

Fast Fashion and Environmental Sustainability: Challenges, Impacts and Pathways Toward Circular Economy Transition

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ABSTRACT

The textile and apparel industry has grown rapidly at a global level, transforming the way clothing is produced, distributed and consumed over the last few decades. Fashion products are now more readily available globally because of the rise of the fast fashion industry approach, which is defined by shortened production cycles, inexpensive clothing and quick trend change. But this expansion has also led to worsen the environmental problems related to waste production, pollution and resource consumption. The fast fashion business contributes to greenhouse gas emissions, water contamination and rising textile waste amounts by requiring large quantities of water, energy and raw materials for fibre production, textile processing and garment manufacturing. The present article reviewed the development of the fast fashion business approach and its effects on the environment within the global textile industry and it explored potential approaches for enhancing sustainability through technological developments, sustainable fibre materials, circular economy strategies and ethical supply chain management.

Keywords: Fast Fashion, Environmental Sustainability, Circular Economy, Textile Waste, Carbon Emissions

INTRODUCTION

The global textile and apparel industry has grown rapidly in recent years and is now considered as one of the most important sectors within the global manufacturing industry. This industry plays an important role in creation of jobs, global trade and economic growth in both developed and developing nations. Along with this quick growth, problems of the environmental and social consequences of fashion manufacturing have increased (Barnes and Lea-Greenwood, 2006). The development of the fast fashion sector approach has radically changed how garments is created, manufactured and utilized globally. Fast fashion is a retail approach that rapidly transforms new fashion styles into cost-effective clothing. Shortened design cycles, adaptable manufacturing techniques and effective supply chains are the foundation of this system, which enables new styles to quickly reach retail locations. Because of this, fashion brands are able

to quickly adapt to shifting consumer tastes and frequently release new apparel designs any time of the year (Cachon and Swinney, 2011). By utilizing modern sourcing systems, global production networks and digital marketing techniques to reach customers internationally, established international brands like Zara, H&M and Shein have made major contributions to the success of this approach (Tokatli, 2008).

The production and consumption of garments have dramatically increased due to the popularity of fast fashion. As the standard lifespan of clothing has severely fallen, global garment production has nearly doubled from the early 21st century (Ellen MacArthur Foundation, 2017). Rising earnings, urbanization and the expanding power of social media and online shopping platforms are some of the factors that have contributed to this trend. These advancements encourage consumers to buy clothes on a regular basis, frequently viewing them as temporary rather than durable products (Bick *et al.*, 2018).

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The fast fashion industry faced a lot of controversy for its negative effects on the environment, even though its economic benefits and popularity. Large volumes of water, energy and raw materials are needed for fibre production, textile processing or clothing manufacturing is the very costly process of textile production. Huge quantities of chemicals are also released into water systems during the dyeing and finishing procedures. Studies showed, the fashion sector is responsible for about 20% of industrial wastewater worldwide and 8–10% of greenhouse gas emissions (Niinimäki *et al.*, 2020). Synthetic fibres like polyester are made from fossil fuels and contribute to microplastic contamination in aquatic habitats, natural fibres like cotton require large freshwater and pesticide treatments.

Another major environmental issue due to fast fashion is the increasing amount of textile waste generated yearly. Because fast fashion garments are often inexpensive and trend driven, they are commonly discarded after only a short period of use. Many of these garments are produced from blended fibres that are difficult to recycle, which complicates waste management efforts. Hence, large volumes of clothing end up in landfills or are incinerated, leading to environmental pollution and inefficient use of valuable resources. This basic production strategy defined as “take make dispose,” differs sharply with the principles of sustainable development and circular economy approaches that emphasize reuse, recycling and resource efficiency (Bocken *et al.*, 2016).

The fast fashion industry is also connected with social and ethical issues. Global fashion supply chains depend on low cost labour in developing countries, where workers may face low wages, poor working conditions and limited labour protections (Joy *et al.*, 2012). These challenges showed the complex relationship between environmental sustainability and social responsibility within the global textile industry.

