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Sustainable approach to counter the environmental impact of fast fashion

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Abstract
The fashion industry is experiencing increasing global scrutiny of its environmentally polluting supply chain operations. In spite of the widely publicized impacts on environment, however, the industry continues to grow, in part because of the rise of fast fashion. The term fast fashion means low-cost clothing collections that take off current luxury fashion trends. Fast fashion helps to satisfy deeply held desires among young consumers in the developed world for luxury fashion, even as it embodies unsustainability. Environmental sustainability can be a centerpiece for managers working across industries that have negative impact on the environment and the fashion industry is not an exception. Impacts from the fashion industry comprise over 92 million tonnes of waste produced per year and 79 trillion litres of water consumed. From the growth of water-intensive cotton, to the release of untreated dyes into local water sources; the environmental and social costs included in textile production are widespread. Due to the heavy production, use and dispose of, the textile and fashion industry has a large environmental impact in every stage of product life cycle. Therefore, fashion industry urgently needs to address its unsustainable practices. The rising public awareness of environmental issues during the last decade has urged clothing retailers and manufacturers to adopt sustainable practices for minimizing the environmental impacts.

Keywords: fast fashion, textile and fashion industry, environmental impact, sustainability

Introduction
Fashion is an expression, largely accepted by a group of people over time and has been characterized by several marketing factors including low predictability, high impulse purchase, shorter life cycle and high volatility of market demand [11]. Fast fashion involves clothing designs that move quickly from the catwalk to stores for taking advantage of available trends. It allows mainstream consumers to buy the hot new look or the next big thing at a reasonable price. Fast fashion became common due to cheaper, speedier manufacturing and shipping methods, an increase in consumers' appetite for up-to-the-minute styles and the rise in consumer purchasing power. Due to this, fast fashion challenges the established clothing labels' tradition of introducing new collections and products on an orderly, seasonal basis. Actually, it's not uncommon for fashion industry to introduce new product lines multiple times in one week to compete in fast fashion retail market [1, 5].

The textile and fashion industry is a significant part of the world trade, being the second sector of consumption worldwide estimated at more than 30 million tonnes per year. This industry has a long and complex supply chain, starting from agriculture and petrochemical production (for fibre production) to manufacturing, logistics and retail. Almost twice the amount of clothing is now produced by textile and fashion brands as compared with the year 2000 [13, 29]. The increase of fast fashion causes an essential increase in the volume of clothing consumed mainly in the developed countries of the world. The conversion of raw textile fibre to finished fabric and final products involve cheap labour, air pollution and the use of harmful chemicals. Additionally, the textile and fashion industries use large amounts of water, energy, and raw materials throughout the supply chain, all of which places a heavy demand on natural resources of Earth. As these resources take the same amount of time to grow and regenerate, despite of the product speed to market and waste disposal, the increased rate of production and consumption of fast fashion is aggravating the garments industry's negative impacts [4, 16].

To make the matters worse, large amounts of chemical pollutants, carbon dioxide and other toxic substances are released into waterways, soil and air during production of clothing. However, the fashion industry's negative environmental impacts don't stop the moment the

clothes are tastefully hung in the retail stores, purchased and then packed off home by the consumers [17]. Instead, the negative thread of impacts continues during the consumer-use phase as the consumer washes, dries, irons and dry-cleans their clothes to within an inch of their lives and then discards the clothes, too often into landfill in place of re-use or recycle. Thus, there are implications both in terms of increased textile waste flows and environmental impacts associated with manufacturing, use and end-of-life management of textiles [20].

Fast fashion leaves a pollution footprint, with each step of the clothing life cycle generating potential environmental and occupational hazards. Even though fast fashion provides buyers an opportunity to purchase more clothing for less, there is a disproportionate burden of environmental health hazards for those who work in or reside near textile manufacturing facilities along with a systematic oppression of the garment workers in these manufacturing facilities. In response to all this, sustainability can be adopted to rectify the environmental destruction brought in by techniques of production and usage of fast fashion [24, 25]. Therefore, this paper reviews the various environmental impacts caused by fast fashion and also include the measures that can be taken to reduce them.

