



Environmental and Waste Management in the Garment Industry in the Republic of Moldova

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Abstract- This paper reflects the situation in the Republic of Moldova regarding environmental management in the garment industry with focus on textile waste recycling and identification of possibilities for raising the industry sustainability and encouraging the transition to circularity principles. Moldova's Apparel is the largest and best-performing industry of the Moldovan economy. It is one of the largest exporters and an important employment generator. The COVID-19 pandemic has disrupted the Moldovan garment industry like never before, but even in these conditions the industry managed to remain in the top of the three Moldovan exporters. The bad part of the garment industry is that it is a big waste-generating industry at both stages: pre-consumption and postconsumption stage. Textile waste which are formed at preconsumption stage are not sorted, therefore they are not recycled. However, in Moldova there are some initiatives for recycling waste obtained in the garment industry. Practice shows there are certain initiatives for the collection and recycling of waste that appear at the post-consumption stage. In order to multiply the existing practices of collecting and recycling of the waste appeared in the garment industry, an information and training of both the enterprises and the population regarding the benefits of the circular economy is required.

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I. INTRODUCTION

In recent years, the effects and consequences of climate change have become more pronounced. These changes are greatly influenced both by the used technologies, but also by the waste that is formed in enormous quantities in different industries, including garment industry, which is a fundamental part of everyday life and an important sector in the global economy.

Clothing represents more than 60% of the total textiles used and in the last 15 years, clothing production has approximately doubled, driven by a growing middle-class population across the globe and increased per capita sales in mature economies. At the same time, clothing use has declined by almost 40%. Both developments are mainly due to the "fast fashion" phenomenon, with quicker turnaround of new styles, increased number of collections offered per year, and often, lower prices [1].

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The fashion industry has a massive impact on the environment, being responsible for 20% of the world's wastewater, 10% of carbon emissions and large amounts of waste. Every second, a garbage truck full of textiles is dumped in the landfill or incinerated. But an unseen impact is the pollution of the oceans with plastic fibers. About 60% of the materials used in clothing are made of plastic. According to the United Nations Environment Program the fashion industry has contributed to the pollution of the oceans with about 1.4 million trillion plastic fibers due to the use of synthetic fibers such as polyester, acrylic and nylon [2].

Globally, less than 1% of clothes are recycled as clothing, partly due to inadequate technology.

Regardless of the size of the country, environmental pollution is the same. The fashion industry in Moldova is a big generator of waste at the pre-consumption stage, but especially at the post-consumption stage. At the pre-consumption stage, the waste is generated by the growing number of garment companies and their production capacities, which do not sort and recycle the waste, so waste go directly to the landfill, with small exceptions.

The consumption of clothes in Moldova is quite high and is caused primarily by the traditions and culture of the country. It generates an enormous amount of waste at the post-consumption stage.

The problem of sorting, collecting, and recycling textile waste today became extremely important because it can generate savings on the one hand, and on the other hand it would protect the environment.

This paper aims to analyze the situation in the Republic of Moldova regarding environmental management in the garment industry with focus on textile waste recycling, and to present the existing potential for increasing the sustainability of the apparel industry by encouraging the transition to the principles of circularity.

II. ENVIRONMENTAL MANAGEMENT AND WASTE RECYCLING IN THE MOLDOVA'S GARMENT INDUSTRY

a) Overview of Moldova's Garment Industry and its trends

Moldova's Apparel Industry is a key sector of the Moldovan economy (more than 5% in total Manufacturing Industry). Is the largest and best-

performing industry of the Moldovan economy and an important employment generator (16000 employees or approx. 20% of the total number of employees in the manufacturing industry), creates jobs and employs women, a big part of them being young and provides key alternatives to migration for Moldovan women, allowing them to earn money while staying at home with their families.

Moldova's apparel industry is one of the largest exporters in the Moldovan economy (about 12 percent of the total exports). Over 70% of the total value of clothing production manufactured in the Republic of Moldova, are export oriented.

Table 1: Export of the garment industry, mil US\$

Indicators	2019	2020	2020/ 2019, %
Textile and Apparel Export	325,363.29	289,801.08	88.9
Total Exports	2 779 164.47	2 485 159.94	89.4
The share of Apparel industry in total exports, %	11.7	11.7	

Source: [3].

