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W4TEX: Strengthening Women's Representation in Senior Textile Positions

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UNIT 5 – END OF LIFE OF THE TEXTILE PRODUCTS

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INTRODUCTION TO THE TOPIC

The end of life (EOL) of textile products refers to the final stage of fabrics and garments, the stage during which these are no longer used in any way and are essentially discarded. We are all familiar with the concept of landfills and how the textile sector contributes to this problem. Besides, landfills are a real problem for society, being a reminder of our vanity and our reckless purchase of textile products that continue to contribute to ever-growing environmental degradation.

The sheer volume of textile waste generated from the relevant sector is a product of a variety of factors like the inability of the sector to correctly foresee consumers' demand, the exaggerated promotion and adoption of consumers of fast fashion, the use of unsustainable methods and materials for textile production and the lack of awareness or unwillingness of textile companies to adopt circular economy models in their material sourcing, manufacturing, packaging, and logistics.

In addition to the above, most textile products are usually a mix of synthetic fibers and dyes that complicate any effort for recycling. Companies find it more cost-effective to simply discard unwanted or excessively produced textile products rather than spend time and money to recycle or reuse them. There are various technological advancements and innovative technologies that sectorial companies can adopt to mitigate the environmental impact of textile waste, but they are still miles away from doing it.

The end-of-life stage of the products is an essential part of the textile industry that influences all other stages in terms of efforts made towards sustainability and reshaping existing policies and decision-making. The final stage of textile products dictates how effective all efforts in previous stages of their life were in terms of eco-consciousness; therefore, understanding the challenges and opportunities related to it is of paramount importance to shape a more sustainable future for the sector.

This module attempts to examine the detrimental effects of the final stage of textile products on the environment and the mitigation measures to be followed to minimize their negative impact.

To enable better understanding, we present you with the following definitions of relevant concepts linked to the module's topic:

Circular economy	An economic system that aims to minimize waste and make the most out of products by reusing or recycling them.

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Closed-loop Recycling	The process of recycling discarded textile products into new ones of the same quality with no added value.
Extended Producer Responsibility (EPR)	A policy approach in manufacturing that holds companies accountable for the overall process of sourcing, producing, distributing, and discarding their products.
Fast fashion	A business model of the textile sector that emphasizes rapid mass production and distribution of products at low cost.
Incineration	The process of reducing waste volume by burning it at high temperatures.
Landfill	A site where waste is being discarded and buried. It usually refers to organic, plastic, and textile waste.
Textile recycling	The process of reusing fibers from old textiles and fabrics to create materials for new products.
Textile take-back schemes	The procedure of collecting and processing discarded textile products by retailers or manufacturers to reuse or recycle them.
Textile waste	Discarded or surplus textile material (e.g. old clothes, fabrics) that come from households and/or manufacturing and retail processes.
Upcycling	The process of reusing/repurposing old textiles to create new products with added value.
Waste hierarchy	A framework that prioritizes waste management strategies.
Zero waste approach	Waste management via effective use of resources, materials, careful design, and recycling.

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DETRIMENTAL EFFECTS

The effects of the improper discarding of textile products during their final stage span from the degradation of the environment to the socio-economic status of society. As global textiles grow in response to the ever-growing consumer demand, these effects are expected to become more and more severe.

Let's explore some of these detrimental effects to better understand the level of influence they have on sustainability and human development.

Environmental Pollution & Health Impact

Landfill overflow and the toxicity of its contents

According to the European Environment Agency (EEA), the number of used textiles exported from the EU has tripled over the past two decades. We basically produce and use textile products, and when their final stage approaches, we discard them to landfills in other countries to avoid pollution, which is kind of ironic and unethical, at least. The preferred 'landfill countries' are usually in Asia or Africa. In most cases, the discarded textile waste in these countries ends up in landfills or informal waste streams, meaning that no eco-friendly process of recycling it takes place whatsoever.

