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Impacts of textile industry on the environment

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The fashion industry, as one of the biggest polluters of the environment, is facing the increasing pressure from the general public to change its trade policy. This article provides an overview on the effects that the production and processing of textile fibers, together with waste from production and as unsold goods, may have on the environment. The environmental problems associated with the acquisition of natural fibers, the production of synthetic fibers, their processing and the final treatment of textiles are described. The need for water and chemicals, as well as the generation of waste at various stages of textile production are discussed. Finally, contributions of the resultant products to the carbon footprint as an important parameter of life cycle assessment are also explained.

Keywords: Environment; Pollution; Raw materials; Chemicals; Waste; Textile industry

Introduction

Unlike in previous years when companies did not pay much attention to the emissions produced, wastewater polluting rivers, and the effects of the production on the environment in general, the situation is currently opposite. Concern and care about the environment and its sustainability for future generations is becoming a part of the personal attitude of each person and, as a result, of the lifestyle of an increasing number of people. When an environmentally oriented individual considers how to minimize their carbon footprint, air travel with its high emissions most often comes to mind, while small daily changes in food and personal food choices or energy management and consumer approach to life are more or less in background. Consumerism is growing visibly, especially in the

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field of fashion. Fast fashion prevails, clothing is produced for a shorter period of time, and new collections of fashion brands appear on the market every few weeks to satisfy the demand, especially on the Internet. It is estimated that 20 new garments are produced per person annually and the purchase of garments increased by more than 60 % compared to a situation in 2000 [1]. In contrast, a wave of slow fashion and a slow lifestyle is rising and customers are willing to pay extra for environmentally friendly products. Across industries, there is a shift from legislative pressures to integrate environmental considerations into corporate management towards a willingness to voluntarily introduce innovative sustainable practices into the production, and thus social responsibility is becoming a part of the corporate policy and advertising campaigns.

The textile industry is one of the biggest polluters of the environment. It has negative impacts on the environment at every step, from growing and harvesting fibers or producing raw materials, via the subsequent production of textiles, their dyeing and related waste, the following transport to processing plants, transport of fashion collections, up to the end customer with disposal of textile waste – worn old clothes or unsold new goods. The social status, ethical consequences, and health risks of the production of textile products in third-world countries in humanly unacceptable conditions are also very important aspects deserving of public attention. Socio-demographic issues go hand in hand with the environmental impacts of the textile and clothing industry. Fashion brands currently produce almost twice as much clothing as in 2000. The so-called fast fashion has increased the permeability of the material in the system and leads to a large amount of textile waste. The environmental impact associated with the textile and fashion industry from production to final disposal can be characterised by enormous water use, chemical pollution, CO_2 emissions, textile waste and, second, by the necessary infrastructure and transport. This is more than 92 million tons of waste produced per year and 79 trillion litres of water per year [2–4]. Textile industry produces 1.2 billion tonnes of CO_2 equivalent per year, which is more emissions than those released by international air and maritime transport [5,6]. More than 60 % of textiles are used in the clothing industry, when much of the clothing industry is located in China and India – the two countries that rely on coal-fired power plants which increases the carbon footprint of each garment. It has been reported that approximately 5 % of total global emissions come from the fashion industry [6,7]. Emissions from production depend to a large extent upon the material produced. In 2015, the production of polyester for textile purposes reached more than 706 billion kg of CO_2 and, for instance, one polyester T-shirt gives rise to emissions of 5.5 kg CO_2 compared to 2.1 kg CO_2 for a cotton T-shirt [8]. Almost 60 % of all clothing produced is disposed within one year of production and ends up in a landfill or incinerators [9]. It is estimated that less than 1 % of the material used for making clothing is recycled in the clothing industry and about 13 % is recycled for use in other areas [9].

The aim of this work is to provide an overview on the effects related to the production and processing of natural and synthetic textile materials upon the environment in order to provide an input for data in the planned life-cycle assessment studies.

