

Review

**TEXTILE WASTE MANAGEMENT IN THE CONTEXT OF THE CIRCULAR
ECONOMY AND ITS SOCIOECONOMIC EFFECTS**

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Abstract

The textile industry, although it represents an important economic sector, simultaneously generates large amounts of waste and has a significant negative impact on the environment. The problem is further intensified by the emergence of fast fashion, which encourages the short-term use of products and their accelerated disposal, despite the fact that many of them are still functionally usable. This model of production and consumption leads to increased exploitation of resources, growth in the amount of waste and deepening of environmental consequences. The application of circular economy principles in the textile industry represents a key step towards sustainable resource management. It is based on reuse, repair, recycling and rational use of materials, which extends the life cycle of products and reduces the amount of waste that ends up in landfills. Textile waste management represents an increasingly significant challenge for modern societies in the context of sustainable development. Textile waste management through this concept not only contributes to environmental protection, but also has significant socioeconomic effects. This paper analyzes the socioeconomic effects of textile waste management, with a focus on employment opportunities and the circular economy

Keywords: textile waste, circular economy, environment, recycling, employment.

INTRODUCTION

The circular economy is a concept aimed at reducing negative impacts on the environment by extending the life of products [1]. Its practical application is based on the principles of sharing, borrowing, reusing, repairing and recycling existing materials and products, to the greatest extent possible. After the end of the use cycle, the materials from which the product is made are processed and used again, most often for the production of new products. This cyclical process of recycling and reuse aims to continuously reduce the amount of waste that is disposed of, as well as to preserve natural resources [2].

Unlike the traditional linear model, in which raw materials are exploited for the production of goods that are discarded and disposed of in landfills after use, the circular economy tends to close material flows and extend the life cycle of resources. The circular economy represents an important instrument for achieving the goals of sustainable development, as it implies

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long-term investments in sustainable management of raw materials, improvement of energy efficiency, reduction of pollution, application of renewable energy sources, as well as development of models of sustainable production and consumption [3].

The textile industry is one of the sectors with a particularly high level of waste generation, which is why the application of circular economy principles in this area can achieve significant economic and environmental benefits. The UN Sustainable Development Agenda 2030 defines the key goals of the development of modern society, whereby the transition to a circular economy is recognized as one of the priority directions of action in the field of environmental protection and mitigation of climate change [4].

On the one hand, circular models enable the creation of new jobs in the sectors of collection, sorting, recycling and production of secondary products. On the other hand, reducing the consumption of resources and more efficient use of materials contributes to reducing production costs and increasing the economic viability of the sector. In addition, the application of the circular economy has the potential to influence consumer awareness and promote more responsible habits in the use of textile products, which in the long term contributes to reducing pressure on the environment and improving social sustainability. In this context, effective management of textile waste becomes a strategic goal that integrates environmental, economic and social aspects, thereby enabling the sustainable development of the sector and society as a whole.

TEXTILE WASTE MANAGEMENT AND TEXTILE RECYCLING

In European Union countries, less than half of end-of-life clothing is collected for reuse and recycling, with only 1% of used clothing being turned into new clothing [5]. The low percentage of recycling is largely due to the fact that the technologies for recycling clothing into fibers that can be reused to make new items are still in the early stages of development. Generating large amounts of textile waste, donating clothes to less developed countries and exporting them in the form of used products, create short-term solutions that reduce the amount of textile waste in developed countries and increase this problem in less wealthy countries, which take upon themselves the storage of clothes after their use [6].

Textile recycling means the reuse or processing of textile materials with the aim of reducing waste, preserving resources and reducing the negative impact on the environment. As such, textile recycling is an important part of sustainable waste management and has a major impact on environmental protection. In addition, clothing that cannot be reused can be converted into products such as recycled fabric or other materials for recycling.

Textile recycling includes the collection, sorting, processing and reuse of old or damaged textile products, such as clothing, bedding and other textile materials. Clothing recycling is a model for converting and processing textile waste or useless clothing into new fashion products when the original condition of the clothing is difficult to reuse [7]. Sources of textile waste, such as waste from textile and clothing production, commercial services and consumption, have raised concerns about the creation of innovative circular textile solutions worldwide. In recent years, the management and disposal of textile waste has become an increasingly urgent global problem [8–11].

