new garments, mostly because of technological limitations and poor recovery infrastructure for textiles. Fast Fashion has created an abundance of cheap and disposable fashion, and consumers just keep garments for half the length of time they did 15 years ago. Add to that the common methods of exporting used clothing from developed countries to developing countries where around 40% of the clothes imported are ultimately waste—too much for the local waste management infrastructure (The OR foundation 2021). This waste trade is a major environmental justice problem because the countries where it is received suffer from pollution resulting from the decomposition of textiles and open burning. The waste problem we have today shows the inherent linear production system and why transformative circle approaches need to be taken to keep material in productive use and out of landfills.

Microplastic Pollution

In modern fashion, synthetic fibre has become one of the main reasons of the invisible ecological threat of microplastic pollution: scientific studies have calculated that textile fibres are responsible for 35% of the primary micro plastic pollution that reaches seas (IUCB 2017). Hundreds of thousands of microfibers are shed during every wash from polyester, nylon and acrylic clothing, while just a fraction of them are captured by wastewater treatment plants before they enter aquatic ecosystems. These long-lasting plastic particles became engrained in the marine life that is part of the marine food chain and could affect the health of humans by being eaten in seafood. The problem has now got in an alarming position with the microplastic being found at almost an uninhabited ocean area and even in Arctic ice cores. In addition, 20% of all discarded synthetic clothes in landfills break down into secondary microplastic pollution. On average, it was estimated that 200 000–500 000 tons of microfiber were entering the ocean each year from the textile source alone, so that the ecological impacts of these fibers may last for centuries. This pollution problem highlights the need for some solutions, such as a solution with the least amount of fiber shedding in the design phase, effective filtering solutions and alternatives to fibers that are biodegradable.

Circular fashion: A Sustainable Alternative

Circular fashion is a paradigm shift from the linear fashion business as usual, and a holistic approach to solving the environmental issues of the fashion industry. This method hinges on the design of garments from the beginning to be long-lasting and recyclable, using durable materials, modular designs and mono material constructions that will make it easier to process at the end of the garment's life. In addition to product design, circular fashion encourages radical input efficiency throughout the value chain: focus on renewable energy (source) and non-toxic dyes and finishes (source) and regenerative agriculture practices (natural fibres) (global fashion agenda and Mackinsey 2020). It's also a rethinking of how traditional ownership works through new business models such as clothing rental schemes and market-to-market and repair businesses which prolong the lifespan of things. Most importantly, circular fashion built a closed loop system for material, with its posts being collected and sorted, and then efficiently converted to high-quality recycled fiber using high-end mechanical and chemical recycling technology. This systematic transversion will only allow the unprecedented cooperation between designers, manufacturers, policy makers and consumers to build an industry in which waste is eliminated, resources are continually recycled and natural system are regenerated instead of being depleted.

Alignment with Global Sustainability Goals

Circular fashion has been central to the United Nations Sustainable Development Goals (SDG's) as it has been responsible for many steps toward system change across various targets. Not only does it align to SDG 12 (responsible consumption and production), but it does so in a radical way by drastically cutting down on the generation of waste and sustainable resource management through re-use, repair and recycling. Furthermore, it actively contributes to SDG 13 (Climate Action) in the fight against the significant GHG emissions of the fashion industry, for instance through longer garment life cycles and closed loop material systems estimated at 4-10% of the entire global GHG emission. Another important SDG supported by circular fashion is SDG 6, which involves clean water and sanitation, as the reduction of water usage mainly in cotton production, and the elimination of pollution from textile dyeing and finishing contribute to this. Moreover, it helps alleviate deforestation and pressure on ecosystems due to pesticides heavy agriculture, and it helps reduce microplastic pollution of synthetic textiles, contributing to SDGs 14 (Life Below Water) and 15 (Life on Land). In addition to the SDG's, Circular Fashion contributes to the goal of the Paris Agreement, which is to decouple industry growth from a finite resource, to create a low carbon climate resilient future. The Global fashion agenda and McKinsey 2020 (Global fashion agenda and McKinsey 2020)