Raw materials for the textile industry

Natural textile fibers of plant and animal origin (cotton, flax, sisal, sheep's wool, natural silk, hemp, jute, etc.) have been used for millennia. Manmade chemical fibers (e.g. polyester, polyamide, elastic fibers, polyacrylic and polypropylene) have come to the use being produced from non-renewable sources (such as crude oil) with the discovery of processes of chemical synthesis. In addition, fibers of cellulose and its derivatives are chemically processed for textile purposes, the product being semi-synthetic fabrics, such as viscose or acetate fibers. Petrochemical-based synthetic fibers account for 40 % of world fiber production, man-made cellulose fibers 5 % [7,10–12].

Sixty percent of the worldwide fibers produced is used in the fashion industry, the rest then as industrial textiles, geotextiles, etc. The vast majority of the fibers produced (in 2018 it was 51 %) are of polyester origin followed by cotton (approximately 25 %) [4].

The textile and fashion industry have a long and complex supply-chain including agriculture and petrochemistry (the production of fibers), raw material processing itself, clothing production, logistics and retail. Each production step has an impact on the environment through the consumption of water, materials, chemicals and power (energy). Many chemicals used in textile production are harmful or even toxic to the environment. The most significant environmental impacts associated with textile production are recorded in Asian countries, where the majority of world clothing production is concentrated. However, the environmental impacts associated with textile waste are a global problem [13,14].

Kočí et al. developed an interesting study of life cycle assessment of carrier bags, which concerns different types of textiles according to the raw materials used in connection with the impact on the environment. An essential idea which, in certain respect, serves also as an argument against fast fashion, is that bags made of materials with a long service life have the least impact on the environment [15].

Textile raw materials of natural origin

According to archeological findings, cotton has been used for the production of textiles since the ancient times, both at the Eurasian continent and in America. However, greater use of cotton took place only after the ginning of cotton fruits had been mechanized by the invention of the respective machine, patented in 1794 by its inventor Eli Whitney. In the middle of the 19th century, it became the main export item of the United States [16]. The largest cotton producers are currently China, India, and the mentioned U.S. All these countries lie in the so-called cotton belt, where the conditions are almost ideal for growing this crop [17]. Important growing conditions include a warm climate, plenty of water when growing and a sunny and dry season when ripening. Pakistan, which is also one of the major producers of fast fashion, is currently the fourth largest producer of cotton (it is also a major consumer of edible cotton-seed oil). The raw materials used by the manufacturer for production are therefore from local sources, which does not burden the environment with unnecessary transport being otherwise a very significant source of pollution for the environment [18–21].

Cotton, as well as flax and other plants used for textile purposes are a source of natural fiber made from renewable materials that decomposes naturally in nature, which is a prerequisite for environmentally friendly character. Along with the fibers, by-products, such as seed oils, are also obtained from these plants. However, cotton is by far the most devastating to environment due to the extreme demands on water and the tendency to be attacked by various insects or fungi [8,19,22].

Conventional cotton comes from industrialized plantations, where high-yielding, often genetically modified hybrids with extensive use of chemical pesticides, insecticides, and fertilizers have been grown for many seasons. In addition, for example, defoliants are used, thanks to which the cotton leaves fall off so as not to contaminate the cotton fiber before further processing. In addition to pests, the application of pesticides also kills potentially beneficial animals that can protect the plant [22]. Quite typical for cotton cultivation is a very high consumption of water. During the harvest, fabrication, and dyeing, this crop is a subject to further chemical treatment and the cotton fabric, as a result, it contains a diverse range of chemicals fixed at the molecular level [19,23].

Organic cotton is grown in an environmentally friendly way without pesticides, insecticides, using natural fertilizers and plant protection by particular insects. During processing of organic cotton, bleaches or dyes with a possible toxic effect are replaced by dyes of natural origin. Otherwise, water consumption is very high as with conventional cotton [7,19].