Most of Moldova's Apparel companies provide C&M (Cut & Make), CMT (Cut, Make Trimming) and FOB (Free on Board) services for European clients. Some companies produce and sell only under their own brand.

Regardless of the business model practiced by Moldovan garment companies, they must consider environmental and occupational safety standards if they want to retain and / or attract new European customers.

The consequences of the COVID-19 pandemic result not only in the economic decline of the garment industry, but also in the increase in the amount of waste, which will further influence environmental pollution.

b) Integration of international environmental, health and safety standards into current practices of Moldova's apparel companies

European Apparel and Textile Confederation EURATEX developed an ambitious program to improve the sustainable growth of the European textile and clothing industry. According to this program, the textile and fashion products of European Union producers must be exceptional in terms of environmental protection, consumer safety and labor rights, which means that special attention is paid to the existence of quality, environmental and occupational safety management systems at the garment manufacturers. Moldovan apparel companies should align with these conditions if they want to retain and / or attract new European customers. To meet these requirements Moldova's Apparel companies must implement Integrated Management Systems based on the provisions of the following international Standards ISO 9001 (Quality), ISO 45001 (Health and Safety), and ISO 14000 (Environment).

The COVID-19 pandemic has disrupted the Moldovan apparel industry like never before. In the pandemic period the number of employees within the Apparel Industry has decreased on average with 33%. Exports in the first half of 2020 fell by more than 38%. But since May 2020, the industry has experienced a recovery trend. In 2020, the export of the garment industry amounted to US \$ 289,801.1 Thousand, or 89.1% compared to year 2019, and the share of this industry in the country's total exports was at the level of the previous year (more than 11%), which means that the industry remains one of the top exporters (Table 1).

The Integrated Management System can be created using different combinations of the three international standards as follows:

1. Integrated Management System "Quality - Occupational Health and Safety" based on the requirements of ISO 9001 and ISO 45001 standards.
2. Integrated Management System "Quality - Environment" based on the requirements of ISO 9001 and ISO 14000 standards.
3. Integrated Management System "Environment - Occupational Health and Safety" based on the requirements of ISO 14000 and ISO 45001 standards.
4. Integrated Management System "Quality - Environment - Occupational Health and Safety" based on the requirements of ISO 9001, ISO 14000, and ISO 45001 standards.

The most complex version of the Integrated Management System is the fourth version, which combines quality assurance, vital safety, and environmental protection. The implementation of Integrated Management Systems that demonstrate business practices based on responsibility and sustainability, as a rule, requires investments that ensure the success of each factory, but also of the industry as a whole and become increasingly important for international customers, and in many cases even requested by them. With the support of the MCP Project (Moldovan Competitiveness Project) funded by USAID, the Government of Sweden, and the UK aid more than 20 apparel companies implemented Integrated Management Systems. This practice has shown visible results. Orders worth tens of millions of Euros have been

secured from existing customers, but new customers have also been attracted by Moldovan Apparel companies that have implemented Integrated Management Systems. This demonstrated that implementation of Integrated Management Systems needs to be extended, given that in the future there will be increasingly stringent requirements for the business activity of companies in the garment industry to meet the requirements of customers and consumers who have undergone essential changes such as due to the influence of the Covid-19 pandemic.

Foreign clients encourage their partners apparel manufacturers from the Republic of Moldova to make ongoing efforts to ensure optimizations for sustainability, and commitment to environmental protection and compliance with occupational health and safety requirements given that the industry uses a very high labor force. Moldovan apparel companies must comply with requirements regarding:

- having a valid environmental permit,
- holding and displaying the environmental policy to address the environmental impact,
- monitoring the impact of the apparel manufacturer's economic activity on the environment,
- setting and approving objectives on environmental issues related to reduction in water consumption and waste disposal, as well as energy consumption and GHG emissions - greenhouse gases,
- providing recycling waste opportunities and monitoring the amount of recycled waste.

c) *Moldovan Legal framework regarding environmental protection and waste management*