Methodology

This study is an extension of a systematic literature review (SLR) to extensively cover innovations, best practices and challenges in the field of circular fashion from 2015 up to 2025. The methodology is organized around the accepted norms of academic review, and comprises of the following elements. A qualitative and exploratory systematic literature review was carried out. The selection of this approach was made to detect patterns, theoretical frameworks, gaps and regional perspectives in the field of circular fashion and sustainable systems of apparel. Grey literature or non-academic sources were not included and only peer-review academic articles were reviewed. To ensure a broad and rigorous search, the following academic were used Web of science, Google scholar and ResearchGate. The databases were selected because they are complete and comprehensive in providing access to high impact journals related to sustainability, textile science, fashion technology and environmental studies. The literature search was limited to publications from Jun 2015 to June 2025. It represents the latest innovations, policy shifts, and industry evolutions over the past decade that have responded to sustainability targets and the adoption of circular economy principles in the fashion industry.

Inclusion Criteria for published papers

Criteria	Inclusion	Exclusion
Publication type	Peer review journal	Conference papers, theses, blogs and non-peer reviewed reports
Language	English	Non-English text
Geographical Scope	International with an emphasis on Asian Studies	Irrelevant paper to circular fashion or sustainable fashion
Focus area	Innovation, best practices, barriers and framework in circular fashion	Papers solely in conventional fashion.

Literature Table 1

Journal	Paper Title	Year	Theme	# Papers from Journal
Journal of Fashion Marketing and Management Sustainability (MDPI)	Circular fashion: A conceptual framework and literature review	2020	Conceptual frameworks for circular fashion	2
Resources, Conservation and Recycling	Circular Economy in the Fashion Industry: A Systematic Literature Review	2021	Circular economy and sustainability	5
Journal of Cleaner Production	Designing for circularity: A systematic review of product design strategies	2019	Design innovations	4
Fashion and Sustainability	Business model innovation for the circular economy: Integrating stakeholder perspectives	2018	Business model innovations	3
International Journal of Consumer Studies	Sustainable business models and value creation for fashion	2022	Value creation through circular business	2
Waste Management	Understanding sustainable clothing consumption: A conceptual framework and review	2020	Consumer behavior	3
Journal of Business Research	Textile recycling in the EU: Challenges and opportunities	2023	Waste management and textile recycling	2
Resources, Conservation and Recycling	Circular economy strategies in retail: A business model perspective	2022	Retail models and circular economy	2
Journal of Industrial Ecology	Assessing the circularity of fashion: Tools and metrics	2021	Assessment tools and life-cycle analysis	4
Sustainable Production and Consumption	Material circularity indicator and its application to fashion products	2017	Measurement and circularity indicators	2
Environmental Science & Policy	Eco-design in fashion: Drivers, barriers, and policy implications	2022	Eco-design and regulatory influence	2
	Policy incentives for circular textiles in Asia: A comparative study	2020	Policy and governance	2

Textile Research Journal	Recycled fiber innovations for fashion and performance	2023	Textile innovation	2
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Innovations in Circular Fashion Design and Production

Three dimension new technologies, novel material and innovative business models are the field of rapid innovation in the last few years for the circular fashion. Both help to prolong the product's life cycle and close material loops.

Technological innovations

Digital and engineering technologies are key enablers. Traceability, inventory control and segregation of reclaimed materials are significantly enhanced by advanced information systems (IoT, Blockchain, AI) that are part of the supply chain[1]. As an example, fashion industry analysts say that a software solution such as Materia MX (developed by Queen of Raw) can “streamline supply chains, reduce waste and optimize resource efficiency”. This software facilitates unsold garment re-sale and re-cycling, thereby mitigating the high re-sale and re-cycling costs and complexity [2]. Likewise, textile phones are testing out the use of “digital product passports”, which are referred to as material content, and generate information during the use of our clothes in practice. The tools enable car manufacturers and recyclers to discover the type of fiber and opportunities for re-use at the end of life, as illustrated in case studies that demonstrate the use of AI, IoT sensors and blockchain to track cars from production to government. For example, Gazzola's research on it all. Highlighting our technological innovations is vital for a more sustainable and circular fashion and some technology can help overcome some of the obstacles of fashion, such as the high cost of investment and the complex fashion reverse logistics process for circularity by optimizing the design manufacturing process.