Genetically modified, the so-called Bt-cotton contains a strain of the bacteria *Bacillus thuringiensis* producing toxins that are able of repelling caterpillars that attack cotton mallets. Hence, this sort of cotton does not require as many pesticides as conventional cotton, but insecticides are still used because genetically modified crop is not resistant, for example, to aphids [24]. Despite some negatives, Bt-cotton production is increasing. Even for a genetically modified crop, it is only a matter of time before pests become resistant to it, as well as to the pesticides used, and thus the need for new substances to protect cotton is still relevant [25]. Genetically modified cotton from Monsanto caused problems in India, as the high price of seeds compared to conventional cotton and low yields due to lack of resistance to local pests led to an increased number of suicides by farmers [19,25].

An estimated 200 tonnes of water is needed per tonne of textile, most of which is used in the cotton grow and in production processes, such as bleaching, dyeing, and finishing clothes [4]. Textile production currently consumes about 44 billion cubic metres of water per year for irrigation, which is about 3 % of global irrigation water consumption. 95 % of this water is used for irrigation in cotton growing. To produce one cotton T-shirt, 2650 litres of water are needed, which is equivalent to forty showers. Conventionally grown cotton ranks first in the size of the water footprint among textile materials. As 44 % of Asian cotton is destined for export, demands of the West can be regarded as a culprit for environmental damage. It is estimated that 20 % of the loss of water in the Aral Sea is due to the consumption of cotton clothing in the European Union. In arid areas, 7 % of the total loss of groundwater can be attributed to the water consumption for the clothing industry. In addition to affecting the loss of drinking water, the clothing industry also produces wastewater, which penetrates the soil and pollutes groundwater when under-treated. Due to the fact that toxic substances are also used for production, water from such quite limited sources is no longer suitable for drinking [4,13].

Flax is a crop cultivated for millennia mainly for fiber, but its oilseeds are also utilised. Linen fabrics are characterized by good absorbency and fast drying, high strength, and therefore a long life [26]. Unlike wool, hemp has the advantage that the substance made from it is not attacked by moths. The hemp plant is resistant to pests, so there is no need for chemical spraying. Like flax, hemp is strong and durable, making it suitable for use in sustainable textile production [27,28]. Bamboo cellulose is used to make fibers that have a number of favorable properties, so they can be used for production of clothes that are healthy and comfortable to wear. In addition, its cultivation does not require much irrigation and is naturally resistant to pests [18,28–31].

Wool is one of the important fibers of an animal nature in the textile industry. These fibers are most often produced from the fur of sheep of various species (domestic sheep, Cotswold sheep, Shetland sheep, merino, etc.), and are therefore among the renewable sources [32]. Other animals that produce wool include camel, alpaca, angora goat, whose wool is called mohair, cashmere goat, bison, musk, etc. If we talk about fibers of animal origin, it is worth mentioning the silk, which is produced by silkworm caterpillars. There is minor negative impact on the environment because synthetic fertilizers or pesticides are not used, but there can be occurrence of soil erosion due to grazing animals, or excessive manure. In addition, a number of chemicals are used in the production process; for example, the use of alkali to clean fatty fibers or anti-shrink or anti-shrinkage substances during washing [7,18].

Leather and its processing

Leather is a material of animal origin often used for the production of clothing, shoes and accessories. Salted skin is stripped of hair in the tannery mechanically or with the help of lime and sodium sulphide. In the next step, muscle residues, ligaments, and hair roots are removed – again, mechanically. The skin is then treated with chromium salts to soften and remove fat, further dyed, lubricated, and treated by a series of other subsequent steps. The biggest problem is the use of chromium salts, which are more effective and cheaper than agents of plant origin, and the leather processed in this way is more resistant to higher temperatures and humidity. This process contributes significantly to the pollution of watercourses by sulphates, heavy metals and chlorides. Making of leather with chromium salts also generates quite a large amount of solid waste which, if stored improperly, can escape into the environment and may endanger soil and water resources. A large amount of water is required for the tanning process: it consumes 1500–2000 litres of water per tonne of leather. Another risk is the wastewater from tanneries, which is not always treated properly, if at all. Polluted water is thus transfered into surface waters, where it can be toxic [33]. The main problems of the leather industry located mainly in third world countries, are the use of outdated technologies, non-compliance with safety labor standards, poor waste management and pollution of drinking water sources [4,34].