In the Republic of Moldova, the legal requirements in the field of environmental protection and waste management are provided by the Environment Agency which is responsible for implementing the state policy in this field. It ensures the implementation of the environmental legislation, harmonized with the European Union legislation established in the Association Agreement between the Republic of Moldova and the European Union, in the chapters "Environment", "Climate change" and "Trade and trade-related issues" (about 50 EU directives, regulations and decisions). The Agency is responsible for the implementation of new environmental tools such as: creation, maintenance and management of the environmental impact assessment system deriving from economic activities, the strategic environmental assessment system, the integrated environmental information system, the monitoring system of the quality of the environment, the monitoring system of natural resources, the integrated environmental authorization system, etc. [4].

The Moldovan legal and institutional frame work regarding environmental protection and waste management contains 49 documents. But the main documents related to environment and waste management are the following:

1. *Environmental Strategy for the period 2014-2023*, approved by Government Decision no. 301 of 24.04.2014, which sets out the priority directions of development in this field. The basic goal of the strategy is to guarantee the population of the Republic of Moldova the right to a sustainable unpolluted and healthy environment, in harmony with economic development and social welfare. The general objective is to create an efficient environmental management system, which will contribute to increasing the quality of environmental factors and ensure the population the right to a clean, healthy, and sustainable natural environment [5].
2. *The Waste Management Strategy in the Republic of Moldova for the years 2013-2027*, approved by Government Decision no. 248 of April 10, 2013. The main objective of the strategy is to establish the indicative direction of the activities for the development of the infrastructure and services necessary for the proper management of waste to protect the environment and the health of the population. Regarding the industrial waste (to which the apparel waste also refers) in a certain strategy it is indicated that the organization of the production waste management activity is the obligation of the generator, i. e. of the enterprise. In the strategy it is clearly indicated that the economic units carry out these activities with their own means or contract the sanitation services. Waste management followed by the apparel factories must be in line with these requirements [6].
3. *Law of the Republic of Moldova No. 209 of 29-07-2016 on waste*, which mentions the waste hierarchy, which includes prevention, preparation for reuse, recycling, other recovery operations, including energy recovery and disposal. According to Article 13, paragraph 2 of this law, to ensure a high degree of recovery, the initial waste generators and waste holders are required to collect at least the following categories of waste separately: paper, glass, metal, and plastic [7]. The garment factories in the Republic of Moldova comply with these provisions of the law and collect cardboard and film separately. As for the fabric and apparel cutting waste, which is formed in the cutting sections, the law does not require their separate collection. As there is no mandatory legal requirement, today, fabric waste, which appears in the cutting sections, is neither collected separately, nor recycled.

The environmental issues, which are closely connected to the waste management, can no longer be addressed separately from the economic problems of the apparel enterprises from Moldova. Global competitiveness and the increasing use of limited resources are leading to considerable economic change. The policy of the European economy tends towards transformations in order to produce more with less resources. That is why the sustainable development of garment companies in the Republic of Moldova is closely linked to the responsible management of the environment, including waste. This requires regulations, incentives and public procurement policies that promote production and consumption patterns that are compatible with a country's sustainable ecological

development. Of particular importance is the education of all kinds of producers and consumers in the field of waste sorting, to be recycled and processed.

d) *Types of waste and their disposal in the garment industry in Moldova*

The Moldovan garment industry is a large waste generator. The value chain of this apparel industry generates a wide range of waste. Among them two categories of waste can be listed:

i. *Pre-consumer waste*

Based on the interviews carried out with more than 25 Moldovan apparel companies we identified that at this stage, the following types of waste are generated (Table 2):

