

The Environmental Impact of Fast Fashion: Lifecycle Assessment and Policy Implications

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Abstract

The rapid expansion of fast fashion has transformed global apparel consumption patterns by accelerating production cycles, lowering prices, and increasing product turnover. While this model has enhanced accessibility and economic growth within the fashion sector, it has also generated significant environmental consequences. High resource consumption, chemical-intensive processing, greenhouse gas emissions, and large volumes of textile waste have intensified concerns regarding the sustainability of contemporary fashion systems. The environmental impact of fast fashion through a lifecycle assessment (LCA) framework, evaluating resource use and emissions across raw material extraction, textile manufacturing, transportation, retail distribution, consumer use, and end-of-life disposal. The findings highlight substantial water and energy consumption in fiber production, particularly cotton and synthetic materials, as well as carbon emissions associated with globalized supply chains. Short product lifespans and limited recycling infrastructure further contribute to landfill accumulation and microplastic pollution.

Keywords: Fast fashion; Lifecycle assessment (LCA); Textile waste; Carbon emissions; Water footprint

Introduction

Over the past two decades, the fast fashion model has fundamentally reshaped the global apparel industry. Characterized by rapid design turnover, low production costs, and accelerated retail cycles, fast fashion enables consumers to access trend-driven clothing at affordable prices. This model has expanded market reach and stimulated economic growth, particularly in emerging consumer markets. However, the environmental consequences of this production and consumption pattern have become increasingly difficult to ignore.

Fast fashion relies on high-volume manufacturing, short product lifespans, and frequent purchasing behavior. These features contribute to significant resource consumption, including intensive water use in cotton cultivation, energy demand in textile processing, and chemical discharge during dyeing and finishing. Synthetic fibers such as polyester, widely used due to their low cost and durability, are derived from fossil fuels and contribute to microplastic pollution during washing. The globalized nature of supply chains further increases transportation-related emissions. Lifecycle assessment (LCA) provides a comprehensive framework for evaluating the environmental footprint of fast fashion. By examining impacts across stages such as raw material extraction, production, distribution, consumer use, and

disposal, LCA reveals the cumulative environmental burden embedded in apparel products. Studies consistently indicate that carbon emissions, water depletion, and waste generation are concentrated not only in manufacturing but also in consumer behavior patterns, including frequent washing and premature disposal. The short usage cycle associated with fast fashion significantly intensifies waste generation. Large volumes of discarded clothing end up in landfills or are incinerated, with limited recycling infrastructure available in many regions. Even when garments are donated or exported, secondary markets often struggle to absorb surplus quantities, shifting environmental burdens across borders rather than eliminating them. In response to these challenges, policymakers and industry actors are increasingly exploring regulatory and market-based interventions. Concepts such as circular economy principles, extended producer responsibility, eco-design standards, and sustainable sourcing guidelines are gaining prominence. Yet implementation remains uneven, and consumer demand for low-cost, rapidly changing styles continues to drive production growth. lifecycle assessment perspective to evaluate the environmental impacts of fast fashion and explores policy measures that could mitigate these effects. By analyzing both production systems and consumption patterns, the paper aims to contribute to ongoing discussions about transforming the apparel sector toward greater environmental sustainability and long-term resource efficiency.

Lifecycle Assessment Methodology in Apparel Studies

Lifecycle assessment (LCA) is a systematic analytical framework used to evaluate the environmental impacts of a product throughout its entire lifespan. In apparel studies, LCA provides a structured approach to measuring resource consumption, emissions, and waste generation from fiber production to final disposal. Given the complex and globalized nature of fashion supply chains, this methodology is particularly valuable in identifying environmental hotspots and informing sustainability policy.

1. Defining System Boundaries

A core component of LCA is the definition of system boundaries. In apparel research, this typically includes raw material extraction, fiber production, textile manufacturing, garment assembly, transportation, retail distribution, consumer use, and end-of-life management. Clear boundary setting ensures that all relevant environmental inputs and outputs are accounted for, preventing underestimation of impacts.