Major Environmental Issues Associated to Fast Fashion

Resource consumption

The manufacturing of materials requires the considerable exploitation of renewable as well as non-renewable resources. The textile and fashion industries use large amounts of natural resources - water, oil and land throughout their entire lifecycle, from production of fibres, manufacturing, distribution, consumption to the clothes' end-of-life at disposal. With each wash, synthetic clothing releases plastic microparticles which are then released into the oceans. Cotton is also the chief pesticide consuming crop in the world and its manufacturing requires large quantity of fresh water [18, 30].

Greenhouse gas (GHG) emission

The textile and fashion industry is responsible for the release of million tonnes of carbon dioxide equivalent per year and accounts for 10 percent of global carbon emissions. The global fashion industry generates a lot of greenhouse gases because of the energy used during its production, manufacturing, and transportation of the million garments purchased each year. Synthetic fibres like polyester, acrylic, nylon, etc., used in the majority of clothes, are prepared from fossil fuel, making production much more energy-intensive as compared with natural fibres [31]. Most of the clothes are manufactured in China, Bangladesh, or India, countries essentially powered by coal. This is the dirtiest type of energy in terms of carbon emissions. Again, the level of emissions is dependent on the fabric type and processing system involved. Polyester/cotton blend that are used for corporate clothing is assumed to have the highest GHG influence in the steaming process. On the other hand, wool has a greater GHG impact earlier in the production, because of methane released by sheep before production has even begun [28].

Land use and landfill

It is especially significant for natural fibre production, and particularly with intensively grown monocultures, the land degradation that can come from chemical pollution of soil and groundwater due to the use of herbicides, insecticides and fertilizers and loss of biodiversity [35]. Most of the textiles end up in landfill. Not only are textiles pretty bulky as compared to other household wastes, and quickly use up the limited space available, but also the (typically 50%) biodegradable fraction then breaks down that release Green House Gases [36].

Soil degradation and deforestation

The soil is a fundamental element of ecosystem. Another thing that is wrong with the fast fashion industry is that it hurts soil, wood land and entire ecosystem. Healthy soil is required for production of food but also to absorb CO_2. One of the main environmental issues the planet is currently facing is the massive, global degradation of soil. It presents a major threat to global food security and also leads to global warming [6]. Goats and sheep raised for the wool are overgrazed in pastures and it contributes to soil erosion, land degradation, loss of valuable plant species, food shortages and famine. Thousands of hectares endangered and ancient rainforests are felled every year and replaced by plantations of trees used to make wood-based fabrics. This harms indigenous communities and also the Earth [5, 6].

Fibre production

The textile industry is shared between natural fibres which include wool, silk, linen, cotton, hemp and man-made ones, the most common of which are synthetic fibres such as polyamide, acrylic produced from petrochemicals. Cheap and easy-care fibres are becoming the textile industry's miracle solution. However, their production creates pollution and they are hard to recycle (nylon taking 30 to 40 years to decompose). When natural fibres like cotton, linen and silk, or semi-synthetic plant-based cellulose fibres such as rayon, Tencel and modal are landfilled, they act as food waste, generating the powerful greenhouse gas, methane [36]. At each of the six stages typically required to make a garment, the negative environmental impacts are as numerous as they are varied. Spinning, weaving and industrial production undermine air quality. Dyeing and printing consume large amounts of water and chemicals, and release various volatile agents into the atmosphere that are predominantly harmful to the health. Fabric dyeing poses an additional risk as untreated dye and waste water is often discharged to local water systems which releases heavy metals and other toxic substances and affect the health of living beings. Polyester, the most widely used manufactured fibre, is prepared from petroleum. With the increase in production in the fashion industry, demand for man-made fibres, particularly polyester, has nearly doubled in the last 15 years. The manufacturing of polyester and other synthetic fabrics is an energy-intensive process requiring large amounts of crude oil and releasing emissions including volatile organic compounds, particulate matter, and acid gases, all of which can cause or aggravate respiratory diseases [25, 28].

Leather apparels and accessories

The production of leather shoes and clothes causes pollution in abundance. The impact of chemicals used in tanning significantly affects the workers and the environment. The negative relationship between chemical exposure of tanning to the environment and the harmful chemicals affecting them is humongous. More than 20 dangerous chemicals are involved in the treatment process of leather apparel to get that smooth desired finished look of the garment [38]. Chromium is one of the cheapest chemical used to tan leather and the

workers exposed to this dangerous chemical suffer from various severe skin diseases. Smoke emitted from tanneries is an important cause of air pollution, the air ending into numerous bronchitis and respiratory infections as well as variety of cancers [20].