Table 2: The types of waste generated by the apparel value chain

#	Value chain stage	Type of waste
1	Supply	<ul style="list-style-type: none"> - The film in which the fabric and some accessories are packed. - Cardboard tubes from fabric, cardboard boxes in which some accessories are packed.
2	Cutting	<ul style="list-style-type: none"> - Fabric cuttings of different sizes, having different compositions as follows: <ul style="list-style-type: none"> o 100% natural fiber fabrics (linen, cotton, silk, modal, viscose) o Mixed fabrics: 92-97% natural fiber plus 3-8% elastane o 100% synthetic fiber fabrics (polyester, polyamide, nylon) o Mixed fabrics of two types of fibers (natural and synthetic in proportion of 40% -60%) o Mixed fabrics of three types of fibers (natural, synthetic and elastane). - Scrap paper (first and last layer to cut) - Non-compliant parts (either mistakes were made in cutting or non-conformities were detected in the fabric).
3	Manufacturing	<ul style="list-style-type: none"> - Thread spool tubes - Broken needles
4	Quality Control	<ul style="list-style-type: none"> - Fabrics, accessories, unfinished and finished goods with irrecoverable defects.

In the Republic of Moldova, preventive evaluations show that the pre-consumption stage generates an amount of approx. 8-10 thousand tons of fabric waste and approx. 3-5 thousand tons of other types of waste.

To clarify the situation regarding the waste management in the apparel industry, more than 25 garment enterprises small, medium, and large one, specialized in manufacturing of different assortments of finished products (clothes for men, women, children) from different fabrics (natural, synthetic, and mixed), which produce under their own brand and / or and provide services for foreign customers were interviewed. Following the interviews, it was found that practically no factory sorts the fabric waste that appeared at pre-consumption stage.

The practice of waste disposal in the garment industry of the Republic of Moldova is as follows:

- The film and the cardboard are collected separately, practically by all the enterprises, and they are handed over to the companies, specialized in the collection and processing of some types of waste.
- Apparel cutting waste is not sorted, and not recycled.
- A very small number of companies that process the raw material received from the international clients in C&M regime, collects the fabric waste and returns it to the client at the client's request, once the order is delivered.
- Most companies have concluded contracts with sanitation companies that pick-up waste from the company and transport it to existing landfills.
- A small amount of fabric waste is provided to farmers for tying the vine.
- Recently some apparel manufacturers started to offer the apparel cutting waste from Jersey fabrics to some organizations who produce handmade rugs.

ii. *Post-consumer waste*

This waste is generated by the last stage of the value chain and represents those garments that are no longer worn or used. In the Republic of Moldova, the waste record at the post-consumption stage is not performed.

At present, there is no single approach to the responsibility of producers for the collection of this waste. In the European Union, France has imposed specific legislation for extended producer responsibility in this field, with visible results. Also, some global companies have started to implement voluntary programs to recover used clothes from customers. In the Republic of Moldova this responsibility is not applied to enterprises. There is no well-developed process for collecting and using / processing this type of waste. Moreover, an impressive amount of second-hand clothes is imported into Moldova, which leads to an essential increase in the amount of waste at post-consumption stage. Only during 2019, second-hand garments worth 100.2 million MDL were sold, which was more than 2 times more than in 2018 (46.9 million MDL). All this amount of goods was imported. Second-hand clothes have a very short service life, which means that they reach the landfill very quickly.

e) *Overview of current recycling practices and recycling opportunities in the garment industry in the Republic of Moldova*

In the Republic of Moldova, the separate collection and recycling of textile including apparel cutting waste is a less promoted aspect in selective waste collection companies. That is why very often textile waste is dumped in landfills along with other types of waste.

Despite this fact, there is a practice of collecting and recycling certain waste in Moldova.

At present, the Ministry of Agriculture, Regional Development and Environment of Moldova, has issued 39 permits to enterprises that carry out waste management activities [8].

The information provided on waste collection and recycling companies shows that all these companies collect and recycle waste other than textile and apparel cutting waste. As mentioned, garment companies collect and hand over film and cardboard for recycling. As for the collection of apparel cutting waste generated during the manufacturing process, that is formed at garment companies at the pre-consumption stage, it is neither sorted, nor collected and nor recycled.

However, there are some initiatives in this area such as [9]:

1. *Collection and recycling of pre-consumption waste.*
The organization Ra Planet transforms any type of fabric into beautiful and turbid carpets of all beauty. Ra Planet is a store with products for arts and crafts

in Chisinau. But the amount of waste collected and recycled / used is still very small.

