

Study of Lodz Society's Knowledge of the Circular Economy in the Textile and Clothing Industry

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Abstract

The textile and clothing industry is one of the most resource-intensive and polluting industries. The circular economy (CE) is one of the solutions to these problems. The textile industry has been identified as one of the most in need of transformation towards CE. The transition to a circular economy requires changes in the behavior and actions of all market players. Consumer interest in sustainability and the CE can stimulate companies to be more responsible and offer more circular solutions. This article analyses the knowledge and attitudes of consumers, adults living in Lodz (Poland), towards new circular models in the fashion industry (e.g. rent, repair). The development of the clothing rental service is still insufficient, but repair and the use of online portals to sell/buy second-hand clothing is becoming increasingly popular. However, it is still necessary to orient people towards environmentally friendly activities.

Keywords

circular economy, textiles, clothing, sustainability, survey research.

1. Introduction

The circular economy (CE) is a concept that seeks to rationalize the use of resources and reduce the negative environmental impact of manufactured products. This model aims to minimize the consumption of raw materials and the generation of waste, thereby reducing emissions and levels of energy use, by creating a closed loop of processes in which the waste generated is treated as raw materials in subsequent production steps [1]. CE is based on eco-design, maintenance, repair, reuse, remanufacturing, renewal and recycling. All these activities lead to the leveling of negative environmental impacts. CE is a weapon in the fight against the waste of raw materials, overproduction and waste segregation [1,2].

One of the pioneers in promoting CE and the transformation of linear economies to CE is the Ellen MacArthur Foundation. Its activities support many industries in adapting to the trend leading to environmental protection. The butterfly diagram was developed by the Foundation as a tool to explain the CE model focusing on two main cycles - a

technical and a biological one. In the technical cycle, products and materials are kept in circulation through processes such as reuse, repair, remanufacturing and recycling. In the biological cycle, nutrients from biodegradable materials are returned to the earth to regenerate nature. In the case of textiles, natural materials, such as for example cotton, can move from the technical cycle to the biological cycle, when they degrade beyond what can be used to make new products [3].

Various approaches to circularity, known as R strategies, have been developed. The 3R strategy (Reduce, Reuse, and Recycle) was initially the main strategy for eco-friendly product processing, which has evolved into the 5R, 7R, and even 9R strategies [4–6]. The 9R principle is based on the activities presented in Figure 1. The R0 state represents a state closer to CE, while R9 is mainly a linear economy. The smaller the loop (lower R), the smaller the external output needed to close it, and the strategy is more circular [7–9].

The textile and clothing (T&C) industry is one of the biggest sources of environmental risks, climate change

and social impacts. The T&C sector is responsible for ca. 20% of industrial water pollution from textile processing and dyeing, ca. 35% of oceanic pollution from virgin microplastics (190,000 tonnes per year) and ca. 8-10% of global CO₂ emissions (4-5 billion tons per year). The sector produces huge amounts of textile waste (more than 92 million tonnes per year), much of which goes to landfill or is incinerated, including unsold products [10,11]. It is estimated that less than 1% of all textiles worldwide are recycled into new ones [12,13].

Today, 60% of textile fibers are synthetic [14]. Polyester is the most widely used fiber, produced by high-carbon processes that require the consumption of more than 70 million barrels of oil per year. Other fibers are mainly derived from cotton, in which large amounts of water are used in the production [14]. Dyeing, printing and finishing processes are also hazardous to the environment, and microfibers are released into the environment during washing [1].

The European textile and clothing industry employs 1.7 million people in 171,000 companies, 99% of which are SMEs [15].