Over use and contamination of water

The textile industry uses high volumes of water throughout its operations, from the washing of fibers to bleaching, dyeing and washing of finished products. It can take up to 200 tons of fresh water to dye and finish just one tonne of fabric [60]. Also, cotton needs a lot of water to grow (and heat), but is typically cultivated in warm and dry areas. Up to 20,000 liters of water is required to produce just 1 kg of cotton. This generates tremendous pressure on this precious resource, already scarce, and has dramatic ecological consequences such as the desertification of the Aral Sea, where cotton production has completely drained the water. The large volumes of wastewater generated also contain various chemicals, used throughout processing. These can cause damage if not properly treated before being discharged into the environment and leads to water pollution [46, 54].

Chemicals

The textile and fashion industries use and release a wide range of chemicals at various stages during the product's life cycle that when left untreated causes serious threat to the living environment. Textile production is a major contributor of environmental pollution because of its high greenhouse gas emissions and contamination of air and fresh water supplies. The heavy use of chemicals in cotton farming causes diseases and premature death among cotton farmers, together with massive freshwater and ocean water pollution and soil degradation [46]. The story does not end here because chemicals continue to be released into the water system when consumers wash and dry-clean their clothes. Also in today's global fashion supply chains the widespread transportation of clothes and textiles leads to increased pollution [6].

High impact dyes

Many dyes present health risks to the people working with them and also damage the environment in a number of ways. The dyeing process generally includes ranges of toxic chemicals which are carcinogenic and possibly disrupt hormones; toxic heavy metals such as chrome, copper, and zinc, are known carcinogens; and formaldehyde, a suspected carcinogen. Many dyes, involving natural dyes, do not "stick" to the fabric well enough and a large amount of coloured water get washed off from the fabric right after it is dyed. For example, only about 80 percent of synthetic dyes known as direct dye are retained by the fabric; the rest is flushed out from the garment polluting the water [29, 37].

Textile waste

The remarkable rise in fast fashion production and consumption volumes results in increasing textile waste. Many western countries handled the textile waste by exporting old garments to developing countries. However, with higher production of waste, this practice could not sustain, as many developing countries banned the import of textile waste, either to protect domestic textile production or because markets are oversaturated by second-hand garments and second-hand clothing has replaced local production [20]. Globally, textile waste is flowing from factories and cascading from closets to landfill. Sadly, across the board, textile recovery rates for recycling remain relatively low, in spite of textiles being considered almost 100 percent reusable or recyclable [2, 40].

Air pollution

Most processes carried out in textile industry produce atmospheric emissions. Gaseous emissions have been recognized as the second greatest pollution problem (after effluent quality) for the textile industry. Textile industry typically generates nitrogen and sulphur oxides from boilers. Other important sources of air emissions in textile operations involve resin finishing and drying operations, printing, dyeing, fabric preparation, and wastewater treatment plants. Hydrocarbons are emitted from drying ovens and from mineral oils in high-temperature drying/curing. These processes can emit formaldehyde, acids, softeners, and other volatile compounds. Residues from fiber preparation sometimes emit pollutants during heat setting processes. Carriers and solvents may be emitted during dyeing operations that is dependent on the types of dyeing processes used and from wastewater treatment plant operations. Carriers used in batch dyeing of disperse dyes may lead to volatilization of aqueous chemical emulsions during heat setting, drying, or curing stages. Acetic acid and formaldehyde are two major emissions of concern in textiles [42, 55].

Microfibers pollution

Microfibers are micro plastics that come from synthetic fabrics such as polyester and nylon, every time when clothes are washed. Each wash sheds about 7,00,000 individual microfibers into the water, making their way into the oceans. The small aquatic organisms ingest these microfibers and with a cyclic chain, introducing plastic in the food chain. According to a study it was found that one person could release almost 300 million polyester microfibres per year to the environment by washing their clothes and more than 900 million to the air by simply wearing the garments [55].

Pollution during packaging

A great deal of packaging is used by the garment industry. Packaging is often part of the product with the shortest span of use that ends up in a landfill, gutter, or ecosystem shortly after buying. Additionally, excess packaging materials are commonly used to improve a product's visibility, unnecessarily drawing on resources that do not affect the product's serviceability [36].