Textile synthetic fibers

The mass expansion of processes based on chemical synthesis started off, among others, the production of man-made chemical fibers (polyester, polyamide, elastic fibers, etc.). In addition, fibers of cellulose and its derivatives are chemically processed for textile purposes; the products being of semi-synthetic nature, such as viscose or acetate fibers. These fibers were developed in the early 18th century to replace rare and expensive natural silk [7,10,11]. Traditional viscose production is not an organic production method, and in addition to growing conventional cotton, viscose producers contribute to environmental pollution. Sustainable variants of viscose produced by closed-loop technologies, where 99 % of chemicals are reused and not being let out as wastewater, are under trademarks, such as Lyocell, TENCEL™, Veocel™, etc. [12,35,36].

Polyester (PES) is currently the most widely used synthetic fiber from non-renewable raw materials. In the first step, glycol and dimethyl terephthalate are obtained from petroleum and subsequently polycondensed to polyethylene terephthalate, from which the polyester fiber is being further produced. Polyester is also obtained directly by recycling plastic (PET) bottles from polyethylene terephthalate, which is advantageous from a point of view of environmental protection. The main advantage in the production of recycled bottles is a lesser air pollution, up to 85 %. However, in terms of quality, polyester made directly from oil is of better quality [7]. Unlike natural materials, dyeing of synthetic fibers can be already performed in the phase when they still are in solution. Dyeing of the already processed polyester is strenuous due to the work under pressure. Allergic contact dermatitis has been found to occur when stained with disperse dyes [4,7,37–39].

Growing cotton uses more water than producing polyester, and the soil is destroyed by erosion and absorbs a lot of chemicals. Polyester is made from non-renewable raw materials. Up to one and a half kilograms of hydrocarbons are used to produce a kilogram of polyester fibers. Compared to the production of cotton fibers, up to twice as much energy is used in the production of polyester. However, the cost of washing or drying finished products is much more energy efficient for polyester. However, the various properties of these materials play a principal role for the customer, so cotton cannot be replaced by polyester or *vice versa* [4,40].

Together with polyester, nylon is one of the most common fibers of synthetic origin made from oil and being readily biodegradable. Nylon is mainly used in carpets, where there is a problem with subsequent recycling, as it is composed of dyes that are added to the polymer solution during production and containing an adhesive [4,7]. Two-thirds of global production of 2.9 Gt of CO_2 equivalent emissions is associated with synthetic materials during the fiber production, textile manufacturing and garment construction [4].

Synthetic fibers have a common problem with microplastics, existing in particles up to 5 mm in size. These are released into the environment and being thus especially dangerous for organisms living in the seas. They enter the environment from household wastewater generated by washing textiles through various water-treatment processes. Both fibers of synthetic and natural origin can be found in the marine environment [40–42]. Synthetic fibers have been found to cause higher mortality rates in organisms, such as *Daphnia manga*. For example, a washing of 6 kilograms of clothes produces around 700 000 fibers. 70–99 % is captured in water purification stations, mainly in bioreactors, sand filters and in sewage sludge, but even so, synthetic fibers are still present in wastewater to some extent. The fibers of such a kind have also been found in products, such as honey, blue mussels, beer, and table salt [41].

Textile dyes

Color is very important in fashion clothing. For each season, the Pantone Color Institute announces the exact color shade influencing the interior design, and especially the entire world of fashion, including chain stores and their designers who include it in new clothing collections. However, this fact is not favorable for the environment, not at all.