Figure 1 – Source: Freepik.com

The amount of textile waste created by Europeans is approximately as high as 11kg annually per person. The textile products that are no longer wanted by their owners reach their end of life due to a variety of reasons, but we must focus on the reasons behind this. An obvious reason why textile products bring their owners to the decision to discard them would be the different fashion trends that change so rapidly or the consumers' need to buy more. In the end, though, the truth remains that no efficient textile product will be discarded by its owner unless it has lost its efficiency. A garment, for example, whose colour is no longer vibrant or has lost its shape due to wear and tear will be considered no longer sufficient to serve its purpose and will end up in some landfill. This is a very frequent phenomenon, and its route of evil relies on fast fashion and low-cost mass production of textile products using synthetic fibres of lower quality.

These textiles are rich in synthetics, chemicals, and dyes, which contribute to the excessive degradation of the environment they end up in. Landfills are now overflowing with products that contain chemicals that, when in such large concentrations, have detrimental effects on the hosting ecosystem as they do not decompose easily and contribute to long-term pollution. It can take more than 200 years for textiles to decompose in landfill sites. Additionally, microplastics included in synthetic fibers like polyester and acrylic find their way to the ground and water systems and eventually harm all forms of life.

In addition to synthetic fibres, the emergence of “smart textiles” has introduced a new and complex dimension to textile waste. The electronic components that they integrate (e.g. microprocessors, sensors and conductive threads) pose an environmental challenge. Although there are no specific studies on the degradation of smart textiles in landfills, excessive research on e-waste offers valuable insights. Like other e-waste, smart textiles’ electronic components contain heavy metals and chemicals, which can get into soil and water systems if discarded improperly. Given the similarities in composition and degradation behavior between smart textiles and e-waste, it is reasonable to conclude that when smart textiles are discarded into the landfill, they contribute to environmental degradation.

The scenery in landfill locations is reshaping our understanding of the end of life of textile products, forcing us to turn to more sustainable solutions like recycling and reusing.

Carbon footprint and resource wastage

The production of textile products is a very energy-intensive procedure, and so is their decomposition process.

Incineration is preferred by the textile sector process for decomposing products that have reached their end of life. During incineration, due to the high temperatures, harmful gases like carbon dioxide and particulate matter are released into the atmosphere. This contributes extensively to climate change and the greenhouse effect. Approximately 25% of clothing waste is incinerated globally, and its CO_2 emissions fill the atmosphere and eventually find their way into the soil and, in the long run, our organism through the food chain.

Figure 2 – Source: Freepik.com

It is almost ironic to think that the level of CO_2 emissions emitted by a textile product’s sourcing, production, and transport is almost equal to the greenhouse emissions during its decomposing stage, either in the landfill or incineration. Shipping waste textile products to landfills, especially when these sites

are far away, takes a lot of fuel consumption, which generates large amounts of CO_2 emissions. As for the incineration process, it has already been analysed in short how it contributes to the greenhouse effect.

Regardless, the issue here is not just the environmental impact that the end-of-life of textile products has by emitting CO_2 into the atmosphere. It is also a waste of resources that adds to the overall loss in terms of sustainability and environmental pollution. It is a waste of valuable materials like natural fibres or water used in the manufacturing process by choosing to incinerate or simply discard a textile product instead of recycling/ reusing it. It is essentially a loss of time, effort, resources, and opportunities to create something new of equal or even added value. It is a missed chance of taking steps towards sustainability and entrepreneurship as the textile sector keeps on creating short-life products without dedicating time to research, which is a vital element of change and evolution.

Exposure to toxic substances and poor air quality

Due to the chemical nature of substances used in textile production, including dyes, inks, pesticides from cotton farming, or fire retardants in smart fabrics, the people involved in the waste management of textile products are constantly at risk. Some of the health-associated risks are:

- Skin irritations and sensitivity

Exposure to toxic chemicals in textiles can cause skin inflammation, commonly known as dermatitis. Its symptoms can be chronic or acute depending on the level and duration of exposure and include redness, swelling, blistering, and/or itching. Additionally, it can cause skin injuries like burns and lead to epidermic allergic reactions such as eczema, rashes, or hives.

- Respiratory issues

Asthma and bronchitis occur when individuals are exposed to textile chemicals for a prolonged period. In severe cases, it can lead to lung tissue damage, increasing the risk of respiratory diseases like pulmonary fibrosis. In most cases, people handling textile waste for some period experience symptoms of shortness of breath or coughing.