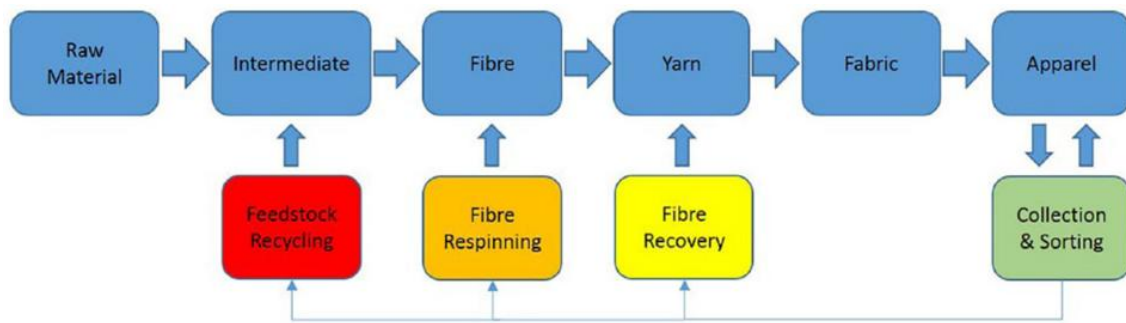


Figure 1 Textile processing chain and recycling processes [10]

Textile recycling offers the following advantages and benefits to society:

- Reduction of waste and reduction of landfills (a huge amount of textiles end up in landfills, where they decompose slowly);
- Resource saving (textile production consumes a lot of water, energy and chemicals);
- Less pollution (synthetic materials release microplastics and are more difficult to decompose);
- Reduction of CO₂ emissions (less textile production means less greenhouse gas emissions);
- Encourages the circular economy (increases the use of materials that have already been produced);
- Support for sustainable fashion (encourages responsible behavior in fashion and consumption).

Textile disposal is done in several ways depending on the type of textile, its condition and the local infrastructure for waste management. These are the main ways to dispose of textiles:

- Donation to humanitarian organizations (Red Cross, local NGOs);
- Sale or exchange (through second-hand stores, online platforms or flea markets);
- Household reuse (old clothes can be turned into wipes, pillowcases, bags, etc.);
- Boutiques that accept old clothes (e.g. H&M, Zara in some countries);
- Specialized bins/containers for textiles (often in larger markets and in urban areas there are containers for collecting textiles);
- Industrial recycling (textiles are mechanically or chemically processed into raw materials for new clothes, insulating materials, furniture filling, etc.);
- Recycling centers (local recycling centers), municipal points and waste;
- Landfilling (if there are no other options, textiles end up in landfills, where they degrade slowly and synthetic materials can pollute soil and water, and this is the least sustainable option to avoid whenever possible).

Textile recycling is an important step towards preserving our planet. Disposing of old clothes responsibly, repairing clothes that can still be worn and avoiding buying more than we need are steps that can mean a lot for our future.

The used clothing/textile industry is a resilient, adaptable business model with clearly defined costs [12]. Textile-to-textile recycling offers many long-term strategic advantages that reuse/resale does not:

- a) no competition with the new fashion retail sector/employment,
- b) a work-based strategy for separation from original material resources,
- c) the possibility of training the existing workforce,
- d) a large job creation is needed to meet the global demand for ecological fibres [13].

THEORETICAL FRAMEWORK: WASTE MANAGEMENT AND SOCIOECONOMIC IMPACTS

Effective waste management does not only mean its disposal, but also the transformation of waste into a resource. In the context of textiles, socioeconomic effects are reflected in:

- reducing raw material costs,
- generating jobs (especially for vulnerable groups),
- development of innovative business models.

The role of the state and the legislative framework is crucial, especially in the application of the principle of extended producer responsibility (EPR), which encourages the design of products for durability and recyclability.

According to the latest available data from the Statistical Yearbook of the Republic of Serbia for the year 2025, the number of employees in the textile industry sector (the number includes the production of textiles, clothing and leather) is 49,843 [14]. The given data refer only to the general category, and do not refer to the reuse and recycling of textiles. There is no exact statistical number exclusively for textile recycling employees in Serbia, but it is possible to get only a rough estimate. As the total number of employees in the recycling sector is around 5,000–6,000 people, but textile recycling makes up only a small part of that, probably around 500 employees, most often in private companies dealing with the collection and processing of secondary raw materials.

Germany currently collects up to 75% of its textile waste for reuse and recycling [15]. According to the European Environment Agency (EEA), the recycling and sustainable manufacturing sectors have created more than 4 million jobs, with textile recycling identified as a significant sub-sector for growth. A 2020 study by the European Clothing and Textile Confederation estimates that around 20 jobs can be created for every 1,000 metric tons of textiles collected.