In the dyeing technologies, the paint is fixed in the processed material by means of dyes, fixing agents, wetting agents, electrolytes (sodium chloride, sodium sulphate), levelling agents, thickeners, surfactants, etc. The dyes and pigments used for coloring natural, synthetic, man-made and mixed textile materials are numerous and can reach 100,000 types and the world annual production is about 700,000 tonnes [42]. Textile dyes are organic, usually water-soluble compounds, including various types of dyes like direct, disperse, reactive, acid, basic, sulphur, and vat ones. Reactive dyes are preferred in textile apparel industry owing to their bright colour, fastness and ease of application [38,43–45].

Direct wastes from the dyeing process is a highly coloured effluent containing the dye of interest, salts, and other washed-out dyeing agents with high pH and dissolved solids (liquid waste). For these textile effluents, high values in terms of several physicochemical and biological parameters, indicating the degree of pollution, are typical (coloring, temperature, salinity, pH, biological and chemical oxygen demand, total dissolved solids, total nitrogen, total phosphorus, non-biodegradable organic compounds, heavy metals). The dyes in water reduce the penetration of light, and consequently reduce the process of photosynthesis of plants in water and also lower the amount of oxygen, which results in poor living conditions for aquatic organisms. In the processing of natural fibers like cotton, the addition of antimicrobials is being applied, making the waste in the water as resistant to biodegradation [42–44,46,47].

The impact of the textile industry on the environment

The journey of a textile product to the customer represents a long and complex supply chain, comprising agricultural and industrial fibers sourcing, textile production, logistics, and retail. Every production step affects the environment due to the use of water, materials, chemicals and energy, chemical pollution and CO_2 emissions. Most environmental impacts are concerned in textile and clothing industries, but the production waste occurs worldwide. Current trends of consuming fashion lead to large amounts of textile waste, most of which is incinerated, landfilled or exported to developing countries.

It can be summed up that the textile and clothing production give rise to an estimated 8–10 % of global CO_2 emissions (4–5 billion tonnes per year) [4]. As already emphasised, this industrial area is a major consumer of water (79 trillion litres per year), which corresponds to the production of about 20 % of industrial water from textile treatment and dyeing. It contributes approximately 35 % of ocean pollution by microplastics (190 000 tonnes per year) and produces huge amounts of textile waste (more than 92 million tonnes per year), much of which ends up in landfills or is incinerated, including unsold product [4,10,23,48,49].

Water

The fashion industry uses a lot of water. In 2015, an estimated 79 billion cubic meters were consumed, an average of 200 tons of water in the production of one ton of textile [23]. Most of water is used for growing cotton and bleaching, dyeing, printing and finishing textiles. Textile production consumes approx. 3 % of global irrigation water, of which 95 % is used for cotton production [48,50,51].

Compared to other textile fibers, cotton has the highest water footprint. More than 40 % of locally grown cotton is intended for export and the consumption of local water significantly affected by foreign demand. It is stated that 20 % of the loss of the water of the Aral Sea is related to the consumption of cotton in the European Union. In addition to the considerable consumption of water for fibers production, a considerable amount of toxic chemicals is used in this sector, which enters the groundwater or surface water with industrial effluents or with industrial inappropriately treated wastewater [52].

Use of chemicals

More than 15 000 different chemicals are used in the textile production processes, especially agrochemicals on cotton plantations [53]. Agrochemicals are behind some respiratory diseases, cancer, neurological and reproductive problems. As being able to penetrate into the soil, they may cause locally a decrease of the soil fertility and biodiversity [54]. The introduction of genetically modified cotton has led to a reduction of usage of pesticides and, at the same time, to the adaptation of pests and the return of chemical protection [55]. Furthermore, the chemicals are used in the processing of fibers as solvents, bleaches, surfactants, plasticizers, dyes, defoamers and water repellents and, together with agrochemicals, reach the final fabric. Most of the chemicals used in the production come from Far East Asian countries, as do about 80 % of the textiles consumed in the E.U. [56,57].