2. Inventory Analysis

The life cycle inventory (LCI) phase involves collecting quantitative data on energy use, water consumption, chemical inputs, greenhouse gas emissions, and waste streams. For example, cotton cultivation requires significant irrigation and pesticide use, while polyester production involves fossil fuel extraction and energy-intensive processing. Data accuracy is critical, yet challenges arise due to fragmented global supply chains and limited transparency in certain production regions.

3. Impact Assessment

The life cycle impact assessment (LCIA) translates inventory data into measurable environmental indicators. Common impact categories in apparel studies include carbon footprint, water footprint, eutrophication potential, human toxicity, and resource depletion. By

quantifying these effects, researchers can compare different fibers, production techniques, and consumption patterns.

4. Functional Unit Selection

A functional unit defines the basis for comparison in LCA. In apparel studies, this may be one garment worn a specified number of times. The choice of functional unit significantly influences results. For instance, a durable garment with extended use may show lower environmental impact per wear compared to a low-cost item worn only a few times.

5. Allocation and Assumptions

Apparel LCAs often require allocation decisions when processes produce multiple outputs. For example, leather production may be allocated between meat and hide industries. Assumptions about consumer behavior, such as washing frequency and garment lifespan, also affect outcomes. Transparency in these methodological choices is essential for credible results.

6. Limitations and Data Gaps

Despite its strengths, LCA has limitations. Data availability can be inconsistent across regions, and rapid changes in production technology may render older datasets outdated. Additionally, social impacts such as labor conditions are not typically captured within traditional environmental LCA frameworks.

7. Policy and Industry Relevance

LCA findings provide evidence-based insights for policymakers and industry stakeholders. By identifying stages with the highest environmental burden, such as fiber production or consumer washing habits, targeted interventions can be designed. LCA also supports eco-labeling, sustainability reporting, and product design improvements.

lifecycle assessment methodology offers a comprehensive and structured tool for evaluating the environmental impact of apparel products. Its application in fast fashion studies highlights critical pressure points within production and consumption systems, providing a foundation for informed policy decisions and sustainable industry transformation.

Raw Material Extraction and Fiber Production Impacts

Raw material extraction and fiber production represent some of the most environmentally intensive stages in the fast fashion lifecycle. The choice of fiber, whether natural or synthetic, significantly influences water use, land demand, energy consumption, and greenhouse gas emissions. As fast fashion prioritizes high-volume, low-cost production, fiber sourcing often amplifies ecological pressure.

1. Cotton Cultivation and Water Use

Cotton remains one of the most widely used natural fibers in apparel manufacturing. Although biodegradable and breathable, conventional cotton farming is highly water-intensive and frequently dependent on irrigation in water-stressed regions. Large-scale cotton cultivation has contributed to soil degradation, biodiversity loss, and depletion of freshwater resources. In addition, pesticide and fertilizer use in conventional farming can lead to chemical runoff, contaminating nearby ecosystems and affecting human health.

2. Synthetic Fiber Production and Fossil Fuel Dependence

Polyester and other synthetic fibers dominate fast fashion production due to their durability, low cost, and versatility. However, polyester is derived from petroleum, linking apparel

production directly to fossil fuel extraction. The manufacturing process is energy-intensive and generates significant carbon emissions. Furthermore, synthetic fibers shed microplastics during washing, contributing to long-term marine and freshwater pollution.

3. Viscose and Semi-Synthetic Materials

Viscose and other regenerated cellulose fibers are marketed as alternatives to conventional cotton and synthetics. While derived from wood pulp, their production can involve deforestation if sourcing is not responsibly managed. Chemical processing methods used to convert cellulose into textile fibers may also release hazardous substances if not properly regulated.

4. Land Use and Biodiversity Impacts

Large-scale fiber cultivation requires substantial land allocation, often competing with food production and natural habitats. Deforestation for wood-based fibers and monoculture farming practices can reduce biodiversity and disrupt ecological balance. Sustainable sourcing certifications attempt to address these issues, but enforcement and transparency vary across regions.