A Sustainable Approach Towards Fast Fashion

Sustainable fashion refers to the production of fashion by ethical means. It involves adopting an approach in the designing, sourcing, manufacturing, and selling of clothing in a manner that can maximize the benefits to the people and communities worldwide and at the same time which aims at minimizing the negative impacts on the environment [20].

It is the need of the hour for the textile industry to invest in clean technology, fashion houses to construct new business models, consumers to change their consumption habits and policymakers to modify legislation and global business rules. Key approaches to create a new paradigm for sustainable fashion, involves limiting growth, reducing waste, promoting a circular economy, using sustainable fibers etc. [9, 40].

Limits to growth

Regardless of actions by the fashion industry to reduce environmental impact, current efforts to improve sustainability are often outpaced by rising consumption. Sustainability potential, for instance, has been constrained by consumer culture (increased consumption) and the tightly related output growth (increased production), both of which are factors that the fashion industry is slow, or unwilling, to mitigate for economic reasons [12, 14]. The textile industry needs to enhance sustainability and business needs to create alternative models for fast fashion to lower its environmental impact. De-growth could lead to better balance in the industry by slowing down production and creating stable businesses focused on better garment quality, longer product life and smaller production amounts. Extended producer responsibility, in which producers and importers are responsible for product disposal and recycling, promote more environmentally friendly business practices by making waste a cost for the industry and encouraging it to reduce over production [10].

Closing the loop

Further to limiting the growth of the fashion industry, promoting a circular economy (keeping materials in the system for as long as possible) is an additional approach to improve environmental sustainability. The extended use of a product can be achieved through various means, often falling on the consumer via improved product satisfaction and person–product attachments [19]. Material recycling at the end of a product's lifetime also gives opportunities to promote a circular fashion industry and minimize waste. Many forms of textile recycling exist for both pre-consumer and post-consumer waste. Recycling, however, is complicated for garments being constructed of fibre blends, which require separation [43, 45]. Mechanical, chemical and thermal recycling of textile materials offer the potential to reduce environmental impacts as compared with processing virgin fibres [50]. Moreover, in some situations, textile incineration with energy recovery can be more sustainable than recycling materials, as textiles might involve chemicals that are not recyclable or recycling might be impossible, owing to inseparable fibre materials. In the future, garments must be designed to be suitable for recycling and closing the material loop must be the norm, requiring systematic changes in the industry. Furthermore, extending the use time of garments and their waste should be integrated for a holistic garment life cycle model, thus, fostering a sustainable fashion industry [51, 52].

Waste in focus

While the recycling technologies can help address textile and inventory waste, it is essential to consider whether the fashion system could instead be redesigned so that waste and, particularly, surplus product are not created. Two approaches can be used to prevent clothing waste and implement more sustainable fashion practices: proactive (prevent, reduce) and reactive (reuse, recycle and dispose) [34, 47]. A mix of proactive and reactive approaches to minimize waste production and reuse the product to extend its lifetime offers a feasible alternative. The least sustainable approach, however, is fully reactive, focused on efficient product disposal [35, 49, 56]. The proactive methods have been developed to design garments that minimize cutting waste and put nearly all offcuts into production. These strategies include: invisible remanufacturing, where fabrics are placed in invisible sections of the garment; visible remanufacturing, where they are placed in external visible places; and design-led manufacturing, where offcuts are used creatively to decorate the garment [53]. It has been predicted that this creative way of manufacturing garments could save as much as 17% of virgin material and 7,927 kg of carbon dioxide during the production of 10,000 garments. Further consideration of small off cuts - which could later be used in mechanical fibre recycling - further offers opportunities to save more fabric and minimize carbon dioxide emission. Creative manufacturing practices could be one solution to reduce the environmental impact of the fashion industry. Similarly, closer collaboration between design and manufacturing could create a new kind of low-waste-driven sustainable design–manufacturing–consumption model [59].

Sustainable fibers

The sustainability of a fiber refers to the practices and policies that reduce environmental pollution and minimize the exploitation of natural resources in meeting lifestyle needs. Across the board, natural cellulosic and protein fibers are thought to be better for the environment and for human health, but in some cases manufactured fibers are thought to be more sustainable. Fabrics such as Lyocell, made from the cellulose of bamboo, are made in a closed loop production cycle in which 99 percent of the chemicals used to produce fibers are recycled. The use of sustainable fibers will be helpful in minimizing the environmental impact of textile production [57].