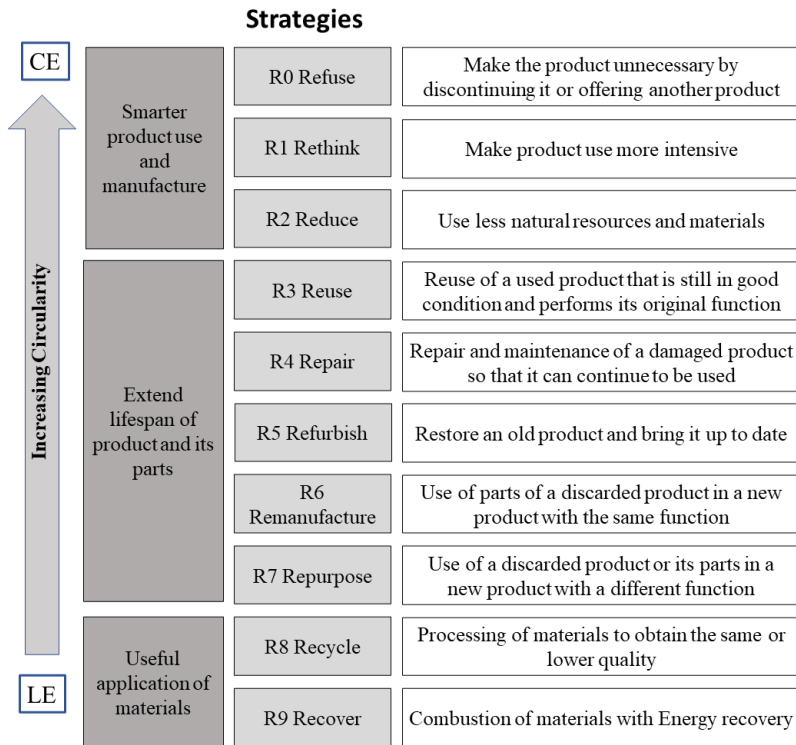


Fig. 1. Classification of 9R-activities used in circular business models (9R Strategy), LE – linear economy, CE – circular economy. Figure made by the authors based on [8,9]

Textile production doubled between 2000 and 2015, and according to the European Environment Agency, it will increase by 63% in 2030 [16]. Europeans consume an average of 26 kg of textiles per person per year [14]. In the European Union, about 11 kg of textiles are thrown away per person every year. Moreover, one truckload of textiles is sent to a landfill or incinerator every second worldwide [13]. Every step of the production chain, from fiber production through fabric to finished product, is present in Europe, making the sector a powerful industry [15]. Textile consumption and production is highly globalized, involving millions of producers and billions of consumers worldwide, making the textile industry one of the largest in the world [14].

In 2019, the production of the entire clothing and textile sector in Poland reached 22.6 billion PLN (textiles 14.7 billion PLN, clothing 7.8 billion PLN). On average, 111.1 thousand people were employed. Compared to all European Union countries, Poland ranks 8th in terms of apparel production and 3rd in the number of enterprises and size of employment [1].

Based on data from the Central Statistical Office (CSO), in 2021 more than 18,000 companies were engaged in apparel manufacturing activities in Poland. The largest number of these companies (4438 companies - 24.6%) operate in the Lodz province [17]. From the 1820s until the 1990s, Lodz was the largest in the country and one of the largest textile industry centres in Europe. Lodz's development followed a pace known only to North American centres [18]. In 2022, the industry, defined by PKD codes 13 and 14, numbered 36,169 entities, of which almost 92% (over 33,000) were micro-enterprises. Since 2021, 668 entities producing textiles and clothing have disappeared [19]. In 2022, the revenue of the Polish clothing market amounted to 53.3 billion PLN, of which 78.3% is revenue from the sale of clothing in stationary stores. Forecasts also show that the industry will achieve higher revenues from year to year. Poles almost exclusively – 98% - buy non-luxury goods, and the largest segment of the clothing market in Poland is women's clothing. The market value of this segment is expected to exceed 36 billion PLN in 2023 [20].

Traditionally, the textile and clothing sector has been based on a linear economy model that involves a “take - produce - use - throw away” pattern. Reducing negative environmental and climate impacts while maintaining economic and social benefits will require a systemic shift toward circularity and a transformation toward a circular economy [1,21].

CE has gained significant attention since the publication of the first Circular Economy Action Plan in 2015 [22]. It included measures to help stimulate Europe's transition towards a circular economy, boost global competitiveness, foster sustainable economic growth and generate new jobs. In 2019, the European Commission launched the European Green Deal, “a new growth strategy that aims to transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use” [23,24]. In March 2020, CE adopted the new circular economy action plan (CEAP) - one of the main elements of the European Green Deal [25]. This new action plan, which includes life-cycle measures, aims to adapt our economy to a green future, strengthening our competitiveness while protecting the environment and giving consumers new rights [26]. The EU's transition to a circular economy will reduce pressure on natural resources and will create sustainable growth and jobs. It is also a prerequisite to achieve the EU's 2050 climate neutrality target and to halt biodiversity loss [25]. The new action plan announces initiatives along the entire life cycle of products. It targets how products are designed, promotes circular economy processes, encourages sustainable consumption, and aims to ensure that waste is prevented and the resources used are kept in the EU economy for as long as possible. It introduces legislative and non-legislative measures targeting areas where action at the EU level brings real added value.

The European Commission, as part of its implementation of the Green Deal, has identified the clothing and textile

industry as one of the most in need of transformation to CE. This is due to the significant consumption of clothing, footwear and home textiles and the problem of disposing of them [24]. On 30 March 2022, the EC adopted the EU Strategy for sustainable and circular textiles. This strategic document is another initiative directly stemming from the 2020 Circular Economy Action Plan. This plan identified textiles as one of the key product categories that requires urgent action due to its high resource consumption and significant environmental impact. The findings of the European Environment Agency (EEA), which has repeatedly highlighted that the textile sector in Europe ranks fourth in terms of adverse environmental impact - just after food production, buildings and transport - were used as the basis for the Strategy currently under discussion [27].