Material innovations

In addition, designers and material scientists are creating new fabrics and fibres that are appropriate for the circular economy[4]. The main direction of our work is Bio based and recycled fibers. Significant mention is made of the utilization of agro-industrial by-products (banana fibers, pineapple leaves, ETC.) to fabrics, thereby lowering the resilience of virgin cotton or polyester. The use of banana agriculture waste for John, for instance, is emphasized to obtain sustainable materials and to contribute to many UN sustainable development goals[5]. Other research reports lab- and start-up-based projects to create leather or fabric out of bacterial cellulose and create biodegradable fabric out of by-products of the food industry. These new materials are sometimes referred to as bio textiles or bio fabricated Leathers and are designed to have similar properties to synthetic polymer without the pollution. The creation of innovations like kombucha derived cellulose leather is a good example of cross industry circularity utilising waste to create new wearable products," academics note. In addition to biology, mechanical and chemical recycling processes have taken strides forward: Poly cotton blends can be mechanically recycled for reuse in minutes using new machines and enzymes are being designed to depolymerize fabrics. These material innovations help lower virgin fibre consumption and provide feedstock for the closed loop recycling [6].

Business model innovation

Just as crucial are innovative methods of fashion services that break the volume-based sales-fueled revenue link. Circular business models are often mentioned in the literature as one of its main themes. This encompasses also models such as products as service (rental subscription leasing), resale platforms [7]. For instance in the case of a services model of clothing, frame-owning governments can loan to customers, and ensure governments are returned, for reuse. In Asia to some companies are piloting rental clothing programs and resale marketplace are growing[8]. Takeback/remanufacture brands include others that ask consumers to send in used items that are cleaned, mended or remade into new clothes and charge them for their service. The researchers noted that these models can prolong the life of products and can generate value to encourage their use instead of disposal of clothes [9]. Another model that's emerging is that of upcycling old fabrics into new, high value design. Recycling and customer engagement are other key research clusters of top modeling studies as well as circular business models. Examples from the rest of the world are lease program, take back labels, and integrated apps. In your opinion, do you think that these models change to support the innovations of materials and technologies by guaranteeing the economic benefits of circularity?

Best practices across the value chain

In both the international and Asian context, diverse circular fashion practices have been experimented with. The above collage (from SWITCH- Asia) demonstrates a variety of initiatives such as bio textile fabrics (lower right corner), upcycle accessories (center top), clothing take-back bins (top right corner) and eco-designed garments (left). Academic compared the three countries (China, Japan and South Korea) and discovered that all three capitalized on the powerful government support, engagement with industry and ecosystem partnerships to drive circular design forward. In practice, the countries are encouraging the “3R approaches” (renovation(remanufacture), reuse (secondhand and rental), and recycling – through coordinated policies, such as the green participate in national “Circular Economy” roadmaps of Japan (Amended Textile Recycling Law) and China. Cho and Lee say that this alignment has produced some new rules that might be applied in other countries in Asia.

In addition to policy, there are some examples of brands implementing global clothing take-back programmes in Asia as well, such as the ones by Many (H&M) and Inditex (Which collects used garments in stores around the world). Asian Startups are also on to innovation, for example, Queen of RAW platform – started by U.S) is expanding its reach into Asian supply chains, connecting with those that have surplus stocks and those that are in need. In terms of the technology side, Switch-Asia mentions such initiative as Pactics (Thailand) making use of recycled bottles to create performance fabrics. In the meanwhile, textile banks are being introduced in cities like Bengaluru to collect donations for recycling/remanufacturing. While there are several best -practices accounts appearing in gray literature, the reviewed academic sources all highlight collaboration between policymakers' business and recyclers as an enabler. Case analyses are synthesized, for instance, to highlight the importance of supporting regulatory frameworks and financial incentives to scale up circular textile programs. Overall, there are a variety of documented best practices – from eco-design to industrial symbiosis, to innovative collections of materials – and Asian countries are leading the way with policy-led models and pilot projects of 3R strategies.

