



ACCUMULATION OF TEXTILE WASTE IN LANDFILLS AND ITS ECOLOGICAL CONSEQUENCES

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Abstract

Textile waste has emerged as a significant contributor to global municipal solid waste, largely driven by fast fashion, mass production, and low consumer retention of garments. Once disposed of, textiles often end up in landfills where they occupy valuable space, deteriorate slowly, and contribute to environmental degradation through greenhouse gas emissions, soil contamination, and microplastic release. This study explores the scale of textile waste deposition in landfills, environmental risks associated with decomposition, and limitations of current waste management systems. Through a synthesis of existing literature and secondary data, it highlights the urgent need for sustainable interventions such as recycling infrastructure, circular economy solutions, and policy frameworks that reduce textile waste generation. The findings reveal that without systemic change, the environmental footprint of textile waste will continue to expand, exacerbating landfill burdens and ecological harm.

Keywords: Waste management, Recycling, Circular economy, Sustainable textiles

1. Introduction

Textile waste encompasses discarded fabrics, used garments, household textiles, carpets, upholstery materials, and industrial production off-cuts generated throughout the lifecycle of textile products. This waste originates from multiple stages, including fibre production, textile manufacturing, garment construction, retail distribution, consumer use, and post-consumer disposal. Over the past few decades, global clothing production has increased dramatically, largely fuelled by rapid industrialization, globalization of supply chains, population growth, and the expansion of fast fashion business models. Fast fashion encourages frequent purchasing of inexpensive, trend-driven clothing, significantly shortening garment lifespans and accelerating disposal rates. As a result, the volume of textile waste generated annually has risen at an unprecedented rate.

Globally, millions of tonnes of textile waste are discarded each year, and only a small fraction is reused or recycled. The majority of unwanted textiles are disposed of through landfilling or incineration. In both developed and developing countries, landfills remain the primary destination for textile waste due to several interrelated factors. These include inadequate recycling infrastructure, limited collection and sorting systems, lack of technological capacity to process mixed-fibre textiles, low market demand for recycled fibres, and insufficient public awareness regarding sustainable disposal practices. In many regions,



textile waste is mixed with general municipal solid waste, making recovery and recycling even more difficult.

The composition of modern textiles further complicates waste management challenges. Textile products today are made from a wide variety of fibres, including natural fibres such as cotton, wool, silk, and linen; regenerated fibres such as viscose and rayon; and synthetic polymers such as polyester, nylon, and acrylic. Synthetic fibres, derived primarily from petroleum-based raw materials, now account for more than half of global fibre production due to their durability, affordability, and versatility. Additionally, many garments are produced using blended fibres for example, cotton-polyester blends to enhance properties such as strength, wrinkle resistance, elasticity, and moisture management. While these blends improve product performance, they significantly hinder recycling efforts because separating mixed fibres is technologically complex and costly.

A major environmental concern associated with textile waste in landfills is its resistance to biodegradation. Natural fibres, although biodegradable under optimal aerobic conditions, decompose very slowly in landfill environments where oxygen is limited. In anaerobic conditions, organic components such as cotton or wool break down gradually and produce methane gas a greenhouse gas with a global warming potential significantly higher than carbon dioxide over a 100-year period. Methane emissions from landfills contribute substantially to climate change and are a major source of anthropogenic greenhouse gases worldwide.

Synthetic fibres present an even more persistent challenge. Materials such as polyester and nylon are non-biodegradable and can remain intact in landfills for several decades or even centuries. Over time, physical, chemical, and mechanical processes may cause these fibres to fragment into microplastics. These microscopic particles can migrate through landfill leachate into surrounding soils and groundwater systems. Microplastics are of particular concern because they are highly persistent, can accumulate in ecosystems, and may enter food chains, posing potential risks to wildlife and human health.