Global textile production almost doubled between 2000 and 2015 and by 2030, clothing and footwear consumption is expected to increase by 63% - from 62 million tonnes in 2023 to 102 million tonnes in 2030. In the EU, global textile consumption, most of which is imported, currently has, on average, the fourth largest negative impact on the environment and climate change and the third largest impact on water consumption and land use from a global lifecycle perspective. Approximately 5.8 million tonnes of textiles are disposed of in the EU every year, or about 11 kg per person, and every second somewhere in the world a truckload of textiles goes to landfill or is incinerated [27].

The updated EU Industrial Strategy highlights the need to accelerate the green and digital transitions of EU industry and its ecosystems [28]. In June 2023 the Textiles Ecosystem Transition Pathway was published [28].

Textile waste is generated in the textile production process as production waste or from used clothing or household textiles as consumer waste. It is preferable to reuse textile materials by returning them back into the production process to save raw materials. If this is not possible, such waste should be recycled mechanically,

chemically or physically. This creates secondary raw materials that can be used to manufacture new products. If the above paths are not possible, thermal and energy treatment in waste incinerators is used. As a last resort, textile waste ends up in landfills [1]. Therefore, one of the primary challenges for the textile and apparel sector is the transformation to CE. According to a European Commission report, by 2030, textiles marketed in the EU will be sustainable, recyclable, made of recycled fibers and without hazardous chemicals.

Carbon footprint and environmental footprint form the basis for assessing the environmental impact of textile materials. The composition of textile materials (natural, synthetic and blends), their production and disposal are of great importance. Recycled materials will not always show a lower carbon footprint due to the difficulty of obtaining good quality fibers, especially from blended materials (e.g. cotton and elastane). Moreover, a large amount of water and pesticides is used in the production of cotton. The solution to this problem may be the alternative use of bast plants. Increased awareness among consumers and clothing distributors is influencing the process of eco-design, which involves creating clothing that is easy to recycle later and gives the smallest possible carbon footprint [29,30].

There are many business models operating within CE of the textile sector. These include renting garments, repairing them, selling them, or remaking them [13].

Currently, the world is dominated by the phenomenon of fast fashion, which is caused by the constant influx of new goods. Fast fashion involves the supply of low-quality, low-cost, fast-fashion clothing in global distribution networks. It is estimated that about 1/3 of the clothing produced never reaches consumers. Globalization and consumerism mean that consumers often view clothing as disposable. Such behavior increases the potential threat to the environment. The term sustainable fashion describes processes in which products are designed and manufactured responsibly, that

is, taking into account the impact of textiles and clothing on society and the environment. Sustainable fashion aims to reduce the industry's environmental footprint in the long term and allows the textile and fashion industry's production system to be transformed towards environmental integrity [1]. Eco-design is an integral and environmentally friendly form of design in line with the trend of sustainability. The approach is to design products taking into account their environmental impact throughout their life cycle [31]. Eco-fashion is considered one form of eco-design for clothing. Products are made using organic raw materials grown without the use of pesticides, or without using textiles that have been treated with harmful chemicals. Moreover, eco-fashion products should be made from recycled fibers and materials, and should be durable enough to last as long as possible [1].

The Make Fashion Circular initiative was launched in 2017 and brings together textile and clothing industry professionals. It aims to stimulate the level of collaboration and innovation required to create a modern textile economy that operates in accordance with CE principles [1]. *Extended Producer Responsibility* (EPR) aims to ensure that producers contribute financially to the cost of waste management, end-of-life, selection, recycling or disposal of waste generated from their products. EPR is regulated by the EU in the Waste Directive (2018) and covers EU member states. France, for example, has implemented EPR for clothing, footwear and bed linen, with manufacturers taking responsibility for recycling or disposing of products. This has resulted in a threefold increase in textile recycling and collection rates [32].

The European Technology Platform for the Future of Textiles and Clothing (Textiles ETP) is a platform that brings together key representatives of business and science within the textile and apparel industry. Some data documents and good practice are also available on the European Circular Economy Stakeholder Platform [33]. In Poland, there is the Polish Circular Hotspot platform, which brings together and enables the

cooperation of all entities that have an impact on the promotion and introduction of CE principles in Poland. This platform interacts with state administration, local administration, business and the world of science. The work involves all sectors of the economy, including construction, packaging, food, electronics, transportation, energy, plastics, as well as textiles [1].

Both in Poland and Europe there are many initiatives to share, rent or buy back clothes. One of the business models supporting CE is sharing. For example, MUD JEANS, a denim pants company in the Netherlands, offers a 12-month rental of pants for a monthly fee. After a year, the user has the option to keep, exchange or return the product [1]. 4F offers sportswear rentals [34], and E-garderobe is a place where Polish women can rent dresses instead of buying them [35]. Adidas has announced that by 2024 it will use only fully recycled materials for its clothing. Moreover, shoes will be made from plastic extracted from the seas and oceans. H&M and Levi's are also producing clothing using recycled waste. Patagonia, a sportswear company, has introduced sweaters, jackets and sweatshirts sewn from recycled plastic bottles and other used waste [1]. Various online portals for exchanging, selling and buying second-hand clothing (e.g. Facebook Marketplace, Vinted, Gumtree, LESS_, or szafa.pl) are becoming increasingly popular. Such action supports CE principles by giving a second, and perhaps even another, life to clothes. This reduces the carbon footprint, which has a positive impact on the environment. Vinted is available in as many as 15 countries, with some 25 million users as of November 2019 [36].