Obstacles and Hurdles to Circular Fashion

However, the obstacles are solid and widespread when it comes to putting circular fashion in practice at scale. In the four categories the following points stand out.

Supply chain complexity and Infrastructure

Structural complexity and lack of infrastructure in global fashion supply chains are serious weaknesses in the shift to circular fashion. Typically, these supply chains are based on linear production models- focusing on mass production, global distribution and fast consumption. Changing their trajectory to move towards circularity comes with a lot of logistical, technological and financial costs. This topic is highlighted by the work of Gazzola et al. (2022) which suggests that one of the main challenges of implementing circularity is the "complexity of reconfiguring supply chains" and that "high investment costs". Circularity requires completely new reverse logistics routes to collect, sort, clean, disassemble and re-distribute post-consumer textiles-elements which are currently missing.

Empirical research in the Asia context has revealed some other structural issues in a region such as India or Bangladesh. Most used garments are gathered by informal workers and intermediaries, who are typically unregulated and do not have access to environmentally friendly processing technologies, Raman et al. (2025) explain. There are no proper collection centres and investment in the advanced machine for sorting and re-spinning fibre to process the textile waste further, which also limits the capacity of recyclers to process textile waste in an efficient manner. In areas with waste collection systems, waste recycling is difficult because of the presence of blended or synthetic fabrics. They are hard to separate, and need chemical or enzymatic recycling methods that are still under development or prohibitively expensive. Therefore, even picked-up clothes are often not recovered to the level of their original fiber value but rather lower value items or combusted. Furthermore, the weak coordination between the different stakeholders across brands, recyclers, governments and consumers leads to inefficiencies and redundancies. Garments are also not tracked consistently, for example, using digital product passports and/or materials identification systems, which further hampers the garment flows between different phases of end-of-life processing.

Consumers' Behaviour and Cultural Factors

Consumer behaviour is one of the most important yet complicated elements for the success of circular fashion systems. It will take a large shift in values to make a paradigm change from a fast, disposable fashion to conscious sustainable consumption and purchasing. The uptake of consumer adoption is however still limited and a major obstacle for the broader use of circular models. Ramirez-Escamilla et al. (2021) believe that consumer participation in circular activities like repairing clothes, resale rental- is “hampered by insufficient consumer incentives and unclear value propositions.” Many circular fashion offers aren't obviously

advertised or easy to find, or seen as less desirable or prominent than the fast fashion. This restricts their appeal particularly among the younger generation that are influenced by social media and instant gratification.

Gazzola et al. (2022) point out the lack of a sense of awareness among consumers about the environmental impacts of fashion consumption. Lots of individuals are not conscious of the life cycle effects of their clothes, such as the water consumption, carbon emissions and waste produced by traditional fashion. Consumers will otherwise be less likely to look for or appreciate these sustainable options, diminishing the leverage of demand side pressure on brands to move towards circularity. In Asia, with a fast-growing middle class and consumer markets with high aspirations these challenges are most pronounced. The popularity of fast fashion remains because it is a cheap, easily available and in line with global fashion. According to the study by Chen and Ma (2023) on the environmental values of urban Chinese consumers, environmental values are not always the primary concern for them when purchasing products, as they emphasize the importance of price, brand awareness, and novelty. Sustainable and ethical fashion awareness is spreading in the urban capitals such as Seoul, Tokyo, and Mumbai but it is not yet a mainstream consideration for many people.

Perception and cultural norms also are a very important factor; in many Asian cultures, re-using clothes is still considered to be poor or bad luck. Research on garments reuse models from S.E.A. countries has revealed that reusing garments is perceived as unhygienic or symbolically inauspicious, which results in social opposition to these models. Although consumers might be concerned about the environment, cultural prejudices prevent them from adopting circular fashion habits such as rethinking their clothing choices and renting clothes. Furthermore, lack of willingness to pay is also a significant constraint. Some of these fashion items are circular in nature, particularly those created from recycled or bio-based materials, and have premium prices because they are more costly to produce and certify; consumers who are used to cheap fashion products may not think they are worth that high of a price unless they are directly associated with our quality and status. Compelling market stories and emotional brand of circular products are also lacking, reducing their perceived values.