The growing concerns of these sustainability issues has inspired scholars, administrators and business stakeholders to evaluate new strategies for improving environmental performance in the fashion industry. To encourage more sustainable production and consumption, initiatives like sustainability monitoring guidelines, enhanced producer responsibility programs and circular textile techniques have been adopted. Also, a lot of fashion brands have started experimenting with more open supply chains, recycling initiatives and sustainable materials. This

analysis seeks to contribute to a better understanding of sustainability challenges within the fashion sector and to provide insights for researchers, policymakers and industry stakeholders working for dropping the environmental footprint of global textile production (Fig. 1).

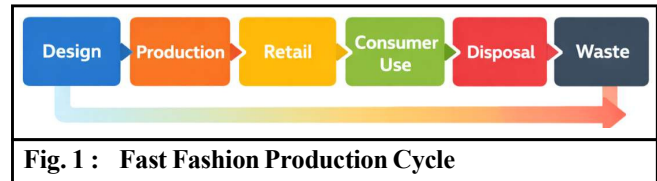


Fig. 1 : Fast Fashion Production Cycle

Evolution of the Fast Fashion Business Model

The fast fashion business model has transformed the global apparel industry by replacing traditional seasonal production with faster and more flexible manufacturing systems. Earlier, fashion collections were introduced only a few times each year. The rise of fast fashion shifted the industry towards shorter product development cycles and rapid responses to consumer demand. This transformation has been influenced by globalization, technological advancement and increasing consumer demand for affordable and trend based clothing (Barnes and Greenwood, 2006). As a result, fashion companies now rely on responsive supply chains that enable quicker conversion of fashion trends into marketable products.

Quick Response Manufacturing:

Quick response manufacturing is an essential feature of fast fashion. Retailers use real time sales data, consumer feedback and market analysis to guide production decisions. Garments are often produced in smaller groups and restocked frequently according to demand. This method improves supply chain efficiency and reduces excess inventory. Studies showed that quick response systems can reduce the design-to-retail cycle from several months to only a few weeks, permitting companies to introduce new styles more rapidly (Cachon and Swinney, 2011).

Globalized Production Networks:

Globalization has also designed the fast fashion model. Many brands outsource manufacturing to countries with lower labour costs and established textile industries. This global sourcing strategy reduces production costs while maintaining large output levels. Enhanced transportation and logistics systems support efficient

supply in international markets, making global production networks an important role of fast fashion processes (Tokatli, 2008).

Digitalization and Data-Driven Fashion:

Technological developments have more faster fast fashion production. Tools such as data analytics, artificial intelligence and demand predicting help companies monitor consumer behaviour and identify evolving trends. In addition, e-commerce platforms allow retailers to reach global consumers and collect valuable market data. These digital technologies enable faster design decisions and more responsive supply chains (Mukendi *et al.*, 2020).

Sustainability Challenges in the Fast Fashion Model:

Rapid production and short garment lives increase resource consumption and textile waste. Textile manufacturing requires lots of water, energy and raw materials in dyeing and finishing processes which contributes to pollution. The study indicates that the fashion industry is a major contributor to greenhouse gas emissions and environmental degradation (Niinimäki *et al.*, 2020). Industry stakeholders are increasingly exploring sustainable methods such as circular economy models, recycling and eco-friendly materials to reduce the environmental impact of fashion production (Bocken *et al.*, 2016).

The evolution of the fast fashion business model shows the combined influence of globalization, technology and changing consumer demand. This model has improved production efficiency and accessibility; it has also created environmental challenges that require more sustainable solutions. It examines the environmental impacts associated with fast fashion production and consumption. To better understand the structural transformation of the fast fashion industry, the major drivers that have contributed to the evolution of the fast fashion business model and their impacts on the apparel sector are summarized in Table 1.