It should be emphasized that CE business models have not yet become widely used or put into practice due to the different barriers, e.g. social, economic, institutional, infrastructural, technological, organizational and supply chain dimensions [37, 38, 39].

On the other hand, a high level of consumer awareness is necessary to implement the circular economy in practice.

Based on the literature review, it can be concluded that research on consumer awareness and attitudes for the textile and clothing sector has been conducted in various countries. However, it should be emphasized that these countries differ in their culture, level of economic development and approach to environmental and social issues, so a direct comparison of the research results is difficult. For example, the impact of consumers' environmental concerns on attitudes, mainly on purchasing behavior and product adoption, was studied [40, 41, 42]. The results of the study by A. Jimenez-Fernandez et al. (2023) confirm previous research, revealing a positive impact of awareness of CE principles on consumer attitudes [43]. Young people's purchasing behavior and intentions were investigated by Kovacs (Hungarian consumers were involved in the research) [44]. Consumer perceptions and actions related to circular fashion, based on the example of young Brazilians, were also studied [45]. Blazquez et al. (2020) studied consumer intentions towards sustainable fashion in the Spanish fashion industry [46]. So far, relatively little attention has been paid to the such analysis in Poland. In Poland, the role of the consumer in the circular economy in textiles and fashion was the subject of studies performed by Koszewska in 2015 [47].

The main objective of this publication is to provide new knowledge regarding the awareness and attitudes of Polish consumers of the circular economy in the T&C industry and the impact of the T&C industry on the environment on the one hand as well as an attempt to determine changes in attitudes and behaviours related to purchasing and using clothing and the handling of unused clothing in recent years on the other.

2. Methodology

The research used an online survey method. For this purpose, an original questionnaire was prepared which residents of Lodz were given to fill in. The selection of the sample was dictated by a few considerations: Lodz has over

a hundred years of textile tradition, and it is still one of the largest textile industry centers in Europe. Moreover, many families still have representatives of the textile industry. Each respondent agreed to participate in the study. The survey was distributed to 400 adult (over 18 years old) respondents via a Google form between June and October 2023. Questionnaires with missing answers to any question or sent after the deadline were rejected. 313 correctly completed questionnaires were received and considered for the study. A survey is a study that provides numerous benefits, e.g. extremely minimal costs involved in online survey research. However, it also has its limitations, such as limited opportunities for in-depth research, the subjectivity of respondents, which includes their momentary disposition, their understanding of the content of the question, their attitude to the survey, the difficulty of reaching some respondents, the different involvement of respondents and the possibility of falsifying the results.

In addition to three sociodemographic questions, the survey contained 26 questions divided into 4 areas. Responses were given on a 5-point Likert scale (1-strongly disagree, 2-disagree, 3-neutral, 4-agree, 5-strongly agree). The survey aimed at getting to know customers' knowledge of the circular economy (a), behavior in the range of disposal attitude (b), customers' shopping preferences (c) as well as the impact of the T&C industry on the environment (d).

Statistical processing was done via Microsoft Excel and Statistica 13.1. Pearson's correlation coefficient was used, which is a measure of linear correlation between two sets of data. In order to assess consumer behavior and knowledge of CE, the study analyzed their dependence on sociodemographic variables (such as gender, age, and education level).

3. Results and discussion

The survey was completed by 313 inhabitants of the city of Lodz (Poland)