Figure 3 – Source: Freepik.com

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- Risk of cancer

Certain chemicals used in textile production are classified as carcinogens, meaning that they have been associated with triggering skin and respiratory cancer. Such chemical agents are formaldehyde and azo dyes that release aromatic amines into the air and can be very dangerous in poorly ventilated spaces like warehouses or sorting hubs.

Figure 4 – Source: Freepik.com

- Neurological effects

Dizziness, nausea, and headaches are common symptoms for people working in textile waste management or production as they maintain contact with chemical substances contained in fabrics at high frequency. Textile solvents have been associated with neurological damage and seem to affect proper brain functions like memory, concentration, and coordination.

- Reproductive health issues

Certain chemicals used in textile production have been accused of causing miscarriages or leading to the delivery of low-birth-weight babies. Moreover, they can disrupt the hormonal system, leading to reproductive issues.

Figure 5 – Source: Freepik.com

The most vulnerable groups that are at high risk of suffering one or more of the above health issues are:

- Informal workers: people working in non-formal textile waste management industries, such as recyclers and waste pickers, who are not being equipped with protective gear.
- Children or people with fragile health in areas that are being used as landfills and are close to discarded textiles.
- Habitants of areas that are being used as textile waste pools. Such areas are usually inhabited by low-income people who experience all side effects of textile waste pollution not only by coming in direct contact with the chemicals they contain but also by having to breathe the polluted air it produces.

Socio-economic Impact

Impact on economy

The textile sector in the EU employs over 1.3 million people, according to the European Commission's "EU Strategy for Sustainable & Circular Textiles", published in March 2022. This number is expected to grow, and hopefully, textile recycling will cover a big percentage of it.

Figure 6 – Source: Freepik.com

The end-of-life of textiles has a potentially significant role in the socioeconomic development of local communities in the context of waste management and recycling. Managing textile waste and processing it for recycling or reuse can lead to the creation of additional job opportunities within the sector. Moreover, it can contribute to the enrichment of the industry with advanced technologies, sustainable solutions, and further development of infrastructure. Most importantly, if the textile industry chooses to invest in proper textile waste management of products reaching their end of life, then informal waste sectors will cease to exist, ensuring that workers of these sectors will be employed under legal, ethical, and safe conditions.

Adopting a circular approach to the waste management of end-of-life textile products benefits societies and economies in a multi-faceted way:

- Promoting textile products' longevity

Although the socio-economic impact of managing/recycling the waste from end-of-life textile products can be great, acting proactively remains the best practice for promoting sustainability. In the specific case, proactivity refers to the efforts for extending the textile products' lifespan. It can be achieved by educating all relevant sector stakeholders on proper practices for maintaining and caring for textile products (e.g. use of appropriate temperatures and detergents when washing) and by highlighting repair and alteration as services that add value to the textiles by giving them a sense of craftmanship. Especially for consumers, this shift in their mindset could not only support sustainability in the sector but also foster new economic opportunities, such as mending and re-designing services.

- Development of circular economy and job creation

Textile recycling can substitute textile waste management (landfills, incineration) effectively. This shift towards a circular economy model that focuses on recycling and reusing can lead to the creation of new green roles in the sector, specifically in the fields of recycling technologies, upcycling, and manufacturing. This, combined with the establishment of recycling hubs in areas with high unemployment rates, can uplift local economies. Moreover, specifically for workers in informal waste sectors, the official adoption of a circular economy system in textile waste management can offer them fair pay and up-to-date health and safety conditions in their workplace.

Figure 7 – Source: Freepik.com

- <u>Economic benefits from waste management of resources</u>

By recycling textile products that have reached their end of life, the industry acts proactively in terms of extracting raw materials for the manufacturing of new ones. The reuse of textiles generates major savings in terms of raw materials, water, and energy usage. As a result, the overall production cost is reduced. Additionally, it minimizes the need for importing raw materials and highlights the development and maintenance of robust supply chains on a local level.