The drivers summarized in Table 1 highlight the structural factors that have accelerated the development

of fast fashion and influenced production and consumption patterns within the global apparel industry. The fast fashion system operates through interconnected production and consumption mechanisms that accelerate clothing turnover and increase resource demand. Understanding these dynamics is essential for analysing the environmental pressures created by modern fashion systems.

Production and Consumption Dynamics

The fast fashion industry operates through an interconnected system of rapid production and high consumer demand. Advances in manufacturing technologies, global sourcing and digital marketing have enabled fashion companies to increase production speed while continuously introducing new styles. This production consumption cycle has encouraged frequent purchasing behaviour and accelerated clothing turnover in global apparel markets (Fig. 2).

Overproduction of Garments

A defining characteristic of the fast fashion model is large-scale garment production designed to keep retail stores constantly stocked with new products. Fashion brands often manufacture clothing in high volumes to quickly respond to emerging trends and maintain competitive positioning. This approach frequently results in excess inventory when consumer demand does not match production levels. Unsold garments may be discarded, recycled at low rates, or sent to landfills, leading to inefficient use of resources and increased environmental pressure (Niinimäki and Hassi, 2011).

Increased Consumer Demand

Consumer demand for clothing has grown significantly due to the availability of affordable fashion products and the influence of digital media platforms. Online marketing, influencer culture and social networking sites continuously promote new fashion trends, encouraging consumers to purchase clothing more frequently. As garments become less expensive and easily

Table 1 : Key drivers influencing the evolution of the fast fashion business model and their impact on the apparel industry

Driver	Description	Impact on Industry
Quick response manufacturing	Rapid design-to-retail cycles	Faster market response
Global sourcing	Production across multiple countries	Lower production costs
Digital technologies	Data analytics and AI forecasting	Improved demand prediction
Consumer demand	Frequent trend changes	Increased consumption

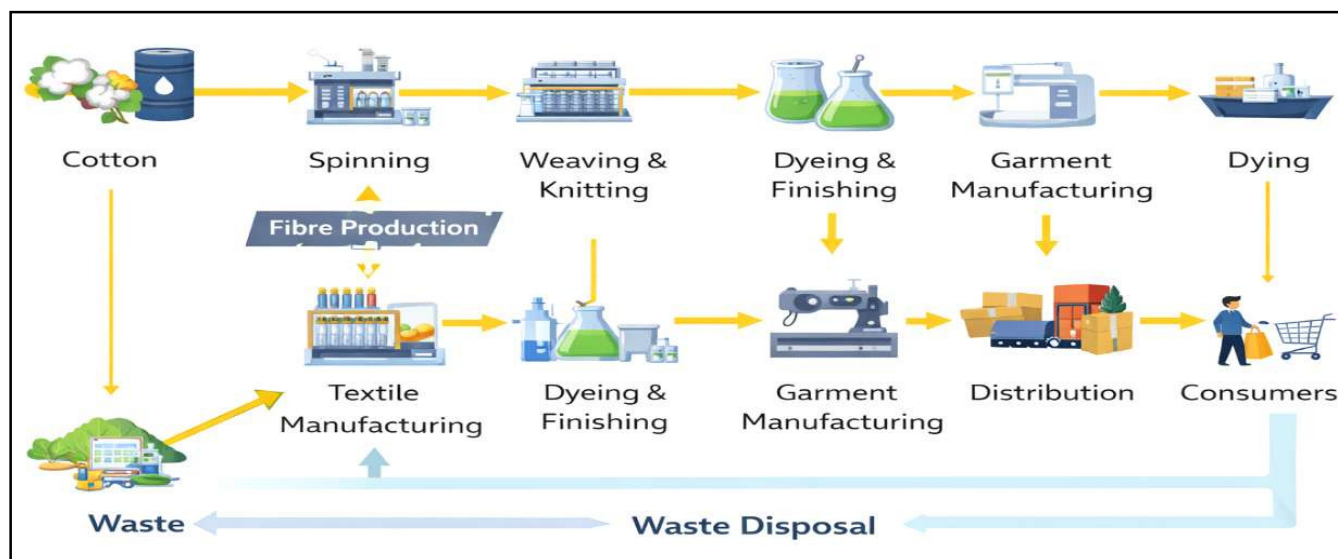


Fig. 2 : Production Dynamics of the Textile and Apparel Supply Chain

accessible, many consumers treat clothing as short-term items rather than long-term products (Joy *et al.*, 2012).