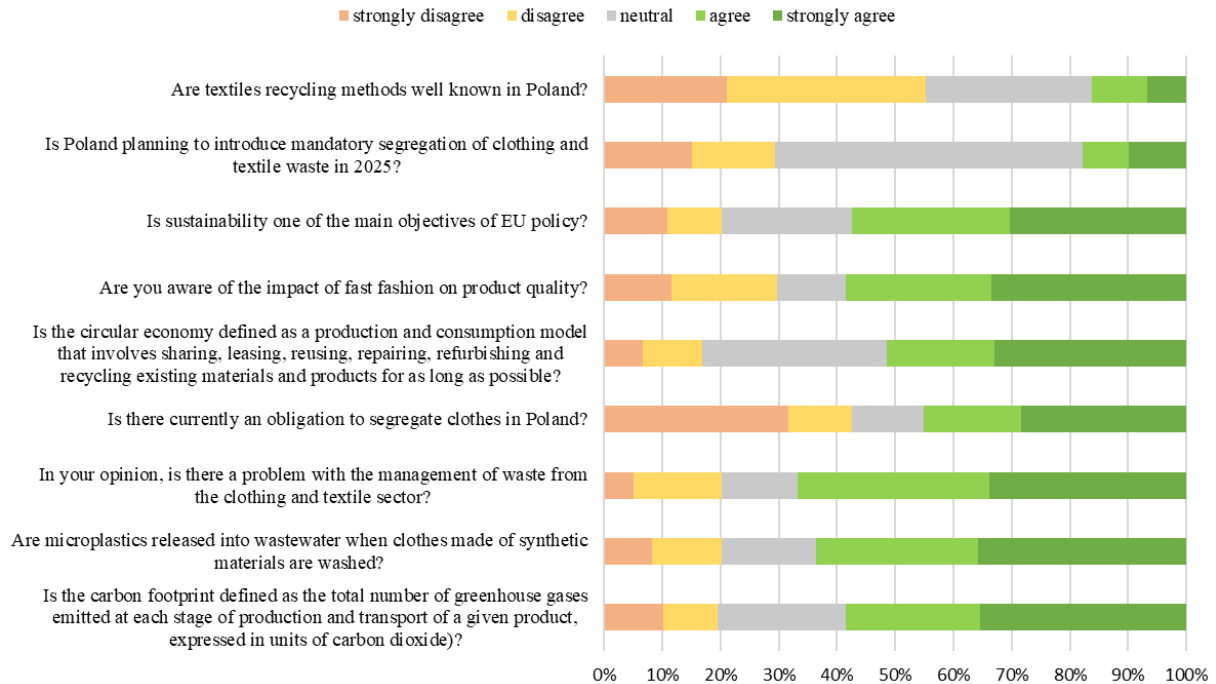


Fig. 2. Lodz citizens' knowledge of the circular economy (percentage distribution of answers in 1-5 scale)

		Respondent	
		Absolute N=313	Relative (%)
Gender	Male	94	30
	Female	219	70
Age group (years old)	18-25	29	9
	26-35	225	72
	36-50	34	11
	Over 50	25	8
Education	Primary	21	7
	Secondary	37	12
	Professional	25	8
	Higher	230	73

Table 1. Characteristics of the group of survey respondents in terms of gender, age and education held

aged 18-62, resulting in a final response rate of 78%. The sociodemographic factors are shown in Table 1, which shows that the study was dominated by women, people between the ages of 26 and 35, and with higher education.

One of the aims of the study was to determine whether CE knowledge, habits, behaviors, and environmental awareness of Lodz citizens depend on sociodemographic factors, such as gender, age, and education level. Analysis of the distribution of responses and the results of statistical tests showed that the behaviors analyzed depend primarily on the age of

the survey respondents. The correlation was significant for several questions.

The first area of our studies was associated with survey respondents' knowledge of the circular economy. Survey respondents were questioned on 9 issues (Figure 2). One of them concerned knowledge of recycling methods in Poland. 55% of survey respondents said that textile recycling methods are well known in Poland. Reducing textile waste and turning it into secondary raw material is an EU waste management goal. The Waste Framework Directive requires member states to establish separate

collection systems for textile waste as of January 1, 2025 [48,49]. Currently, the rate of textile waste recycling in Europe is low due to the limitations of textile recycling technology and the low demand for products derived from recycled materials [50]. Organizing the collection of used textiles is associated with the need for convenience for consumers on the one hand, and the costs incurred by waste collection companies (collectors) on the other [50].

The correct answer to the question "whether sustainability is one of the main objectives of EU policy?" was given by 58%. The impact of fast fashion on product quality was noted by 58%.

Survey respondents were asked about their knowledge of CE; 51% of respondents showed good knowledge of the definition of the CE concept.

42% of survey respondents are aware that there is currently no obligation to segregate clothes in Poland, while almost the same number (45%) believes that there is this obligation. According to the European Union guidelines, it will be mandatory to segregate textiles by January 1, 2025. Unfortunately, less than

one-fifth of Lodz survey respondents (18%) are aware of the introduced obligation to segregate textile waste in the near future. Organizing separate collection of textiles is a key condition for transforming waste into high-quality raw materials [51].

Survey respondents were asked to determine whether the management of T&C waste is problematic. 67% of survey respondents perceive problems with waste management in the T&C sector, while 20% disagree. 13% of survey respondents had no opinion. Many authors believe that textile waste management is a huge problem that should be solved as soon as possible [52]. The fashion market is characterized by short life cycles of clothing products, a large variety of products and a high level of impulse buying. This is evidenced by huge amounts of textile waste, which pose a disposal problem [10,53]. The disposal problems are mainly due to the material heterogeneity and quality of textile and clothing materials. Clothing includes a variety of chemical fabric finishes and embedded components such as zippers and buttons, which pose problems in industrial waste treatment [49]. Moreover, the waste is susceptible to contamination and moisture if stored carelessly [54], and collection points are too few and far between [55]. An additional challenge of utilizing textile waste is the lack of available data on the volume of textiles, which is due to the lack of systematic systems for monitoring and controlling the flow of used materials. As can be seen, the effective collection of textile waste is much more difficult than the collection of other recyclable materials, such as glass, plastic and metals [50]. Survey respondents demonstrated good knowledge of the problem associated with the release of microplastics from synthetic garments during washing (64%). Survey respondents also showed good knowledge of carbon footprint (58%). The term ‘carbon footprint’ is better known by younger people than older ($r = -0.721$, $p = 0.019$).