Organic cotton: Cotton grown and processed without any chemicals, involving pesticides and synthetic fertilizers. Organic cotton certifications also ensure cotton farmers are treated and paid fairly, and work in safe, hygienic conditions. Organic cotton farming also needs 88% less water, and 62% less energy than traditional cotton [7].

Organic hemp

One of the oldest fibers around and is one of the most eco-friendly fabrics. Aside from converting into fabric sustainability, it requires 50 percent less water than organic cotton and no pesticide [15]. Possibly the most seasoned fibre on the planet, hemp helps keep warm in winter and cool in summer and gets gentler the more it is washed. It's also incredibly useful, being excellent at temperature regulation, both in hot and cold climates and has natural UV protective properties [21, 23].

Organic bamboo (bamboo linen)

Bamboo is one of the fastest renewing plants on earth as it can be harvested without killing the core plant. It also requires only natural rainfall to grow and consumes more carbon dioxide than hardwood trees. Bamboo linen is made in a similar way to other types of linen like hemp or flax, using a process that is largely mechanical. This type of bamboo fabric is a bit rougher and must be approached cautiously as it can either be one of the most sustainable fibers or the least, depending on how it's made into fabric [27].

Corporate sustainability

Oversight and certification organizations like Fair Trade America and the National Council of Textiles Organization provide evaluation and auditing tools for fair trade and production standards. While some companies do elect to get

certified in one or more of these independent accrediting programs, others are engaged in the process of green washing [32, 33]. Capitalizing on the emotional appeal of eco-friendly and fair trade goods, companies market their products as green without adhering to any criteria. To combat these practices, industry-wide adoption of internationally recognized certification criteria should be adopted to encourage eco-friendly practices that promote health and safety across the supply chain [26, 44].

Trade policy

While fair trade companies can attempt to compete with fast fashion retailers, markets for fair trade and eco-friendly textile manufacturing remain small and ethically and environmentally sound supply chains are difficult and expensive to audit. High income countries can promote occupational safety and environmental health through trade policy and regulations. Although occupational and environmental regulations are often only enforceable within a country's borders, there are several ways in which policymakers can mitigate the global environmental health hazards associated with fast fashion [39].

The role of the consumer

Trade policies and regulations will be the most effective solutions to bring about large-scale change to the fast fashion industry. However, consumers in high income countries have a role to play in supporting companies and practices that minimize their negative impact on humans and the environment [58]. While certifications attempt to raise industry standards, consumers must be aware of green washing and be critical in assessing which companies actually ensure a high level of standards versus those that make broad, sweeping claims about their social and sustainable practices [61]. Consumers in high income countries can do their part to promote global environmental justice by buying high-quality clothing that lasts longer, shopping at second-hand stores, repairing clothing they already own, and purchasing from retailers with transparent supply chains**.**

Conclusion

In the last two decades since the fast fashion business model became the norm for big name fashion brands, increased demand for large amounts of inexpensive clothing has resulted in environmental and social degradation along each step of the supply chain. The environmental and human health consequences of fast fashion have largely been missing from the scientific literature. The cost pressure and level of competition in the fashion industry remain very high, making it difficult to change business practices. Yet, it is essential that the industry as a whole takes responsibility for its environmental impacts, including water, energy and chemical use, CO_2 emissions and waste production. Minimizing and mitigating these impacts, however, requires change, which businesses are often opposed to for a multitude of reasons, first and foremost being economic. For instance, investment in the latest pollution-control technology is an essential requirement for the short-term future of the textile industry, necessary to remove chemicals, heavy metals and other toxic substances from waste streams. There is an emerging need for research that examines the adverse health outcomes associated with fast fashion at each stage of the supply chain and post-consumer process. Advancing work in this area will inform the translation of research findings to public health policies and practices that lead to sustainable production and ethical consumption. A new system-wide understanding of how to transition towards such a model, requiring creativity and collaboration between designers and manufacturers, various stakeholders and end consumers is required. Moreover, a functional system for textile recycling must be constructed. One of the most difficult challenges going forward will be to change consumer behaviour and the meaning of fashion. Consumers must understand fashion as more of a functional product rather than entertainment, and be ready to pay higher prices that account for the environmental impact of fashion.

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