It is almost impossible to obtain information on the chemical cocktail used, and the data in safety data sheets are often the only source of information. Börjeson et al. state that 2 450 chemicals used in the textile industry have hazardous properties for health, of which 10 % are of higher or even high risk. These include fragrances, azo dyes, brominated flame retardants, perfluoroalkyl acids, phthalates and antibacterial agents, as well as antibacterial agents which can lead to the increased antibiotic resistance [4]. These substances tend to be persistent and bioaccumulative, which is a prerequisite for their spread to very distant uninhabited places. For example, waterproofing industrial textiles contain chemically stable fluoropolymers that have been found in the bodies of polar bears and seals [58]. Replacing toxic chemicals with low-toxicity alternatives that are considered safe under current regulations may pose a risk in the future. In this context, textile production in localities with a vague approach to environmental protection is risky due to high impacts on the environment and human health [2,56].

Waste from the textile industry

A large amount of waste from textile production processes is discharged into the water by the manufacturer, which may have a very adverse impact on the environment. These are wastes that cannot be accumulated in landfills for various reasons; mainly due to economic restrictions. It is more advantageous for producers to dispose the waste with minimised financial expenses. In countries with appropriate legislation, it is no longer possible to dispose of wastewater as it has been a practice in the past, or as is the case now in some third-world countries, where multinational companies are primarily targeting their business plans [38,59,60].

Wastewater contains chemicals, dyes, large amounts of insoluble matter and organic pollution. Wastewater from the textile industry is usually alkaline, can have a higher temperature, and often forms a foam on its surface, which hinders the access of air oxygen to the water and often causes the death of aquatic fauna and flora. Further, elevated temperature changes the conditions in the water, disturbs the balance of biotypes and affects its self-cleaning ability. The non-biodegradable substances present can last a very long time and cause difficulties during further handling. Toxic substances destroy organisms in water and inhibit self-cleaning function. These are, for example, hydrogen peroxide, chlorine, sulphides, heavy metal compounds, acids and alkali. Lipophilic oils and fats that are entrapped on aquatic organisms or aquatic plants have another negative effect in the aquatic environment. Wastewater from the textile industry can be treated together with sewage wastewater in treatment stations or in separate treatment plants that can also be a part of textile factories [42,46,60–62].

In the legislation of the Czech Republic, the term "waste" is defined according to Act 541/2020 Coll. on waste to be "*any movable thing which a person disposes of or has the intention or obligation to dispose of*" [63]. The textile industry produces solid waste, which is directly linked with its production (e.g., unused parts of fabrics) and most often being recycled in production. Waste from the used textiles can be further used for beneficent purposes or processed as a cleaning material. Those used textiles that can no longer be used, usually end up in municipal waste landfills or incinerators. However, the largest amount of waste from the textile industry is clothing that customers dispose of after a short period of use, and such a waste also includes old clothing in garbage. The collection of textile waste is currently mostly organized either by processing companies or by charities, usually in special containers at announced locations. Textile waste is further sorted, part is used by a new consumer, part is processed into a secondary raw material [4,7,64,65].

Carbon footprint

The carbon footprint expresses the amount of greenhouse gases (carbon dioxide, water vapor, traces of methane, etc.) released into the air and converted to the equivalent amount of carbon dioxide. An important producer of these gases is the textile industry, the respective processing and practical use. The integrated pollution prevention and control estimates that the textile manufactures generate around 10 % of global greenhouse gas emissions. Although the information on these estimates does not indicate the scope of the study and the methods used, a comparison of these estimates with other sources suggests one that these outputs do not include end-customer carbon footprint data (retail clothing transport, washing, drying). In the textile industry, as in other sectors, the production of greenhouse gases is influenced by the way in which raw materials are obtained, in-house production, transport, energy consumption and the use of products themselves [4,10,49].

