

## Review Article

# Assessing Impacts and Responsibilities: Environmental and Socio-Economic Dimensions of Sustainable Fashion

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## I N F O

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## A B S T R A C T

The fashion industry, particularly in its “fast fashion” model, significantly impacts the environment and society through resource-intensive production, pollution, waste generation, and labor exploitation. Environmentally, the industry contributes to water depletion, chemical contamination, greenhouse gas emissions, microplastic pollution, and large volumes of textile waste. Socio-economically, low-cost production often relies on exploitative labor in developing countries. Sustainable fashion aims to mitigate these effects through circular economy principles, ethical labor practices, and reduced resource consumption. However, challenges such as scaling sustainable practices, cost accessibility, and systemic supply chain complexities limit its widespread adoption. This review synthesizes current literature on environmental and socio-economic impacts, emerging sustainable practices, and the responsibilities of stakeholders in achieving a more sustainable fashion industry.

**Keywords:** Sustainable fashion, fast fashion, environmental impact, socio-economic impact, circular economy, labor ethics, textile waste, resource consumption.

## Introduction

The global fashion industry has experienced remarkable growth over the past several decades, fueled by increasing consumer demand for trendy, affordable, and fast-changing apparel. This expansion has created significant economic opportunities, including job creation, technological innovation in textile production, and global trade growth. However, these economic benefits have come at a substantial cost to both the environment and society. The rise of fast fashion — characterized by rapid production cycles, low-cost garments, and high turnover — has entrenched an industry model that relies heavily on resource-intensive processes, extensive energy use, and globally dispersed, complex supply chains.<sup>1,2</sup>

Fast fashion accelerates the production and consumption of clothing, often prioritizing short-term trends over product longevity. This approach has intensified environmental pressures, including excessive water consumption for cotton cultivation, chemical pollution from dyeing and finishing, greenhouse gas emissions from manufacturing and transportation, and large volumes of post-consumer textile waste.<sup>1,2,4</sup> Furthermore, the environmental burden is often unevenly distributed, disproportionately affecting communities in low- and middle-income countries where manufacturing is concentrated. These communities frequently face exposure to contaminated water, air pollution, and unsafe working conditions, highlighting the intersection of ecological degradation and social inequity.<sup>8</sup>

In response to these challenges, sustainable fashion has emerged as a potential solution, aiming to integrate ethical labor practices, environmental stewardship, and circular economy principles throughout the supply chain.<sup>3</sup> Sustainable fashion encompasses strategies such as using eco-friendly or recycled materials, implementing energy-efficient production processes, extending garment lifecycles through reuse and recycling, and ensuring fair wages and safe working conditions for laborers. Despite growing awareness and adoption of these practices, significant barriers remain, including the difficulty of scaling sustainable initiatives, higher production costs, limited consumer willingness to pay premium prices, and systemic inertia within global supply chains.<sup>3,6,10</sup>

### Environmental Impacts Of Fashion

The environmental footprint of the fashion industry is vast and multifaceted, spanning resource depletion, pollution, greenhouse gas emissions, and waste accumulation. The rapid growth of fast fashion and the global nature of textile supply chains have amplified these impacts, making the sector one of the most environmentally burdensome industries worldwide.

### Resource Consumption And Pollution

Fashion production is highly resource-intensive, beginning with raw material cultivation and extending through textile manufacturing and garment finishing. Cotton, the most widely used natural fiber, is particularly water-demanding. Studies estimate that producing a single cotton T-shirt can consume between 2,700 and 3,000 liters of water, equivalent to approximately three years of drinking water for one person.<sup>5</sup> Beyond water, significant amounts of energy are required for spinning, weaving, and dyeing, often derived from fossil fuels, which further contribute to carbon emissions.<sup>4</sup>

Chemical use in textile processing compounds the environmental burden. Dyeing, bleaching, and finishing fabrics involve hazardous chemicals such as azo dyes, heavy metals, and chlorine-based agents, which frequently enter wastewater systems. In regions with inadequate treatment infrastructure, these pollutants contaminate rivers, lakes, and soils, threatening aquatic life and human health.<sup>6</sup> The fashion industry is also responsible for approximately 10% of global greenhouse gas emissions, comparable to the emissions from international flights and maritime shipping

combined.<sup>4</sup> These emissions arise from energy-intensive production processes, long-distance transportation of textiles and garments, and emissions from synthetic fiber production, particularly polyester.<sup>4</sup>

### Waste Generation and Microplastic Pollution

Fast fashion promotes a culture of disposable clothing, with garments often worn only a few times before disposal. This contributes to enormous volumes of textile waste, estimated at over 92 million tonnes annually worldwide.<sup>4</sup> Most of this waste is landfilled or incinerated, releasing additional greenhouse gases, chemicals, and toxins into the environment.