5. Energy Consumption and Emissions

Both natural and synthetic fiber production require significant energy inputs. Irrigation systems, agricultural machinery, chemical processing, and fiber extrusion contribute to greenhouse gas emissions. The carbon intensity of these processes depends heavily on the energy mix used in producing countries.

6. Emerging Sustainable Fiber Alternatives

Growing awareness of environmental impacts has stimulated research into organic cotton, recycled polyester, hemp, bamboo, and bio-based materials. While these alternatives may reduce certain environmental burdens, scalability, cost, and certification challenges remain barriers to widespread adoption.

raw material extraction and fiber production constitute critical environmental hotspots in the fast fashion lifecycle. The dominance of water-intensive crops and fossil fuel-based synthetics underscores the need for improved sourcing standards, sustainable agricultural practices, and innovation in low-impact fiber technologies. Addressing impacts at this foundational stage is essential for reducing the overall environmental footprint of apparel systems.

Conclusion

The lifecycle assessment of fast fashion reveals a production and consumption model that generates significant environmental pressures at every stage, from raw material extraction to end-of-life disposal. Fiber production demands substantial water, land, and energy resources, while textile manufacturing processes contribute to chemical pollution and greenhouse gas emissions. Globalized supply chains further increase the carbon footprint through transportation, and short garment lifespans intensify textile waste accumulation. The fast fashion model's emphasis on speed, volume, and affordability has externalized many environmental costs. High turnover rates encourage frequent purchasing and premature disposal, amplifying landfill burdens and microplastic pollution. Even when recycling or donation systems exist, they often struggle to manage the sheer volume of discarded clothing, shifting environmental impacts rather than resolving them. Lifecycle assessment methodology

highlights critical environmental hotspots, providing a data-driven foundation for targeted policy intervention. Measures such as extended producer responsibility, eco-design standards, mandatory disclosure of environmental metrics, and incentives for circular production models can help internalize environmental costs. Encouraging durable design, improved fiber sourcing, and expanded recycling infrastructure are equally essential. Ultimately, addressing the environmental impact of fast fashion requires systemic transformation rather than incremental adjustment. Policymakers, industry actors, and consumers must collaborate to shift from linear production models toward circular and resource-efficient systems. Without structural reform in both production practices and consumption behavior, the environmental footprint of the apparel sector will continue to grow alongside global demand.

Bibliography

- Allwood, J. M., Laursen, S. E., De Rodríguez, C. M., & Bocken, N. M. P. (2006). *Well dressed? The present and future sustainability of clothing and textiles in the United Kingdom*. University of Cambridge Institute for Manufacturing.
- Ellen MacArthur Foundation. (2017). *A new textiles economy: Redesigning fashion's future*. Ellen MacArthur Foundation. <https://ellenmacarthurfoundation.org>
- Fletcher, K. (2014). *Sustainable fashion and textiles: Design journeys* (2nd ed.). Routledge.
- Niinimäki, K., Peters, G., Dahlbo, H., Perry, P., Rissanen, T., & Gwilt, A. (2020). The environmental price of fast fashion. *Nature Reviews Earth & Environment*, 1(4), 189–200. <https://doi.org/10.1038/s43017-020-0039-9>
- Sandin, G., & Peters, G. M. (2018). Environmental impact of textile reuse and recycling: A review. *Journal of Cleaner Production*, 184, 353–365. <https://doi.org/10.1016/j.jclepro.2018.02.266>
- Shen, L., Patel, M. K., & Worrell, E. (2010). Life cycle energy and environmental implications of cotton-based textile products. *Resources, Conservation and Recycling*, 55(2), 159–167. <https://doi.org/10.1016/j.resconrec.2010.08.001>
- UN Environment Programme (UNEP). (2019). *Sustainability and circularity in the textile value chain: Global stocktaking*. United Nations Environment Programme.