- *Collection of post-consumer textile waste.* Several organizations are active in this field. Some of them collect clothes that the owner no longer needs but are in good condition and sold them. The money collected is for charity. While clothes that are not in good condition are redistributed to animal shelters. Other organizations collect clothes and after they are sorted and redistributed to the socially vulnerable, the elderly, the homeless. Different NGOs collect clothes in street containers and in stores through the so-called "take back" programs. There are various advantages and disadvantages of these channels, but the main differentiation is that street collection methods can affect the quality of clothes and subsequently limit the possibilities for reuse and recycling.

Based on the existing practice of collection and recycling of apparel cutting waste, it can be concluded that at the current stage the main method of disposing of apparel waste in the Republic of Moldova is storage in existing landfills. This method has several drawbacks:

- It requires enormous landfill capacity for the storage of this type of waste,
- The landfills pose a threat to the water supply of the population. Every time it rains, the water drains through the garbage and picks up chemicals such as paints and bleaches from textile waste stored in the landfill. The water accumulates at the bottom of the landfill, often in large quantities and can often be more toxic than sewage water.
- The time required for the degradation of most textiles, when disposed of by storage, is long.
- Textiles, even from biodegradable natural fibres, do not degrade easily in landfills due to the lack of sunlight and oxygen.
- During degradation, textile waste emits greenhouse gases and pollutes the soil and water by contamination with chemicals and dyes,
- Wool fibres decompose relatively quickly, but during decomposition methane is produced, which is a strong greenhouse gas,
- Synthetic fibres generally do not decompose, which is a permanent source of soil and water pollution.

Discussions with garment manufacturing companies have shown that some companies use the method of incinerating the apparel cutting waste. However, it should be noted that incineration for energy recovery is a method of disposing of textile waste in industrial combustion plants. According to European legislation, incineration is not a form of recycling, but only a form of energy recovery or controlled waste disposal. Although it is preferable to use the method of waste disposing by storage, according to some studies, the amount of energy used for textile production is

significantly higher than that recovered. In addition, combustion processes in low-performance installations can lead to the release of hazardous chemicals into the atmosphere. Thus, after greenhouse gases have been removed into the atmosphere during the production process, it happens once again, this time by combustion.

As reported by the companies interviewed, virtually all of pre-consumption waste are disposed of in landfills, except for rather small quantities, waste arising from the production of clothing made of light, natural fabrics, or Jersey-type fabrics, some of which:

- Is sold to farmers for the tying of vines,
- Is sold to car repair centres, which are used as a material for hygienic purposes,
- Is sold to produce hand-made items.

III. CONCLUSIONS

Globally, textile waste accounts for 5% of total waste, being a huge source of pollution, second only to the oil industry, according to statistics. The impact of the fashion industry on the environment is huge. In the Republic of Moldova, the garment industry generates a large amount of waste, which rains down on the environment too, because the main method of disposing of apparel waste is storage in existing landfills, which requires enormous landfill capacity. The landfills pose a threat to the water supply of the population and produce during decomposition methane, which is a strong greenhouse gas.

Statistics show that in the Republic of Moldova as well as at the world level, during the last 10 years the quantity of purchased clothes has increased almost twice, which generated an increase in waste. Of the amount of waste generated by the fashion industry only a small quantity is reused.

However, there are some initiatives for recycling waste obtained in the garment industry. Practice shows that a small amount of waste was used to make handmade rugs that are sold quite well. There are certain initiatives for the collection and use of waste that appear at the post-consumption stage.

In order to multiply the existing practices of collection and recycling of the waste appeared in the garment industry, an information and training of both the enterprises and the population regarding the benefits of the circular economy is required.

The waste management in general, including waste management in the garment industry, as well as the training of skills in this field is closely linked to the legislation of the Republic of Moldova regarding waste. The main legislative instrument in this field is Law on waste. It presents a waste management hierarchy that includes: Extended producer responsibility, Waste recovery, Waste reuse and recycling, Waste disposal, Waste incineration and co-incineration. But the existing

legislation does not reflect the particularities of the garment industry waste. The law in force does not reflect the collection and recycling of textile waste.

The need and demand for textile waste recycling is enormous as well as for efficient management of textile waste and recycling of garments, in order to ensure environmental protection.

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