Rapid Trend Turnover

Fast fashion retailers regularly introduce new designs within short time intervals to maintain consumer interest. This rapid turnover of styles encourages shoppers to update their wardrobes more frequently in order to remain aligned with current fashion trends. As a result, the traditional seasonal fashion cycle has been replaced by continuous product introductions throughout the year (Fletcher, 2014).

Low Garment Utilization

Clothing production has increased worldwide; the average lifespan of garments has declined considerably. Many fast fashion items are worn only a limited number of times before being discarded or replaced by newer styles. Reduced garment utilization increases textile waste generation and places additional pressure on resources used during textile production (Sandin and Peters, 2018).

The interaction between large-scale production and increasing consumption has intensified environmental pressures within the fashion industry. Understanding these production and consumption patterns is essential for developing strategies that encourage more sustainable consumption behaviour and responsible resource use.

Environmental Impacts of Fast Fashion

The rapid expansion of the fast fashion industry has

generated significant environmental concerns due to intensive resource use, pollution and large volumes of waste. The production of garments involves several stages including fibre production, textile processing, dyeing and distribution which collectively require substantial amounts of energy, water, and chemicals. These processes contribute to climate change, environmental degradation and ecosystem damage. The study analyzed that the fashion sector is responsible for a notable share of global greenhouse gas emissions and environmental pollution (Fig. 3).



Fig. 3 : Environmental Impacts of Fast Fashion (Bick *et al.*, 2018)

Carbon Emissions

The textile and apparel industry contributes knowingly to global greenhouse gas emissions due to energy intensive manufacturing and long international

supply chains. Fibre production, textile processing and transportation require fossil fuels and electricity, which increase carbon emissions. Estimates indicate that the fashion industry contributes approximately 2–8% of global greenhouse gas emissions, largely due to rising clothing consumption and rapid production cycles.

Water Consumption

Textile production is highly water intensive, particularly during cotton cultivation and wet processing stages such as dyeing and finishing. Large quantities of freshwater are required to produce fabrics and garments. For example, producing a single cotton garment can require hundreds of gallons of water. The growing demand for fast fashion therefore places additional pressure on freshwater resources and contributes to water scarcity in textile-producing regions.

Water Pollution

Chemical dyes, finishing agents and textile treatment processes can lead to significant water contamination when wastewater is not properly treated. Dyeing operations release toxic substances, heavy metals and synthetic chemicals into rivers and aquatic systems. It is estimated that textile dyeing processes contribute to around 20% of global industrial water pollution, posing risks to ecosystems and human health.

Textile Waste Generation

The short life cycle of fast fashion garments contributes to growing volumes of textile waste worldwide. Rapid trend turnover encourages consumers

to discard clothing after limited use. Universally, more than 92 million tonnes of textile waste are generated each year, much of which ends up in landfills or incineration facilities. The increasing disposal of clothing represents a major environmental challenge because many garments are made from synthetic fibres that are difficult to recycle.

The environmental impacts associated with fast fashion highlight the urgent need for more sustainable production and consumption systems. Researchers increasingly emphasize the adoption of circular economy strategies, improved recycling technologies and responsible consumer behaviour to reduce the ecological footprint of the fashion industry (Table 2).