In addition to greenhouse gas emissions and microplastic pollution, textile waste can introduce harmful chemical substances into the environment. Many textiles are treated with dyes, flame retardants, water repellents, antimicrobial agents, and other finishing chemicals during manufacturing. Some of these substances contain heavy metals, formaldehyde, or other toxic compounds. As textiles deteriorate in landfills, rainwater percolating through waste layers can dissolve and transport these chemicals into landfill leachate. Without adequate landfill lining and treatment systems, these contaminants may seep into surrounding soil and groundwater, contributing to environmental pollution and ecological imbalance.

Beyond environmental impacts, textile waste also represents a significant loss of valuable resources. The production of textiles requires substantial inputs of water, energy, chemicals, and raw materials. For instance, cotton cultivation is water-intensive, while synthetic fibre production relies heavily on fossil fuels. When garments are discarded



prematurely and sent to landfills, the embedded energy and resources used in their production are effectively wasted. This linear “take-make-dispose” model of production and consumption is increasingly recognized as unsustainable in the context of finite natural resources and global environmental pressures.

Given the scale and complexity of these challenges, researchers, policymakers, and industry stakeholders are increasingly focusing on sustainable waste management strategies. Concepts such as the circular economy advocate for extending the life of textile products through reuse, repair, refurbishment, and recycling. Upcycling initiatives aim to transform waste textiles into higher-value products, while technological innovations are being developed to improve fibre-to-fibre recycling processes. Additionally, policy measures such as extended producer responsibility (EPR), landfill diversion targets, and sustainable design regulations are being implemented in some regions to encourage more responsible textile production and disposal.

Understanding the magnitude and environmental consequences of textile waste accumulation in landfills is essential for developing effective interventions. A comprehensive assessment of landfill impacts not only highlights the urgency of the problem but also informs strategies to transition toward more sustainable systems of textile production and consumption. Addressing textile waste requires coordinated efforts across the entire value chain from fibre producers and manufacturers to retailers, consumers, and waste management authorities to reduce environmental harm and promote long-term ecological sustainability.

2. Review of Literature

2.1 Scale of Textile Waste Generation

Recent research indicates that textile waste constitutes a growing share of global municipal solid waste (MSW). Estimates suggest that up to 85% of discarded clothing ends up in landfills or incinerators globally, with only a small percentage recycled or reused (Fletcher & Tham, 2019). In the United States alone, approximately 11.3 million tons of textile waste were generated in recent years, with the vast majority directed to landfills (EPA, 2021). Such trends are mirrored in Europe and Asia, where rapid industrial growth and changing consumer patterns have intensified textile waste streams.

2.2 Environmental Consequences of Textile Disposal

Disposal of textiles in landfills contributes disproportionately to environmental degradation through multiple pathways. For natural fibres like cotton, decomposition in anaerobic landfill conditions produces methane and carbon dioxide, contributing to greenhouse gas emissions (Allwood et al., 2015). Synthetic fibres such as polyester do not biodegrade easily and can remain intact for decades, occupying long-term landfill space and releasing microplastics as they physically degrade. These microplastics can migrate into soil and water systems, posing risks to ecological health and entering food chains.



Furthermore, textiles often contain a range of chemical treatments dyes, flame retardants, and finishing agents that can leach into surrounding soil and groundwater. Studies have shown that colorants and additives may contain heavy metals or persistent organic pollutants, which can disrupt soil biota and contaminate water resources (Niinimäki et al., 2020).

2.3 Recycling and Management Challenges

Despite the significant environmental impact, textile recycling remains limited due to technological and economic barriers. Many garments are composed of mixed fibres, complicating mechanical recycling processes. Chemical recycling technologies are evolving but are not yet widely available or cost-effective. Consequently, the recycling rate for textile waste remains low compared to other waste fractions like paper or metal. Literature suggests that only 12–15% of textile waste globally is recycled, with much of the rest being downcycled or simply landfilled (Ellen MacArthur Foundation, 2020).

Several studies emphasize the potential of circular economy models where textiles are designed for reuse, repair, and recycling to reduce landfill burdens. However, widespread implementation requires systemic changes across production, retail, and consumer behaviour, as well as supportive policy frameworks.