The analysis of given data sources clearly shows the potential for creating new jobs in the transition of the circular economy [16]. This transition is gaining strength, as public concern puts the facts about textile waste, its disposal and complex production processes in the center of attention [17]. The industry is now on its way to viewing its waste stream as a strategic raw material, and the circular model as the best long-term solution for providing raw materials for textile production. Powering this reshaping of the unused value of textile waste is a revolutionary technology that is fast approaching. This is certainly a huge opportunity, along with the potential for huge growth. Once the production process is up and running, this renewed industry will require the creation of new jobs and the acquisition of skills related to the preparation of textiles for recycling.

On the other hand, the main drivers of the economy in the textile industry of Serbia are employees, who should have attitudes about an eco-oriented ethos [18]. In other words, it is

necessary that the employee has safe and healthy working conditions, regular payment of personal income, work relationship without overtime that is not conditioned by discrimination or forced labor, and that all legal conditions apply to their work relationship [15]. Opening new jobs means that employees can count on safe work, social and health benefits, and the workplace to be the center of everyday life, because in addition to salary, it also provides a wide range of social services (education, training, hot meals, health insurance, childcare, subsidized vacations, etc.) [19].

Understanding how employment can be applied to textile recycling in the future is crucial for creating new jobs through the circular economy [20]. The fact that 61,000 people are already employed in the textile sector in Serbia, which indicates that it is a powerful sector, it is necessary to single out the category of textile recycling/reuse, which can bring strong growth in the next business cycle [18]. As the textile recycling sector grows, more workers will be needed to collect, sort and process materials for recycling, including both „low-skilled” and „high-skilled” jobs [21].

The workforce should be multi-skilled and with a smaller number of workers. Workers should rotate around different projects, while managers should be able to lead projects, measure performance, drive innovation, manage talent and communicate effectively. This also presents new challenges for skill development and requires a fundamentally different skill set for managers and workers [15].

The most common jobs in the textile recycling sector:

- Operators for sorting and sorting textiles;
- Technicians for material separation (e.g. cotton, polyester, wool, etc.);
- Designers for "zero-waste" fashion;
- Engineers for sustainable fiber development;
- Experts in logistics and waste management.

The National Employment Service describes the textile sorter job as follows: „Textile sorters work along conveyor belts to manually separate unwanted textiles into specific material categories in plants. Qualifications: entry level/physically demanding”. The reuse/resale market depends on intensive sorting in order to generate income. Every textile-to-textile recycling platform today incorporates manual sorting into its operations. Sorting is generally considered unskilled work at entry levels, with minimal compensation [22].

The disposal of textile waste is of key importance for the circular economy strategy and is linked to an increase in the number of jobs. The Environmental Protection Agency helps in collecting and diverting textile waste, and converting it into valuable raw materials. However, recruiting and retaining workers is perhaps the biggest challenge facing the labor market in the textile sector in Serbia.

Effective and profitable implementation of a new workforce is not a problem if the required workers cannot be recruited and retained. Retaining highly skilled workers, such as engineers and plant operators, is a challenge that can be solved through retraining and upskilling. The use of vocational training and education is a modern approach for „lifelong

training” while encouraging the acceptance of circular strategies [23]; which, if adopted, will strengthen the efforts of Serbia's textile/recycling industry to retain its workforce.

CONCLUSION

The textile recycling sector represents an important segment of the broader circular economy and has seen rapid growth in recent years, due to the increasing demand for sustainable fashion, strengthening of legal regulations that limit textile waste and growing consumer awareness of environmental problems. The increase in activity in this sector is accompanied by the growth of employment, especially in areas that combine digital tools, sustainable design and waste management, thus opening real chances for career development within the circular economy.

The long-term impact on job creation in the textile sector can be significantly improved through regulatory and economic policies. The introduction of legal frameworks, such as extended producer responsibility, contributes to increasing the recycling rate, intensifying the collection of textile waste and creating new jobs. The data show that there is significant potential for employment in the areas of collection, sorting, processing and recycling of textile waste.

The application of the circular economy model, in which waste is viewed as a strategic raw material, is one of the key ways to ensure the long-term provision of resources in the textile sector. Improving business models and harmonizing operations with the principles of the circular economy in the Republic of Serbia can contribute to increasing the competitiveness of national companies, while simultaneously solving social and economic challenges, especially in the textile sector.

Textile waste management has great potential for socioeconomic development, especially in countries like Serbia, which has a long tradition of textile production and a high unemployment rate in certain regions. By combining environmental and social goals, Serbia should develop a national plan for textile waste management in accordance with EU practices and increase consumer awareness of sustainable consumption.

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