Synthetic fibers, including polyester, nylon, and acrylic, are central to fast-fashion production due to their low cost and durability. However, these materials shed microplastic fibers during washing, which enter rivers, oceans, and marine ecosystems. These microplastics persist in the environment, accumulate in aquatic organisms, and can enter the human food chain, posing long-term ecological and health risks.<sup>7</sup> Even recycled textiles and garments containing synthetic fibers contribute to microplastic pollution unless proper filtration or waste-management technologies are implemented.

### Environmental Justice

The negative environmental consequences of fashion disproportionately affect vulnerable populations, particularly in low- and middle-income countries (LMICs) where textile manufacturing is concentrated. Communities near industrial clusters often suffer exposure to untreated wastewater, toxic chemicals, and airborne pollutants, which can cause skin, respiratory, and systemic health issues.<sup>8</sup> Workers in these facilities may also face unsafe conditions, inadequate protective equipment, and limited access to healthcare.

Moreover, the globalization of fashion contributes to an environmental injustice: consumers in high-income countries benefit from cheap, trendy clothing, while the ecological and social costs are externalized to production regions in LMICs.<sup>8</sup> This imbalance underscores the importance of integrating environmental justice considerations into sustainable fashion strategies, ensuring that resource use, waste management, and pollution mitigation prioritize both ecological and human health.

**Table 1. Environmental Impacts of Fashion**

Impact Category	Description	Key Metrics / Examples
Water Consumption	High water use in cotton cultivation and textile production	2,700–3,000 liters per cotton T-shirt
Chemical Pollution	Toxic dyes and finishing chemicals contaminating water and soil	Heavy metals, azo dyes, chlorine compounds

Greenhouse Gas Emissions	CO <sub>2</sub> emissions from production, transport, and disposal	~10% of global emissions from fashion
Waste Generation	Short lifespan of fast-fashion garments	>92 million tonnes textile waste/year
Microplastic Pollution	Synthetic fibers shedding in washing	Polyester and nylon fibers enter oceans
Environmental Justice	Disproportionate impact on vulnerable communities	Water/air contamination near factories

## Socio-Economic Dimensions

The socio-economic impacts of the fashion industry are closely intertwined with its environmental footprint, reflecting inequalities in labor conditions, economic benefits, and access to sustainable alternatives. While fast fashion provides affordable clothing for consumers and drives economic growth globally, it often does so at the expense of workers' rights, community welfare, and ethical accountability.

### Labor Exploitation

The fashion industry's reliance on global supply chains means that production is frequently outsourced to developing countries, where labor is cheaper and regulations may be weakly enforced. Workers in these contexts often face long hours, unsafe working conditions, and minimal wages insufficient to meet basic living standards.<sup>9</sup> For example, garment factories in countries such as Bangladesh, India, and Vietnam have been repeatedly linked to industrial accidents, unsafe building conditions, and inadequate fire safety measures.<sup>9,10</sup>

The pressure to produce low-cost, high-volume clothing exacerbates these conditions. Companies may prioritize speed and efficiency over worker welfare, limiting labor protections and discouraging unionization. Women, who comprise a significant portion of the global garment workforce, are particularly vulnerable to exploitation, including wage disparities, harassment, and limited access to maternity or healthcare benefits.<sup>9,10</sup> This systemic exploitation raises significant ethical concerns and highlights the need for enforceable labor standards and global supply chain accountability.