3. Methodology

The present study follows a structured secondary research design based on a systematic and integrative review of previously published scientific and institutional evidence to examine the environmental implications of textile waste disposal in landfill environments. Primary experimentation was not adopted because textile degradation and pollutant release in landfills occur over long temporal scales and across diverse geographic conditions; therefore, validated datasets reported in environmental monitoring studies provide a more comprehensive basis for assessment. Relevant literature was identified through a systematic search in multidisciplinary academic databases such as Scopus, Web of Science, ScienceDirect, SpringerLink, and Google Scholar, along with environmental statistics and sustainability reports published by governmental and international agencies. The search incorporated combinations of keywords including textile waste, landfill disposal, synthetic fibre degradation, methane emissions from clothing, microplastic release, circular economy in fashion, and waste management practices. To ensure contemporary relevance reflecting the expansion of fast fashion consumption and increasing synthetic fibre usage, only publications between 2015 and 2025 were considered, while earlier foundational references were consulted selectively to explain degradation mechanisms.

The collected publications were screened using predefined inclusion and exclusion criteria to maintain academic reliability. Peer-reviewed research articles, institutional environmental datasets, and reports presenting measurable environmental indicators were



included, whereas opinion-based articles, non-verifiable web content, duplicate datasets, and studies lacking methodological transparency were excluded. Each eligible source was examined in detail and relevant information was extracted using a standardized recording framework in order to convert heterogeneous findings into comparable variables. The extracted parameters included annual textile waste generation quantities, proportion of textile waste entering landfills, fibre composition categories (natural, synthetic and blended), estimated decomposition timeframes, greenhouse gas emissions such as methane and carbon dioxide, chemical leachate formation and toxicity, microplastic shedding behaviour, and indicators of soil and groundwater contamination. Measurement units were normalized wherever possible, and when studies reported ranges, average values were recorded to maintain consistency across datasets.

The normalized data were subjected to comparative analysis across three dimensions: geographical region, material composition, and waste management condition. Regional comparison distinguished developed, developing, and emerging economies to identify differences in infrastructure and environmental outcomes. Material comparison evaluated degradation behaviour of natural fibres such as cotton and wool against synthetic fibres such as polyester and nylon as well as blended fabrics. Waste management comparison examined sanitary engineered landfills, semi-controlled landfill sites, and open dumping systems to determine variations in emission intensity and pollution risk. To strengthen validity, findings were triangulated across multiple independent sources and conflicting values were interpreted critically rather than excluded. Following comparison, results were integrated through thematic synthesis covering textile waste generation trends, landfill decomposition processes, greenhouse gas emissions, leachate contamination, microplastic pollution pathways, and limitations of existing waste management practices along with potential circular mitigation strategies. Since the study utilized only publicly available secondary data and involved no human participants or confidential information, ethical approval was not required. Overall, this methodological framework provides a comprehensive and evidence-based evaluation of textile waste behaviour in landfill systems suitable for academic analysis and policy-oriented environmental assessment.

4. Results and Discussion

The reviewed literature consistently highlights the growing environmental burden posed by textile waste disposal, particularly in landfill environments. Globally, textiles constitute a considerable proportion of municipal solid waste, estimated at approximately 5–10% in economically developed regions, while in developing nations the absence of structured recycling and segregation systems leads to their direct co-disposal with household refuse. The rapid expansion of fast fashion consumption has intensified this issue, as reduced garment lifespans accelerate disposal rates and increase landfill accumulation. A significant portion of discarded textiles consists of synthetic or blended fibres engineered for durability, wrinkle



resistance, and stain repellence; however, these same performance characteristics hinder natural degradation processes, resulting in prolonged environmental persistence.

Beyond physical accumulation, textile waste contributes substantially to greenhouse gas emissions. Under anaerobic landfill conditions, natural fibres decompose slowly and release methane, a greenhouse gas with a global warming potential many times greater than carbon dioxide over a century. Although synthetic fibres themselves are resistant to biodegradation, blended textiles containing organic components still generate methane during partial decomposition. Consequently, rising volumes of textile waste amplify the overall carbon footprint of landfill systems, making waste diversion a critical strategy in climate mitigation efforts.