To face these challenges, experts suggested to launch an education campaign, labeling system of transparency and innovative marketing strategies for Sustainability that will fit into lifestyle aspirations. In some markets, behavior nudges like discount coupons for returning used clothing or sustainability gamification are also being piloted to boost engagement, for instance. Even with the most innovative circular process models, they will not grow and have an impact without a more robust consumer demand.

Economic Constraints in Circular Way

One of the most systemic and widespread barriers for the adaptation of circular fashion is the Economic Limitations [10]. Despite the efforts of circular business models to decrease the environmental footprint and to optimize long-term efficiency, they are often accompanied by large initial investments and can be costly, particularly for small and medium enterprises (SMEs) and price sensitive brands. The price difference between conventional and circular production systems is one of the main issues. While a good choice for the environment, recycled and upcycled fibers often end up higher priced than virgin fibers because of audit steps in addition to the collection, sorting, cleaning and processing steps. For instance, mechanical and chemical recycling technologies, especially technologies that can process blended fibers are still under development or commercially underutilized, and thus, lack economies of scale. The consequence of this is that garments made out of recycled input can be 25-27% more costly than the traditional fabric. Moreover, sustainable manufacturing process will require the certification of traceability infrastructure and eco compliance audits, which will increase the operating costs, while brands aiming to apply the circular principles like zero waste pattern cutting, cradle to cradle design and closed loop logistics will have to deal with costs of retaining staff to transform production lines and costs of developing reverse logistics system for post-consumer takeback programmes, which will involve substantial investments and time.

Furthermore, in many countries, government subsidy, tax incentives or financial support is lacking to further inhibit adoption. The European Union (EU) has implemented extended producer responsibility legislation and provides awards for sustainable innovation but most Asian economies have either weak or non-existent laws or awards for extended producer responsibility. This places the full financial cost of transition on brands, and makes circularity an economic not yet very attractive in the short term. This constraint is further compounded by the market dynamics as the higher price points of circular products mean they are niche or premium products, and consumer price sensitivity restricts demand particularly in developing regions. Because many brands rely on low margins, high volume business models, additional costs to consumers may not be viable without a strong pull from consumers or a push from regulators; many businesses continue to focus on profit over sustainability.

However, SMEs have other challenges, such as not having the financial stability and R&D capacity of multinational companies, and therefore they may find it difficult to innovate, or to recover losses if the shift to a circular system is unsuccessful. Small scale Indian apparel export industries attribute cost uncertainty and fluctuation in supply chain for recycled fabrics as one of the main reasons for not using it as a procurement material, as per Patel and Jangra (2023).

Moreover, the return on investment (ROI) from the circular initiatives is also not always immediate or easily measurable, e.g. the benefits of the repair and rental or resale platforms can take years to materialise and consumer behaviour is not consistent. This mismatch between short term business metric and long term sustainability goal is demotivating companies to take conscience decisions, towards circularity.

To overcome these economic constraints, scholars and policy makers call for a combination of measures such as financial support (green financing schemes), regulatory measures (private public partnership) and proposal (raw material offering tax breaks for circular design and innovation grant for small business that experiment with circular supply chain).