### Consumer-Producer Disparities

A fundamental ethical issue in the fashion industry is the disparity between consumers and producers. Consumers in

wealthier nations enjoy the benefits of low-cost, fashionable apparel without directly bearing the social or environmental costs associated with production. Meanwhile, communities in manufacturing regions absorb the brunt of negative impacts, including exposure to pollution, unsafe working environments, and poor living conditions.<sup>8</sup>

This imbalance represents a form of environmental and social injustice, where economic benefits are concentrated in high-income countries while burdens are externalized to low-income regions.<sup>8,10</sup> The ethical challenge is compounded by the invisibility of these impacts to consumers, who often remain unaware of the conditions under which their clothing is produced. Addressing this disparity requires increased transparency in supply chains, consumer education, and global collaboration on labor and environmental standards.

### Challenges in Sustainable Alternatives

Sustainable fashion seeks to address these socio-economic challenges by integrating ethical labor practices, eco-friendly materials, and circular economy principles into production and consumption models.<sup>3</sup> Strategies include fair wages, safe working conditions, organic or recycled materials, and the promotion of recycling, upcycling, and garment longevity.

Despite the potential benefits, scaling sustainable fashion remains a significant challenge. Ethical production often incurs higher costs, which may limit affordability for consumers accustomed to fast-fashion pricing.<sup>6</sup> Additionally, systemic inertia within global supply chains — including reliance on established production hubs, logistical complexity, and corporate profit pressures — constrains widespread adoption of sustainable practices.<sup>10</sup> Consumer behavior also plays a critical role; while awareness of sustainability issues is growing, many consumers prioritize price and trendiness over ethical or environmental considerations.<sup>6,10</sup>

**Table 2. Socio-Economic Impacts of Fashion**

Dimension	Description	Challenges
Labor Conditions	Workers in low-cost production countries face poor conditions	Low wages, unsafe workplaces, limited protections
Ethical Concerns	Disparity between consumer benefits and worker/environmental burdens	Exploitation, inequity in global supply chains

Consumer Behavior	Fast fashion encourages overconsumption	Short-term use, disposability culture
Economic Access	Sustainable fashion is often higher-priced	Limits affordability for lower-income populations
Industry Scalability	Difficult to scale ethical and sustainable production	Small-batch production vs global demand

### Emerging Trends And Opportunities

Recent research in sustainable fashion highlights several promising trends and persistent gaps in addressing the industry’s environmental and socio-economic challenges. While awareness of sustainability is increasing among consumers and producers alike, systemic and structural issues continue to limit the impact of isolated interventions.

#### Systemic Sustainability

Systemic sustainability emphasizes the need for holistic approaches to environmental and social challenges, rather than relying solely on individual solutions such as the use of organic fabrics, eco-friendly dyes, or energy-efficient machinery.<sup>10</sup> This approach advocates for considering the full lifecycle of garments—from raw material extraction to production, distribution, consumption, and end-of-life disposal. For example, assessing carbon footprints, water usage, and chemical emissions at each stage enables more informed decision-making and identifies opportunities for interventions that maximize overall environmental benefits.<sup>10</sup> Moreover, systemic sustainability includes addressing labor conditions, fair wages, and community impacts, linking ecological concerns with social responsibility.<sup>3</sup>

#### Circular Economy

The circular economy represents a key strategy for reducing the environmental footprint of fashion. Unlike the traditional linear “take-make-dispose” model, circular fashion seeks to extend garment lifespans, reduce waste, and promote recycling or upcycling.<sup>3,6</sup> Strategies include designing clothes for durability, encouraging second-hand markets, implementing textile recycling programs, and innovating biodegradable or recyclable fabrics. Studies show that circular approaches can significantly decrease resource consumption, water usage, and landfill pressures, while also reducing microplastic pollution associated with synthetic fibers.<sup>6,7</sup> Additionally, circular models may provide socio-economic benefits by creating new jobs in repair, recycling, and resale sectors, supporting local economies and reducing inequality.

#### Supply Chain Transparency

Increasing transparency across the supply chain is another emerging trend that addresses both ethical and environmental concerns.<sup>9</sup> Traceability systems,

certifications, and digital tracking technologies enable brands to monitor labor conditions, material sourcing, and environmental practices. Transparent supply chains enhance accountability, helping consumers make informed choices and discouraging exploitative practices. For instance, blockchain-based tracking systems have been applied in some textile supply chains to ensure that organic cotton or recycled fibers are verified throughout the production process.<sup>9</sup> Beyond ethical benefits, transparency facilitates more accurate measurement of environmental impacts, allowing companies to implement targeted sustainability strategies.