- <u>Economic benefits from reduced carbon footprint</u>

The circular economy approach can increase the overall profit of the textile sector in an indirect form. More specifically, by adopting upcycling/ recycling of textile products, the sector minimizes its carbon footprint and contributes to the EU climate goals. This means that the textile industry will be able to save time and, more importantly, money that would potentially be spent towards battling environmental degradation (e.g., healthcare costs for health issues related to pollution).

Figure 8 – Source: Freepik.com

- <u>Opportunities for expanding recycling networking</u>

Developing a well-organized and robust circular economy sends out the message that the textile industry is taking steps forward and provides others with trust in the sector. Chances for collaboration with new markets and expansion of existing networks become more visible and frequent. In the long term, this is beneficial for the textile sector as it guarantees its economic growth among other positive outcomes.

- <u>Shift in consumers' spending and support of sustainable fashion</u>

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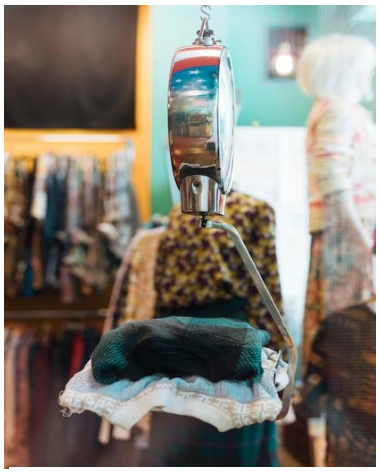

Figure 9 – Source: Freepik.com

EU consumers are nowadays characterized by a desire to follow the constantly growing trend of shifting toward sustainable fashion. This includes products that have been ethically produced but also products that have been given a second chance upon arrival of their end-of-life time. There is an increasing number of companies asking consumers to recycle their old textiles in specially allocated bins within their retail stores, and the number of second-hand fashion shops is rising. Consumers' demand for sustainable fashion is not only due to their continuously developing eco-consciousness but also because second-hand textile products are usually more cost-effective. This is a win-win condition where both consumers and the environment experience the positive effects of sustainability in the textile sector.

Degradation of human/wildlife ecosystems and bonds

The ineffective waste management of textile products at the end of their life cycle affects the world not just on an economic level but can also be a severe challenge for human health and wildlife ecosystems. Given the fact that textiles are mankind's discovery, it is not an exaggeration to say that humankind is responsible for the disruption of their relationship with nature and all organisms that it encloses.

The risks that result from improper textile waste management to human health and degradation of wildlife ecosystems include but are not limited to the following:

- Air and water pollution

Figure 8 – Source: Freepik.com

The chemicals contained in textiles (e.g., dyes, inks, flame retardants) are released into the atmosphere during the end-of-life stage of products either by leaking into the landfill's soil or evaporating into the air during incineration. Additionally, pollutant substances like microplastics leak from textiles into the waterfront during their transportation by sea. As a result of the above, the air becomes unclean, the soil is contaminated, and the marine environments experience pollution. Humans begin to develop respiratory health issues; the food they grow is now full of chemicals that give them short and long-term health conditions, and all aquatic life ingests microplastics and chemicals that alter their environment. The pollution of marine and agricultural ecosystems from textile waste is sometimes not visible to the bare eye and has probably been going on for years but has become more

intense and its effects more severe since the wide adoption of e-commerce and fast fashion by consumers.

- Toxicity in wildlife and threat to biodiversity

The contamination of soil and sea with toxic chemicals from textiles presents a real threat to entire ecosystems and can even lead to population declines of certain species. It is truly remarkable the level of damage it can do to terrestrial and marine biodiversity.

Chemicals like heavy metals (e.g., cadmium, mercury) that are contained in textiles can persist in the soil for years, affecting both plants and animals. The first microorganisms thriving in the soil to be contaminated are earthworms and microbes, whose role in ecosystems is vital. These microorganisms allow the soil to be fertile and contribute to the recycling of CO_2, and as one can imagine, when their numbers decline due to soil contamination, the effects can be multifaceted and severe.