Barriers to Innovation

Regulations and policies are fundamental for supporting or hindering the building of circular fashion ecosystem [12]. There has been greater awareness and concern around sustainability and the degradation of the environment, however, policy implementation is inconsistent, disjointed and in many areas feels less firmly in place in the developing world than in the developed world [13]. The EU is a leader around regulatory support for circular fashion, and its Extended Producer Responsibility (EPR) directives assign financial or operational responsibility to the producers to manage post-consumer phase of textile products [14]. In addition, EU Strategy for Sustainable and Circular Textile (2022) requires the implementation of eco design principles and product durability, recyclability and transparency along the textile value chain. Legal enforcement, financial incentives for sustainable innovation have all been put in place to support these policies, and as a consequence EU based brands are increasingly investing in circular design and supply chain transparency and waste recovery systems [15]. Compared, most of the Asian countries are weak in both policy formulation and enforcement of it when it comes to circular fashion; some have formulated national waste management strategies or sustainability target, but few have dedicated legislation for the fashion and textile sector, for instance, Indian's policy landscape only covers textile waste via solid waste management frameworks, while it is lacking in sector-specific standard enforcement capacity and incentives for fashion manufacture to move towards circular practices[16]. Although the garment industries in Bangladesh are well known to the world, there is a lack of government regulation or pressure to recycle and reuse the material. In spite of the international fame of its garment industries, there is little government scrutiny or pressures on textile recycle reuse and sustainable production in Bangladesh [17]. Furthermore, policy disintegration in government agencies leads to confusion and makes it hard to implement policies. Circularity is commonly distributed amongst various departments, e.g., environment, industry and trade, and Urban Development, with lack of coordination and overlapping responsibilities. This institutional disintegration will hinder the process of policy making and the effectiveness of national circular economy agendas.

One of the other big regulatory gaps is the lack of compulsory sustainability reporting and transparency requirement for fashion brands in many developing countries [16]. This makes sustainability reporting and acting on a measurable circular target hard for a brand to do, as there is little accountability, and can lead to so called greenwashing [18][6] where companies use a green narrative without real change. Besides, import export regulation in many countries of Asia is not conducive to the circular trade in textiles [10] for example by restricting import of used clothes, the domestic industry is also restricted in the amount of excess reusable textile inputs. Likewise tariff structure would not differentiate between virgin and recycled material which would not incentivize incentive wise sustainability sourcing. In some countries, however, despite the presence of an initiative, there has been less progress in the direction of systematic solutions tailored to fashion and apparel sector, such as China with its Circular Economy Promotion Law (revised in 2018) [5] or Japan with its Resource Circular Fashion Strategy (RCFFS), which focuses more on industrial waste and energy efficiency.

To solve these regulatory and policy gaps scholars and policy advocate suggest:

- National strategies that are comprehensive and aligned with the textile industry development and the climate goal. Comprehensive national strategies with regards to the goal of the climate, and the development of the textile industry.
- Established clear and enforceable eco design regulations specific to fashion industry.
- Access to innovation programs funded by the government to support SME's in transition to circular model [19]

- Developing standardized labelling, digital product passport and material tracking system
- Public Private Partnership (P3) for the development of logistic facilities in the reserve.

Thematic Trends in Literature (2015-2025)

Over the years from 2015 to 2025, a clear shift from conceptual ideas to practical application and systematic change can be observed. these thematic can be summarized into 3 phases.



Early Exploratory Phase (2015-2018)

At this time, academic research interest in circular fashion was still in its infancy and the literature was mainly based on conceptual frameworks, definitions and value propositions. Theorists like Fletcher (2016) and Niinimäki (2017) established key concepts leading to an understanding of the circular fashion as an extension of the concepts of 'circular economy' and 'sustainable design'.

Key themes included:

- Ontology and range of circular fashion
- Linear vs. Circular Textiles system comparison.
- Exploration of Environmental benefit [11]
- Seeks a change of paradigm in consumption and production

The majority of the most studied during this period were theoretical or review only, and few studies were empirical. Awareness raising and identification of potential benefits and the formulation of limited research agendas was the main objective of research, with little focus on western eccentric and Asian specific contributions.

Applied innovation phase 2019 to 2021

With the rise in interest in circularity, literature from this stage started exploring how to implement it through practical interventions and emerging technologies and how businesses could adapt to it. It was a time of the beginning of empirical studies, pilot projects and industry partnerships. Studies have been done on the use of circular principle in various stages of fashion value chain[20]. Dominant themes included:

- Mechanical and chemical method [21] are the two main techniques of textile recycling.
- Circular business models (rental, resale, repair and take back schemes) [22]
- Design of echo and modular clothing system[23]

- Material Innovation [6]

An initial life cycle assessment application to assess the environmental impact was developed. An initial life cycle assessment application to assess the environmental impact was developed.