#### Persistent Challenges

Despite these opportunities, the fashion industry faces substantial barriers to widespread adoption of sustainable practices. High production costs for ethical and eco-friendly garments often make them less competitive compared to fast-fashion alternatives, limiting market penetration.<sup>6</sup> Infrastructure limitations in recycling and waste management further constrain circular initiatives, particularly in developing countries where much of the garment production occurs.<sup>10</sup> Consumer behavior also plays a critical role; while awareness of environmental and social issues is growing, many consumers continue to prioritize affordability, convenience, and trendiness over sustainability.<sup>6,10</sup>

#### Responsibilities And Pathways For Sustainable Fashion

Achieving sustainability in the fashion industry requires concerted efforts from multiple stakeholders. Responsibility is shared among industry players, policymakers, consumers, and civil society, with each group playing a crucial role in reducing environmental impacts, ensuring ethical labor practices, and promoting circular economy principles.

#### Industry Stakeholders

Fashion brands and manufacturers are central to driving sustainability. Companies must adopt lifecycle-based assessments to evaluate environmental and social impacts from raw material sourcing through production, distribution, consumption, and end-of-life disposal.<sup>3,10</sup> Implementing circular economy practices, such as garment recycling, upcycling, and designing for durability, can significantly reduce waste and resource consumption.<sup>3,6</sup>

Brands also have a responsibility to ensure ethical labor practices throughout their supply chains. This includes paying fair wages, providing safe working conditions, respecting labor rights, and addressing gender inequalities in the workforce.<sup>9,10</sup> Beyond compliance, companies can demonstrate leadership through sustainable innovation, partnerships with ethical suppliers, and investment in environmentally friendly technologies. For example, some leading brands are experimenting with biodegradable fabrics, waterless dyeing technologies, and digital tools to optimize material usage and reduce carbon footprints.<sup>3</sup>

### **Policymakers**

Governments play a critical role in shaping the regulatory and infrastructural environment for sustainable fashion. Environmental regulations, such as restrictions on chemical discharge, emission limits, and mandatory waste management, help reduce the industry's ecological footprint.<sup>10</sup> Policymakers can also incentivize sustainable production through tax benefits, subsidies for eco-friendly technologies, and support for research and development in textile innovation.

Infrastructure investment is another key responsibility. Establishing efficient textile recycling programs, industrial composting for biodegradable fabrics, and accessible second-hand markets enables circular practices to scale effectively. Policymakers can also encourage transparency and corporate accountability through mandatory reporting standards, certifications, and supply chain traceability initiatives.<sup>10</sup>

### **Consumers**

Consumers are powerful agents of change in sustainable fashion. Conscious purchasing decisions, such as choosing ethically sourced materials, prioritizing quality over quantity, and supporting brands committed to sustainability, can influence production practices.<sup>1,2</sup> Participation in second-hand markets, clothing swaps, and garment repair further extends the lifespan of clothing and reduces waste.

Education and awareness campaigns are critical for fostering consumer engagement. Highlighting the social and environmental impacts of fast fashion can shift behavior patterns, encouraging individuals to consider the lifecycle impacts of their clothing choices. Digital tools, such as apps for tracking the sustainability of brands or platforms for reselling used garments, also empower consumers to make informed decisions.

### **Collective Action**

No single stakeholder can achieve sustainable fashion alone. Collaboration among industry, government, civil society organizations, and consumers is essential to address systemic challenges. Multi-stakeholder initiatives, such

as sustainability alliances, certification programs, and public-private partnerships, help standardize ethical and environmental practices across the sector.<sup>3,10</sup>

### **Critical Reflection**

Achieving full sustainability in the fashion industry remains a complex and multifaceted challenge. While numerous initiatives and innovations have emerged to address environmental and socio-economic impacts, systemic barriers, structural limitations, and trade-offs continue to hinder widespread adoption and effectiveness.