The implication is that awareness of the circular economy in the T&C industry is high, but it is still too early to fully

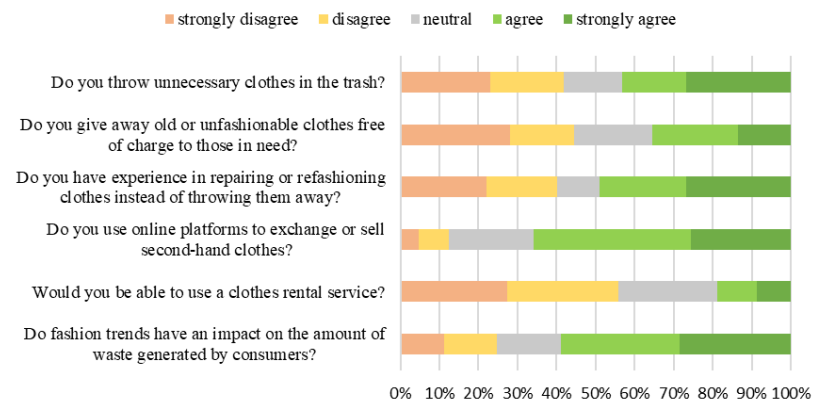


Fig. 3. Lodz citizens' behavior in the range of disposal attitude (percentage distribution of answers in 1-5 scale)

implement it.

Currently, relatively little is known about the disposal attitude of clothing. On the basis of the survey, (Figure 3) we tried to find out the post-consumer behavior of consumers. Unfortunately, 43% of survey respondents still throw unused clothes in the trash. 35% of survey respondents donate clothes after use to those in need. It seems that still many consumers are not aware that there are many organizations or charities that are happy to accept clothing donations. Depending on the charity, used clothes of worse quality can be recycled and used to make other products. Used and unneeded clothing can be donated to people in need or to family and friends. Our result differs significantly from the test result obtained in Lehner's study (77% of survey respondents) [55] and in Koszewska's study (60% of survey respondents) [47], while women were far more likely than men to sell or donate clothes. Donation has proven to be an extremely popular way to dispose of clothing probably because of pro-social motivations [56]. In addition to donation, survey respondents often indicate reselling used textiles (24% of survey respondents) [47]. Significantly more people are using online platforms to exchange or sell their clothes (66%). Technological innovations involving the creation of online platforms for the resale of unused textiles have been gaining popularity recently. Examples include “Facebook Marketplace” and “Vinted” operating in many countries, “Blocket” in Sweden, “Gumtree” and “LESS_” in the UK, and “szafa.pl” in Poland [32].

However, the most popular one in Poland is the “Vinted” application, which is very intensively promoted on television and the internet [35]. The popularity of online clothing exchange portals is seen especially in younger people, which is statistically significant ($r = -0.324$, $p = 0.007$).

Another option for extending the life of clothes is to repair them. Consumerism and the huge quantities on the European market of questionable quality clothing from China have caused people to throw away clothes instead of repairing them. However, repairing used clothing is becoming increasingly popular. Our research showed that 49% of survey respondents repaired clothes. According to a study by Lehner et al. [55], 35% were eager to repair clothes [47]. Those with lower education are more likely to repair their clothes ($r = -0.407$, $p = 0.004$). It seems that useless clothes are mainly reprocessed and repaired by thrifty consumers, which may indicate actions taken not out of environmental knowledge and awareness, but for economic reasons [47]. In contrast to Koszewska's study [47], where it was interesting that there was no correlation between the willingness to repair clothes and the age of survey respondents, in our study older people are more likely to repair their clothes ($r = 0.276$, $p = 0.007$), which may be due to their upbringing, skills and material situation. Care for the environment should be promoted by using clothes longer and repairing them. To this end, Sweden has reduced VAT on repair services, which increases the competitiveness of

companies specializing in tailoring [55]. Such action should also be considered in other countries.

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Another interesting aspect of CE in connection with the textile industry is the possibility of using clothing rental services. Online second-hand clothing rental platforms are an option, where consumers are offered clothes for rent for a predefined period of time. With the ability to rent clothes, it is possible to wear new outfits from brands of one's choice for various occasions without having to own them permanently. Many apparel retailers have launched rental subscription models, offering luxury fashion apparel and casual wear. Most often, such activity is done for a monthly fee [57]. The online clothing rental market is expected to grow steadily [58]. However, this activity has problems including low consumer awareness, lack of public acceptance and often problematic regulations. In our studies only 19% of survey respondents are considering this possibility and 56% are opposed to it. Probably time is needed for Lodz society to start using such a solution *en masse*. The spread of the clothing rental service could help to reduce the overproduction and oversupply of clothing. However, the clothes must be suitable for prolonged use by a variety of customers, therefore the garments should be made of high-quality materials and in the spirit of timeless design. Low-quality garments and rapidly changing trends would be inadvisable [59].