Literature also starts to discuss the problems of adoption like the high cost of infrastructure deficit and no awareness of computer consumers. Researchers have been emphasizing policy support for industry engagement cross sector collaboration [24] more and more. Prominent is the fact that academic discourse on the phenomenon started to show up more often in studies emerging from Asia, taking a closer look at the local impact of fast fashion and the informal recycling sector, specifically China, India and Southeast Asia.

Systematic and contextual integration phase 2022-2025

The literature since 2021 clearly shows a transition towards system level thinking and integration to address the urgency of policy interventions and changes in supply chain to respond to climate action. This thematic focus has now grown to include the entire system redesign multi stakeholder ordinance and digital traceability tools.

The most notable research strengths were in the fields of:

- The collaborative effort of the stakeholders between Government brand and Jews and consumers
- In the field of circularity, lifecycle assessment and material flow analysis were used to quality circularity[16]
- Backward part of the circular supply chain management (SCM) system (BLM) and product password system.
- The study of behavioral economics in the context of circle consumption. Behavioral Economics in circle consumption.
- Digital solutions: blockchain, transparency in the supply chain; AI, waste sorting[25]

In this stage, Asian scholars and institutions have become more visible and proactive in this and context specific studies have been produced by scholars and institutions from countries such as India, China, Japan, South Korea etc.

- Formal voice collection and integration to informal recycling
- A lack of policy and regulatory solutions
- Cultural obstacles to second use/reuse of materials.
- Regional innovations (e.g. biodegradable textiles; cooperative circular networks)

Table 3: Thematic Evolution Summary

Period	Focus
2015–2018	Conceptual frameworks, theoretical exploration, environmental potential
2019–2021	Technologies, materials, business models, early empirical studies
2022–2025	Systemic transformation, LCA, stakeholder collaboration, regional focus (esp. Asia)

Future Directions and Recommendations

Moving forward, we need future research on circle fashion that takes a multi-dimensional approach to address the ongoing policy, consumer, economics and regional implementation gaps. It is important to perform comparative analysis of effectiveness of the policy across various regions to find out best practices and understand the impact of regulatory frameworks such as EU's Extended Producer Responsibility (EPR) lost in comparison to the less structured regulatory system in Asia. Furthermore, consumer behavior modelling needs to be studied, including psychological culture and socioeconomic factors impacting consumer adoption, and testing interventions such as behavioral nudges, digital engagement mechanisms and targeted awareness-raising campaigns. There is also economic feasibility of the project which requires detailed cost benefit analysis, return on investment (ROI) and the creation of financial models that take advantage of incentives like tax breaks, green financing and carbon credit. To create all-encompassing solutions and to establish standardized evaluation frameworks, interdisciplinary studies that combine design innovation and economic modelling and environmental science are needed. Additionally, empirical case studies are required for less researched areas, namely underrepresented areas in Asia where most of the textile production takes place, to gain insight into specific problems

like informal waste collection system, policy deficits and cultural attitudes towards second-hand clothes. These local lessons can feed into a more comprehensive strategy and policy development that can be scaled up and adapted to the economic and cultural context of a region. The future research should be a combination of global and regional research with collaborative cross sector approaches to ensure that circular fashion moves from niche initiative to a mainstream fashion globally.

Conclusion

Over the last decade, circular fashion has gone from a vision to a reality, with a series of new technologies for recycling, new materials based on renewable raw materials and the emergence of new business models such as rentals, resales or repairs. Scholarly research findings and industry reports have highlighted the following best practices at global and regional levels, such as the increasing impact of Asia in sustainable textile innovation. The big scale adoption is still hindered by entrenched structural issues like disintegrated value chain, lack of reverse logistics, and poor technology infrastructure, and cultural and behavioral factors like consumer resistance to second-hand clothes and willingness to pay for sustainable options. To achieve systematic transformation definition industrial choice, an integrated approach combining continuous academic research with actionable insight and a comprehensive policy framework that incentivize circular practices and penalized linear always intensive model, combined with strong multi-stakeholder collaboration among friends, comment and consumers. It is through these coordinated actions that the industry can move from sustainability projects to a truly circular industry, meeting global climate global goals and contributing long-term to the efficiency of resources. Yeah

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