One major challenge is measurement inconsistency. Sustainability assessments often vary across companies, regions, and product types, making it difficult to compare impacts or track progress reliably.<sup>6,10</sup> For example, carbon footprint calculations may exclude key lifecycle stages such as transportation or end-of-life disposal, while water or chemical usage metrics may differ depending on data sources and methodologies. These inconsistencies can obscure the true environmental and social costs of garments, complicating policy development, corporate accountability, and consumer decision-making.

Another significant barrier is the limited scalability of ethical and sustainable models. Many sustainable fashion initiatives, such as small-batch ethical production, organic fiber sourcing, or advanced recycling technologies, face challenges in meeting global demand for affordable clothing.<sup>6</sup> Higher production costs and supply chain complexities often prevent smaller brands from scaling these practices, while larger brands may resist adoption due to profit pressures or logistical challenges.<sup>10</sup> This imbalance limits the potential of sustainable solutions to transform the industry at scale.

The issue of trade-offs also warrants consideration. Sustainability in fashion often involves balancing environmental, economic, and social objectives, and achieving perfection across all dimensions may be unrealistic. For instance, producing organic cotton reduces chemical pollution but can require more water, while recycling synthetic fibers reduces landfill waste but may generate microplastics.<sup>6,10</sup> Similarly, ethical labor practices may increase production costs, affecting affordability for consumers in low- and middle-income markets. Recognizing these trade-offs is essential to implement pragmatic strategies that maximize benefits while minimizing harm.

Finally, consumer behavior and systemic inertia present ongoing challenges. Although awareness of sustainable fashion is growing, many consumers remain driven by low prices, convenience, and rapidly changing trends.<sup>6,10</sup> Supply chains, regulations, and corporate practices are often slow to adapt, creating a mismatch between sustainability ideals and real-world implementation.

Given these challenges, sustainability in fashion should be viewed as a spectrum rather than a binary goal. Incremental improvements, continuous innovation, and adaptive strategies can collectively shift the industry toward more responsible practices over time. Progress may involve prioritizing the most significant environmental and social impacts first, scaling successful models, and fostering collaboration among stakeholders to create systemic change. Ultimately, embracing a nuanced, reflective approach allows for meaningful, long-term sustainability in a sector characterized by complexity and global interdependence.

## Conclusion

The global fashion industry exerts profound environmental and socio-economic pressures, ranging from resource depletion and pollution to labor exploitation and systemic inequities. Resource-intensive processes, such as cotton cultivation, textile manufacturing, and garment finishing, contribute to water scarcity, chemical contamination, greenhouse gas emissions, and substantial textile waste. Fast fashion's emphasis on rapid production and consumption exacerbates these challenges, creating a culture of disposability and amplifying the industry's ecological footprint. Simultaneously, the reliance on low-cost labor in developing countries exposes workers to unsafe conditions, low wages, and limited labor protections, highlighting the ethical and social dimensions of unsustainable production.

Sustainable fashion presents multiple pathways to mitigate these impacts. Ethical labor practices, fair wages, and safe working conditions are essential to address social inequities within global supply chains. Circular economy principles, including recycling, upcycling, and designing for garment longevity, help reduce resource consumption, waste generation, and microplastic pollution. Consumer engagement, awareness, and responsible purchasing behavior further complement these efforts by creating market incentives for more sustainable production and encouraging longer garment lifecycles. Emerging trends, such as supply chain transparency, systemic sustainability approaches, and technological innovations, provide additional opportunities to drive meaningful change.

Despite these pathways, achieving sustainability in fashion remains a complex and ongoing process. Structural barriers, including high production costs, supply chain inertia, limited recycling infrastructure, and persistent consumer preferences for fast fashion, pose challenges to widespread adoption. Sustainability should thus be conceptualized as a spectrum rather than an absolute state, emphasizing incremental improvements, trade-offs, and continuous monitoring of environmental and social outcomes.

Meaningful transformation in the fashion industry requires systemic collaboration among all stakeholders: brands

must adopt lifecycle-based, ethically grounded production practices; policymakers must enforce regulations, incentivize sustainable practices, and invest in recycling infrastructure; consumers must make informed choices and participate in garment reuse and circular initiatives; and civil society organizations must advocate for accountability, transparency, and education. By integrating these efforts, the fashion industry can gradually transition toward a more responsible, equitable, and environmentally sustainable model, balancing economic growth with ecological integrity and social justice.

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