Sustainable Alternatives in the Fast Fashion Industry

Growing environmental concerns associated with fast fashion have encouraged the development of more sustainable approaches in the textile and apparel sector. Sustainable fashion focuses on minimizing environmental impacts by improving resource efficiency, promoting responsible production practices and encouraging longer product life cycles. Many methods have been proposed to reduce the environmental footprint of the fashion industry, including circular economy practices, sustainable fibre materials, technological innovations and improved supply chain management.

Circular Economy Approaches

The circular economy concept aims to reduce waste and resource consumption by promoting reuse, recycling and regeneration of materials. In the fashion industry,

Table 2 : Environmental Impacts Across Textile Production Stages

Production Stage	Environmental Impact	Description	Reference
Fibre Production	Water consumption and agrochemical inputs	Cultivation of natural fibres such as cotton requires large volumes of freshwater and agricultural chemicals, which can lead to water scarcity and soil degradation.	(Chapagain <i>et al.</i> , 2006; Shen <i>et al.</i> , 2010)
Textile Processing	Chemical pollution and wastewater generation	Dyeing, bleaching and finishing processes discharge dyes, salts and toxic chemicals into wastewater streams, contributing to water pollution.	(Kant, 2012; Holkar <i>et al.</i> , 2016)
Garment Manufacturing	Energy consumption and emissions	Cutting, sewing and finishing operations rely on electricity and industrial machinery, leading to energy use and greenhouse gas emissions.	(Muthu, 2014)
Transportation and Distribution	Carbon emissions from global logistics	Global sourcing and long distance transportation of garments increases fossil fuel consumption and carbon emissions.	(Christopher <i>et al.</i> , 2004; Turker and Altuntas, 2014)
Product Disposal	Textile waste accumulation	Short garment life cycles result in increasing volumes of textile waste that are commonly disposed of through landfill or incineration.	(Muthu <i>et al.</i> , 2012; Gwilt, 2014)



Fig. 4 : Circular economy framework for sustainable textile production

circular practices include clothing resale, repair services, textile recycling and garment take back programs. These approaches extend the lifespan of garments and reduce dependence on virgin raw materials. Research suggests that circular fashion systems can meaningfully decrease textile waste and environmental pressure by keeping materials in use for longer periods (Geissdoerfer *et al.*, 2017) (Fig. 4).

Sustainable Fibre Materials

The use of environmentally friendly fibres is another important strategy for improving sustainability in the textile sector. Sustainable fibres such as organic cotton, hemp, bamboo and regenerated cellulose fibres require fewer chemicals and lower resource inputs compared to conventional materials. Also, recycled fibres including recycled polyester and regenerated textile fibres, help reduce waste and energy consumption during production. The adoption of sustainable materials can therefore contribute to lowering the environmental footprint of fashion manufacturing (Shen *et al.*, 2010) (Table 3).

Table 3 : Sustainable Fibre Materials	
Fibre Type	Sustainability Advantage
Organic cotton	Reduced pesticide use
Hemp	Low water requirement
Bamboo	Rapidly renewable resource
Recycled polyester	Reduces plastic waste

Technological Innovations

Technological advancements are increasingly supporting sustainable performs in the fashion industry. Innovations such as waterless dyeing technologies, digital textile printing and automated manufacturing systems help reduce water consumption, chemical use and material waste during production. Digital design tools and virtual sampling technologies also allow designers to develop garments without producing multiple physical prototypes, thereby reducing resource consumption and production waste (Nayak and Padhye, 2015).

Sustainable Supply Chain Management

Sustainability in fashion production also requires improved transparency and responsibility across global supply chains. Sustainable supply chain management focuses on the sourcing of raw materials, ethical labour practices and environmentally responsible manufacturing processes. Many companies are now approving sustainability certifications, environmental reporting frameworks and traceability systems to monitor environmental impacts throughout the production process. These practices help promote accountability and encourage more responsible production within the fashion industry (Kozlowski *et al.*, 2015).

Sustainable substitutes offer important pathways for reducing the environmental impacts of fast fashion. The integration of circular economy principles, eco-friendly materials, technological innovations and responsible supply chain management can help transition the fashion industry toward more sustainable and environmentally responsible production systems.