Survey respondents were asked for their shopping preferences (Figure 4). In line

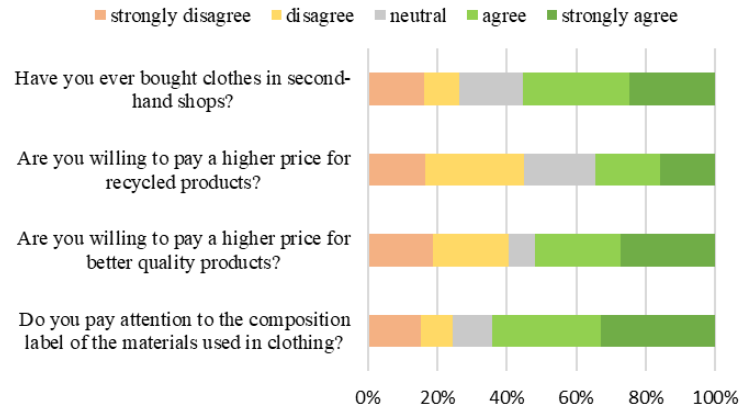


Fig. 4. Lodz citizens' shopping preferences (percentage distribution of answers in 1-5 scale)

with the principles promoted by CE, textile companies are building new business models that include activities such as renting, leasing, repairing and reselling textiles. Through exchange or sale, used clothes can be given a second life by another user [60]. Buying clothes from second-hand stores in Poland is becoming increasingly popular. Our research shows that a total of more than 55% of survey respondents bought second-hand clothing. According to a research report by the Polish company “Wtórpol” under the title “Poles’ knowledge of clothing recycling”, 43% of survey respondents buy or exchange used clothes. The majority of survey respondents (71%) have bought second-hand clothing at least once [61]. Our survey found that 52% of survey respondents would be willing to pay more for better quality clothing but only 35% of them for recycled clothing. It is encouraging to know that 64% of those surveyed pay attention to the material composition of the clothes they purchase. According to a study by Kovacs [44], the most preferred items associated with the circular economy are high-quality clothes with a long shelf life, with willingness donate or exchange clothes, while there is less preference for buying second-hand clothes.

Survey respondents were asked about their knowledge of the impact of the T&C industry on the environment (Figure 5).

62% of survey respondents strongly agree and agree that textile manufacturing is responsible for water pollution, but only 34% are aware that dyeing and

finishing operations are a source of water pollution. 38% of survey respondents know that the production of textiles from natural fibres consumes large quantities of water, mainly younger people ($r = -0.436$, $p = 0.007$). The question “Is every type of textile waste recyclable?” was answered positively by 42% of the survey respondents. 42% know that cotton and wool garments can be dumped on compost. 39% of survey respondents strongly agree and agree that the carbon footprint of the textile industry is large. 50% of those surveyed see room for further learning of the impact of textiles on the environment, with only 30% thinking they have sufficient knowledge.

Millennials (born 1981-1996) and Gen Zers (born 1997-2012) represent one of the age groups with the strongest environmental impact. This study shows that the majority of Millennials and Gen Zers are familiar with the concept of CE and are aware of the problem associated with managing waste from the clothing and textile sector. This age group, which has recently emerged as major consumers, exhibits green consumption behavior [62,63]. Some authors claim that young people are characterized by a greater awareness and tendency to use more eco-friendly fashion [62,64]. Moreover, Millennials are more likely to buy recyclable and reusable products, as well as eco-friendly, repairable, durable and artisanal products [64]. About half of Millennials (50%) and Gen Zers (54%) said they were willing to spend an additional 10% or even more on environmentally friendly products,