Figure 11 – Source: Freepik.com

Plants accumulate the chemicals from contaminated soil, and as the food chain moves up, herbivore animals feed on them and consequently ingest the chemicals. Next, the carnivores and omnivores feed on the herbivores, and all the harmful substances end up in their bloodstream. By using the natural food chain principle as a vessel, dangerous toxic chemicals from textiles enter the organisms of all wildlife and cause disruptions in the normal cycle of life. Wildlife animals may present increased vulnerability to disease, reproduction problems, and lower birth rates. In some cases, these chemicals can even cause abnormal development in wildlife animals or unbalanced sex ratios and, therefore, population decline in their species.

Figure 12 – Source: Freepik.com

The pollution of the aquatic ecosystems from microplastics and the chemicals leaking from the textile products that are at their end-of-life stage is, unfortunately, of great scale. Marine organisms ingest all these harmful tiny particles and chemical substances, mistaking them for food. As a result, they suffer blockage of their digestive system, which causes them to starve to death, and high levels of toxicity that give them short- and long-term suffering. These pollutant agents are also ingested by aquatic organisms like mussels and oysters that can filter the water, As a result, their numbers and, consequently, the marine ecosystem decline.

- Breaking the human-wildlife bond

The human- wildlife bond refers to the deep connection that humans share with the natural world, a bond that has been in place since the beginning of time. It is a connection that is profoundly beneficial for humans as they have been relying on animals and plants for all aspects of their lives: food, health, socialization and cultural practices, as well as emotional and spiritual being. The degradation of the ecosystems due to textile waste and improper management of textile products reaching their end of life has affected this bond immensely.

The pollution of soil, air, and sea has led to the destruction of the natural world's habitats. People living in areas close to such habitats have come to realize the extent of this effect. Think of contamination in rivers, lakes, and streams, the change of habits and environment of different animals due to pollution, the toxicity in marine life that leads to dead fish on the sea surface, or high levels of toxicity in sea life creatures that are part of the human food chain. The natural world suffers the consequences of the pollution caused by human activities and loses its connection to mankind. Humans feel it too when, for example, they can no longer go fishing due to the high level of toxicity in the water or when they issue warnings on consumption of animal products that high concentrations of chemical substances were detected.

Figure 13 – Source: Freepik.com

The health and well-being of humans were always related to and dependent on the natural world. For instance, in some indigenous populations, the natural world and its health and prosperity are connected to spiritual practices and traditional rituals that sustain the community's sense of belonging and cultural identity. In other parts of the modern world, nature and sustainable ecosystems are a source of income for human habitats via tourism or agriculture. The extinction of species or the contamination of the soil can affect these areas severely.

Figure 14 – Source: Freepik.com

People have lost the close contact they used to have with nature partially because pollution caused by several reasons (textile waste is one of them) disrupted nurturing activities that they once experienced in it. The rise of e-commerce and fast fashion is all the evidence we need

to prove that humans are now disconnected from nature and no longer care or can understand in depth the effect of their actions on it.

MITIGATION MEASURES

The end of the life of textile products can contribute to waste, pollution, and environmental degradation to a great extent. Certain measures can be taken to minimize or eliminate the risks posed by the detrimental effects on the ecosystems. Following is a brief presentation of ways we can support environmental sustainability during the management of textile products that have reached their final stage.

Proactivity in production

Durability and repairability in design

Encouraging textile companies to produce high-quality textiles that are characterized by longevity and can be repaired easily if necessary is one of the easiest ways to support sustainability in the sector and prevent pollution.