Policy Frameworks and Regulations

Several policy initiatives and regulatory frameworks have been introduced to promote sustainable practices and circular economy principles within the global fashion and textile industry (Table 4).

Consumer Behaviour and Greenwashing

Consumer behaviour plays an important role in the expansion of the fast fashion industry. The availability of low cost clothing, frequent trend changes and strong marketing strategies encourage consumers to purchase garments more frequently than in the past. Social media platforms, influencer culture and online retail channels have further accelerated fashion consumption by constantly promoting new styles and seasonal collections. Many consumers tend to treat clothing as short term products rather than durable goods, which contributes to increased textile waste and resource consumption (McNeill and Moore, 2015).

Table 4 : Major Policy Frameworks Supporting Sustainable Textile Production

Policy Initiative	Key Focus	Reference
EU Strategy for Sustainable and Circular Textiles	Promotes circular economy principles, eco-design of garments, improved recycling systems and reduction of textile waste.	(European Commission, 2022)
Sustainable Apparel Coalition Initiatives	Encourages environmental performance measurement and sustainable supply chain management in the apparel sector.	(Niinimäki <i>et al.</i> , 2020)
Circular Economy Policies for Textiles	Supports resource efficiency, waste reduction and recycling within textile production systems.	(Liu <i>et al.</i> , 2019)
Extended Producer Responsibility (EPR)	Requires manufacturers to manage collection, recycling and disposal of textile products after consumer use.	(OECD, 2021)

Rising environmental awareness has influenced consumer attitudes toward sustainable fashion at this time. Many consumers now prefer brands that claim to follow environmentally responsible practices. The growing demand for sustainable products has also led to the problem of greenwashing, where companies promote misleading or exaggerated environmental claims in their marketing strategies. Some fashion brands advertise “eco-friendly” or “sustainable” collections whereas continuing large scale fast fashion production, creating confusion among consumers about the actual environmental performance of these products (Delmas and Burbano, 2011).

Greenwashing practices may include vague sustainability claims, limited transparency in supply chains or selective disclosure of environmental information. These practices can weaken consumer trust and hinder genuine sustainability efforts within the fashion industry. Therefore, improving transparency, strengthening environmental regulations and promoting consumer awareness are essential steps to report greenwashing and support more responsible consumption patterns.

Understanding consumer behaviour and the influence of marketing practices is important for promoting sustainable fashion choices. Encouraging consumers to purchase fewer but higher quality garments, support ethical brands and participate in recycling or reuse initiatives can contribute to reducing the environmental impacts of fast fashion.

Conclusion

The fast fashion industry has transformed the global textile and apparel sector by enabling rapid production, flexible supply chains and affordable clothing for consumers. Even though this model has increased accessibility and economic growth, it has also created serious environmental challenges. Rising carbon emissions, excessive water consumption, chemical

pollution and increasing volumes of textile waste demonstrate the environmental cost of fast fashion production and consumption. The short life cycle of garments and the growing demand for inexpensive clothing have intensified pressure on natural resources and global ecosystems.

This assessment highlights the urgent need to transition toward more sustainable production and consumption practices within the fashion industry. Circular economy approaches such as recycling, reuse, repair and extended garment life cycles offer effective strategies for reducing textile waste and improving resource efficiency. The development of sustainable fibre materials, including organic and recycled textiles, can pointedly lower the environmental footprint of clothing production. Technological innovations in textile processing and recycling also present opportunities for improving sustainability.

The meaningful progress requires coordinated efforts from multiple stakeholders. Strong policy frameworks, responsible industry practices and greater transparency across supply chains are essential for promoting sustainable production systems. At the same time, consumer awareness and responsible purchasing behaviour can help reduce the demand for unsustainable fast fashion products. Collaborative action among researchers, policymakers, industry leaders and consumers will be crucial for building a more sustainable and resilient fashion industry in the future.

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