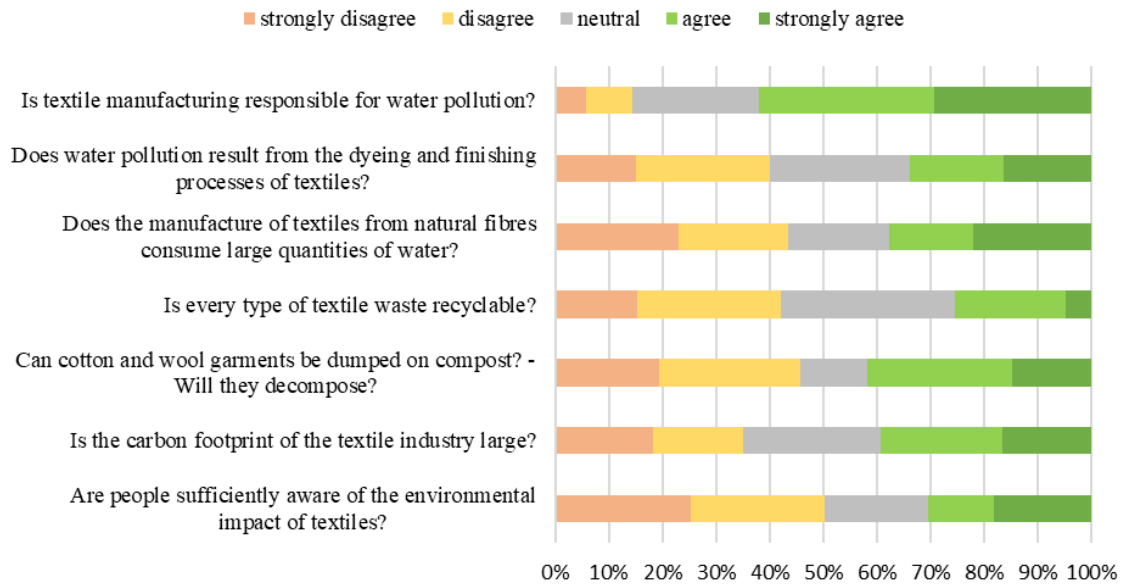


Fig. 5. Lodz citizens' knowledge of the environmental impact of the T&C industry (percentage distribution of answers in 1-5 scale)

compared to only 34% of Gen Xers and 23% of Baby Boomers ($r = -0.237$, $p = 0.017$) [62]. Our research also indicates that 67% of Millennials and 72% of Gen Zers already sell second-hand clothing through online portals. This confirms that younger generations today are paying increasing attention to sustainability and the circular economy.

Based on the current research, our findings constitute a valuable complement to existing research in the field of Lodz citizens' knowledge of the circular economy, behavior in the range of disposal attitude, shopping preferences as well as knowledge of the environmental impact of the T&C industry. The authors' indirect motivation to conduct this research was to encourage respondents to reflect on the impact that we, users of textiles and clothing, have on the environment through our choices. It is known that consumers' awareness of the fashion industry's environmental and social damage is increasing, along with the transformation of their purchasing habits [43].

4. Conclusion

This publication is devoted to the study of the circular economy in the T&C sector taking into account Lodz consumer attitudes and behavior. The behaviors declared by the survey respondents allow

us to conclude that the awareness of Lodz society regarding CE is increasing. However, pro-ecological activities in the clothing and textile industry require further stimulation, like in other countries, e.g. in Spain [43]. The analysis of the distribution of responses and the results of statistical tests showed that the behaviors analyzed depend primarily on the age of the survey respondents. Mainly younger people (millennials and Gen Zers) are aware of water consumption during clothing production and know what the term carbon footprint means, while older people are more willing to repair broken clothing. In addition, younger people are more willing to use online portals to sell and exchange clothes.

In our study, 67% of survey respondents assessed that textile waste management is a serious problem. There is also a lack of awareness among the respondents of the Lodz study about the European Commission's obligation to segregate textiles in the near future. The development of the clothing rental service is still insufficient, and it will probably take time to convince people to use this solution. On the other hand, more and more people repair their clothes, especially older people, which is probably due to their upbringing, financial situation and skills. Online portals dealing with the exchange and sale of used clothing are becoming more

and more popular. 66% of respondents evaluate such activities positively.

It should be noted that some studies related to the assessment of society's knowledge and the basics of the CE concept have already been carried out, e.g. [65]. For example, one study measured the level of university students' knowledge of the circular economy concept and the findings showed that they have a high level of knowledge in this field, which reflects their deep understanding of its concepts and principles [65]. The authors of the study suggest that future research should examine the extent to which knowledge can be translated into practice in real life. They further suggest that future research should identify the long-term impact of such knowledge on sustainable development and social change. This seems to be an interesting approach.

It should be also noted that the study concerned consumer behavior and treatment of textile waste in Poland, a country where pro-ecological activities began relatively recently (compared to Western Europe). Poland is also a country where a lot of textile products are produced and large amounts of waste generated. Due to the relatively small sample size (313 respondents), it is advisable to continue the research on a larger number of respondents.

Interestingly, Poland ranks 12th among 28 countries where individuals have changed their daily activities to combat climate change, with 72% of Polish consumers actively engaged in such activities and 31% of respondents indicating restrictions on clothing purchases [65].

The results of the research presented may constitute valuable tips for consumers

of fashion brands who would like to make purchasing decisions based on the idea of sustainable fashion. In summary, consumers need more education about the benefits of circular economy and the environmental and social consequences of their purchasing choices. Based on the results of various studies, it can be concluded that more intensive and quick actions should be taken in the near future to protect the environment.

Declaration of Conflicting Interests

The Authors declare there is no conflict of interest.

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