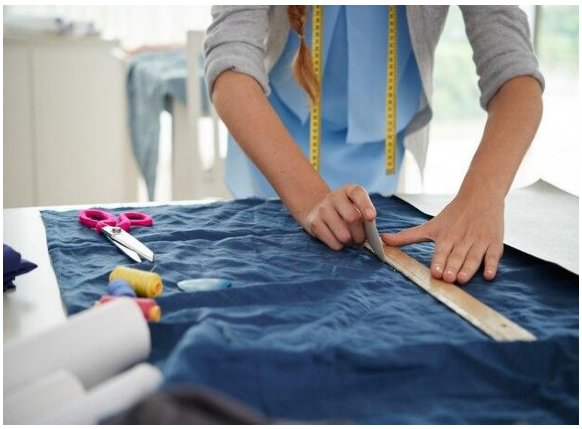

Figure 15– Source: Freepik.com

Textile design is dictated by consumers' demand but is adaptable to changes depending on available resources and materials. The sector needs to start thinking about how design can prolong fibers' life by incorporating techniques and materials that are receptive to different conditions, maintain their characteristics, and can be maintained easily. Smart textiles, for example, do not fulfill all these characteristics as they have microprocessors and technologically advanced components that are hard to replace if needed. That leads to the fabrics being discarded without any opportunities for restoration or upcycling.

Figure 9 – Source: Freepik.com

Additionally, whenever the use of simple and durable design in textiles is not possible, companies should think about creating special services offering repair and restoration at affordable to the average consumer prices.

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Ethical manufacturing

To support sustainability and minimize pollution from textile waste, companies in the sector must pay attention to ethical manufacturing. From sourcing eco-friendly raw materials to the methods and materials they use for making their products desirable, everything should be in line with green energy and free of chemicals.

By doing so, their companies act proactively and minimize the amount of pollutant agents like chemicals and microplastics leak into the environment. Natural fiber and dyes are composed of substances that are eco-friendly and do not disturb nature's course in any way.

Figure 17– Source: Freepik.com

Circular economy and collaborative waste management systems

Material recovery and reuse

The textile sector must urgently invest in the circular economy. In closed-loop systems, products are being used for as long as possible, and when their end-of-life date is here, they get a second chance by being recycled or repurposed. Imagine how this would be beneficial from an environmental point of view in the textile sector with all the boost that it experiences. That, in combination with the use of sustainable materials and design in manufacturing, could be the only thing necessary to lead the way into an overall sustainable and progressive textile sector.

Figure 18– Source: Freepik.com

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Partnerships for Effective Waste Management

Should textile companies choose to form effective and open-source collaborations with local authorities, waste management companies, and competitors to battle the waste and pollution they cause, the world would be a much greener place. This would require textile companies to establish procedures and frameworks for effective waste management and, additionally, a robust networking system that would rely on blockchain for transparency and accurate monitoring of the process.

Figure 19– Source: Freepik.com

This concept is supported by SDG 17, which focuses on the need for robust global cooperation and the importance of multi-stakeholder partnerships for the enhancement of sustainable development. It underlines the effectiveness of knowledge exchange, co-development of innovative solutions and coordinated investment in sustainable infrastructure.

CONCLUSION

The end of life of textile products poses a hurdle in efforts towards environmental sustainability as it is a source of contamination of the soil, air, and sea pollution and general degradation of the ecosystem. The reasons for this are various, but primarily, it is the effect of the chemicals and polluting materials used in the textile manufacturing phase. These effects are intensified by inefficient waste management and the discarding of textile products no longer in use.

The contamination and pollution of the environment related to textile waste and the discarding of no longer used fabrics affect all living creatures and plantations in many ways, all of which are disturbing for their ecosystem.

Its effect goes beyond and reaches the point that disturbs the eternal bond between humans and the natural world. This relationship is of profound importance for mankind and always has been, but unfortunately, its foundations begin to crumble due to the excessive and uncontrollable consumerism of all humans.

There are ways in which textile companies can act to repair the damage caused and, most importantly, stop it from happening again in the future. For example,

manufacturers can start incorporating in their production materials and methods of producing that are more sustainable. Additionally, they can invest in designing textiles that are more durable and repairable, aiming to prolong their life cycle and provide more chances for recycling/ reusing them later.

On the other hand, the textile sector would benefit by adopting a circular economic model followed by an extensive network of partnerships relevant to waste management and legal framework collaborations.

In conclusion, the growing consumer demand for textiles must not pose a threat to the environment. Companies in the sector need to act accordingly and stop their textile products from polluting the environment once they are no longer being used. Their efforts must be joined and characterized by ethical procedures in all stages of manufacturing. The strong bond that humans share with nature must carry on, no matter what. Our connection to the natural world is above and beyond any need for buying more products.

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