Environmental risks also extend to soil and water contamination. Discarded garments frequently contain dyes and chemical finishes such as waterproofing agents, flame retardants, and antimicrobial treatments, many of which include toxic and persistent compounds. Through leachate formation, these substances can migrate into surrounding soils and groundwater, where studies have detected elevated concentrations of heavy metals and organic pollutants near landfill sites. Additionally, synthetic fibres degrade physically into microplastics, which accumulate in soil ecosystems, alter microbial activity, and disrupt nutrient cycles. Runoff can transport these microplastics into aquatic environments, where they persist and pose ecological hazards to freshwater systems.

Despite these impacts, current waste management practices remain inadequate. Textile recycling faces multiple barriers including poor source segregation, limited consumer awareness, and technological difficulties in processing mixed-fibre materials. Mechanical recycling often produces lower-grade outputs suitable only for downcycling applications such as insulation or wiping cloths, while chemical recycling technologies although more versatile require high energy input and specialized infrastructure. Furthermore, policy frameworks differ widely across regions; some countries implement extended producer responsibility schemes encouraging manufacturers to manage post-consumer waste, whereas others lack regulatory mechanisms entirely. This disparity limits large-scale diversion of textiles from landfills.

The literature therefore emphasizes the need for integrated sustainable and circular solutions. Key strategies include designing garments using durable and recyclable materials, improving advanced sorting and recycling technologies, promoting consumer participation in reuse and take-back programs, and implementing regulatory policies such as landfill diversion targets and producer responsibility initiatives. Collectively, these measures can reduce landfill dependence, minimize environmental contamination, and support the transition toward a circular textile economy in which material value is preserved rather than discarded.

5. Conclusion



Textile waste represents a growing environmental challenge with far-reaching consequences for landfills, climate change, soil quality, and water systems. The persistence of synthetic and blended fibres in landfill environments, coupled with chemical leaching and greenhouse gas emissions from natural fibre decomposition, underscores the complex risks associated with textile disposal. Despite growing awareness, textile recycling and sustainable management practices remain underutilized due to technological, economic, and policy barriers.

Addressing the impact of textile waste requires a multifaceted approach: strengthening recycling infrastructure, engaging consumers in sustainable behaviours, and implementing supportive policy frameworks that incentivize circular design and production. Only through coordinated action across stakeholders from manufacturers to policymakers to consumers can the environmental burden of textile waste be meaningfully reduced.

6. References

1. Allwood, J. M., Laursen, S. E., De Rodriguez, C. M., & Bocken, N. M. P. (2015). *Well dressed? The present and future sustainability of clothing and textiles in the United Kingdom*. University of Cambridge Institute for Manufacturing.
2. Ellen MacArthur Foundation. (2020). *A new textiles economy: Redesigning fashion's future*. <https://ellenmacarthurfoundation.org>
3. Environmental Protection Agency. (2021). *Advancing sustainable materials management: Facts and figures report*. U.S. EPA. <https://www.epa.gov>
4. Fletcher, K., & Tham, M. (2019). *Earth logic: Fashion action research plan*. The J J Charitable Trust.
5. 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>
6. 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>
7. Shirvanimoghaddam, K., Motamed, B., Ramakrishna, S., & Naebe, M. (2020). Death by waste: Fashion and textile circular economy case. *Science of the Total Environment*, 718, 137317. <https://doi.org/10.1016/j.scitotenv.2020.137317>
8. Bick, R., Halsey, E., & Ekenga, C. C. (2018). The global environmental injustice of fast fashion. *Environmental Health*, 17(1), 92. <https://doi.org/10.1186/s12940-018-0433-7>
9. Koszewska, M. (2018). Circular economy challenges for the textile and clothing industry. *Autex Research Journal*, 18(4), 337–347. <https://doi.org/10.1515/aut-2018-0023>
10. Roos, S., Sandin, G., Zamani, B., & Peters, G. (2016). Environmental assessment of Swedish fashion consumption. *Mistra Future Fashion Report*. Stockholm Environment Institute.



11. Textile Exchange. (2022). *Preferred fiber & materials market report*.
<https://textileexchange.org>