The way of how cotton is cultivated has a big impact on greenhouse gas emissions. The conventional method is the use of plant protection products; i.e., the application of synthetic fertilizers, the depletion of the soil by repeated cultivation of the same type of plant. This produces 3.5 times more greenhouse gases than a method utilising the growing of organic cotton, which emphasizes the renewable nature of resources (for example, by alternating cotton with peas) and non-chemical, mechanical pest removal. Estimated two-thirds of global greenhouse gas production are associated with the production of synthetic materials. In contrast, materials of plant origin (jute, flax, hemp, etc.) capture carbon, thereby may reduce its concentration in the atmosphere [4,49].

Most greenhouse gases are produced during the initial extraction of fibers, which is particularly pronounced for synthetic fibers, which comes from non-renewable sources. The energy consumption, for example, to produce one kilogram of polyamide is *ca.* 160 kW [4,53].

The impact of the textile industry on the environment is not only a consequence of production, but also production and trade both being always related to the need to transport goods from the production plant to the customer, which is very important in connection with the fast fashion. All common modes of road and rail transport, ship and air delivery are being used. Each mode of transport has its pros and cons. The disadvantage of the former, from a point of view of environment is a noise and land use during the construction and maintenance of roads. Compared to this, the air transport is typical for a high fuel consumption. According to the World Bank, air transport is four to five times more expensive than land transport and 12–16 times more expensive than sea transport [4,48,66].

The impact of transport on climate changes is indisputable. Transport accounts for 64 % of total global fossil fuel consumption, 27 % of total energy use and approximately 23 % of CO_2 emissions from energy consumption in vehicles. The environmental impact of motoring and traffic is expected to continue and increasing dramatically. The corresponding emissions have been increasing by 1.7 % every year since 2000. Sixty percent of this increase is accounted for by non-OECD members, in whom economic growth has been associated with the increased demand for motor vehicles. Air pollution caused by dense traffics is associated with a wide range of health problems, including severe cardiovascular and lung diseases. For instance, every year, almost 185 000 deaths can be directly attributed to the air pollution caused by vehicles [36,48,53].

The clothing industry produces a large amount of greenhouse gases not only due to the high energy consumption in the mixes of power used to obtain raw materials, in production and transport, but also depends on the energy sources. China, one of the largest producers, uses coal as a source of power, making China's carbon footprint evidently higher than Europe's carbon footprint [4,48].

The results of a study of textile consumption in Sweden show that the use of clothing has a 14 % share of the clothing industry's impact on climate changes. In the first stage, it is transport from retail, then there is an effect of washing (consumption of electricity and detergents), drying (currently, electric dryers are used to a large extent), ironing, or custom cleaning. A solution to reduce greenhouse gas emissions would require a comprehensive and sophisticated approach, comprising reduction of production, use of renewable energy sources, preference of natural fibers over synthetic ones (as natural fibers give rise to a lower carbon footprint than the fibers produced from non-renewable sources, and when using shipping over air transport [4,48].

Conclusions

This article has provided an overview on the effect of the production and processing of textile materials on the environment. Today, it is already known how to prevent harmful effects and how to protect the environment; great emphasis being placed on various new eco-innovations. The fashion industry is lagging behind in this respect, not emphasizing impact on quality of the environment, but prioritizing profits and quantity, cost reduction and the constant change of product range. A care about the environment would require additional costs, while another change in fashion collections would force customers to shop again. High profits in the clothing industry are offset by environmental damage when neglecting occupational safety and pleasant working conditions.

However, end customers are now beginning to demand fashionable goods that are environmentally friendly, not only for the environment itself, but also for natural and human resources. In principle, any production damages the environment, but if it is unnecessary overproduction, it damages it more and unnecessarily.

Public presentation of environmental problems associated with textile production can be an encouragement for ordinary consumers convincing them of a new lifestyle and a need for organic products. Thus, it can be a guide for the professional public in the search for new, environmentally friendly and sustainable technological processes.

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