

Environmental and Social Concerns in
Fashion Textile Production

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Introduction

The outfit you are wearing today is likely made of a variety of textiles, such as polyester, cotton, wool, and leather. Each of these garments has gone through extensive design and production processes, eventually arriving in your closet. Leaps and bounds have been made to improve production practices within the \$2.5 trillion global apparel industry (Maloney, 2019). However, there is still a way to go in regards to improving labor practices, environmental awareness, and consumer practices. By examining the general life cycle of garments, it is possible to identify the measures companies and consumers can take to push the fashion industry to adopt more circular, sustainable, and ethical practices. This paper argues that in order to create a socially and environmentally responsible apparel industry, designers and brands must consider every detail of the materials they plan to use, employ innovative practices to minimize their negative impacts, and provide consumers with a transparent understanding of the products they buy and how to care for them throughout their life cycle.

The Industry

When considering the best practices a brand can adopt when improving its impact on the world, the current state of fashion must be considered. A particular concern is the rise of fast fashion, and how it has changed the way people buy, wear, and dispose of clothes. Fast fashion has become a \$30.58 billion industry as of 2021 (Business Wire, 2021). Jasmin Malik Chua for *Vox*, described it as “cheap, disposable

clothing, made indiscriminately, imprudently, and often without consideration for environmental and labor conditions” (Dottle & Gu, 2022). Though this description sounds harsh, it is accurate and references two major concerns with the fashion industry: environmental impact and unethical social practices. Fast fashion allows for affordable yet stylish clothing, but the garments are low quality, playing a part in shortening clothing’s average lifespan to only 4.4 years (Palacios-Mateo et al., 2021). In 2019, the world produced 92 million tons of textile waste (Palacios-Mateo et al., 2021). Unfortunately, fast fashion aligns with the industry’s view of success, which is increased sales, profits, and consumption (Jutidamrongphan et al., 2021).

In order for this cycle of unsustainable practices to come to an end, apparel companies must adopt a new mindset and way of working by considering the entire lifecycle of the materials they plan to use, including the garments’ eventual disposal (Jutidamrongphan et al., 2021). Collaboration and communication in the design phase are key in order to minimize fabric and chemical waste, as 30% of the fabric and fibers produced are wasted in production (Jutidamrongphan et al., 2021; Palacios-Mateo et al., 2021). To minimize this, designers and pattern makers must optimize the efficiency of their pattern geometry for minimal waste. They must also consider garment assembly. The more complex a garment is to construct, the longer it will take, putting excess pressure on workers (Jutidamrongphan et al., 2021).

Sourcing

Before fibers can be woven into fabric they must first be sourced. This stage comes with a host of concerns for both synthetic and natural fibers. Labor standards in supplier factories are directly influenced by the demands of lead firms, such as buyers

and traders, which often manifest as a call for lower prices (McGuire & Laaser, 2021). The result is supply chains optimized for profits, not worker or environmental welfare.

Agriculturally-Based Textiles

The primary agricultural-based textile that will be discussed in this paper is cotton. The global cotton market was valued at \$38.54 billion in 2020, and it was the most prevalent fiber in textiles until it was surpassed by polyester in the 21st century (Dottle & Gu, 2022; PR Newswire [PRN], 2021). Cotton can be grown conventionally, with synthetic pesticides, herbicides, and fertilizer, or organically, with natural substitutes (Delate et al., 2021). Cotton accounts for 69% of the total water used in the textile industry, with conventionally grown cotton using the third highest amount of pesticides of any crop in the United States: 3.8 pounds per acre of cotton grown (Delate et al., 2021). Because of cotton's prevalence in the textile industry, decreasing the water and chemical usage of cotton is vital to improving fashion's impact. A move towards organically grown cotton is one step that can be taken by growers and apparel producers to decrease water usage and chemical use.

Organic cotton is significantly better for the environment, using 91% less water than conventional. When examining the life cycle assessment (LCA) of a cotton shirt, utilizing organic cotton decreased greenhouse gas emissions by 58% (Kazan et al., 2020). These benefits have prompted a move towards increased production of organic cotton, which produced over \$2 billion in sales in 2019, and has grown 56% globally between 2016 and 2018 (Delate et al., 2021). Even though there are many benefits to organic cotton, it is more challenging to grow. Farmers deal with sensitivity to water irregularity and negative impacts from weather, weeds, and insect pests (Delate et al.,

2021). Organic farms can also face issues with sourcing reliable organic seed and cross-contamination from conventional farms, posing the risk of wasted crops (Delate et al., 2021). Despite the challenges faced by organic cotton growers, the benefits outweigh the difficulties. In comparison to conventional cotton's environmental impact, organically grown cotton is preferable, and support and regulation from governing bodies can help to ease some of the challenges faced by growers.

The Human Factor

In agriculture, there is a human factor connected to both the growing and harvesting of crops, which leads to the discussion of social concerns in agricultural materials. In regards to social impact, cotton has been associated with a concern present in the apparel industry as a whole: forced labor. According to the International Labour Organization (ILO) (n.d.), as of 2016, around 24.9 million people were trapped in forced labor, with 4 million of them under state-imposed forced labor. Martin and Herlaar (2020) compared textile supply chains when analyzing the Social Life Cycle Assessment (SLCA) of a wool shirt, and found textile production was a primary source of forced labor in the fashion industry, with transportation also accounting for a high number of "medium risk hours," which was how the severity of labor issues was measured.

This problem manifested and gained notoriety in Uzbekistan. Despite declarations and international laws condemning slavery, Uzbek citizens of all occupations, including teachers, students, medical employees and government employees, were forced into remote cotton fields, deprived of their normal paychecks, and compensated only \$1.50 per day (McGuire & Laaser, 2021). Though some citizens

were wealthy enough to buy themselves out, Uzbekistan's National Security Service and the Uzbekistan government used the premise of "patriotic duty" and "God's will" to create a "cycle of inequality" that left citizens exhausted, poor, and trapped in this annual cycle (McGuire & Laaser, 2021).

As of 2021, the ILO reported that Uzbekistan had successfully ended the systemic use of child labor and forced labor, but localized areas still employed the practices. Uzbekistan also plans to start producing textiles and garments in addition to raw cotton, which should create higher wage jobs (ILO, 2021). However, quantitative numbers that realistically outline the presence of forced labor are difficult to obtain, and the exact state of forced labor in Uzbekistan remains foggy (McGuire & Laaser, 2021).

Despite the apparent improvements in Uzbekistan, forced labor in the apparel industry continues to be an issue. In 2021, the U.S. banned cotton imports from the Xinjiang region of China due to forced labor allegations (Ravi & Teitelbaum, 2021). Major retailers have pulled their supply chain from this region, but China's opacity prevents corporations' ability to track the labor practices used for their products (Ravi & Teitelbaum, 2021). The labor concerns in Uzbekistan and China are just two examples of the worker mistreatment that currently exists around the globe, particularly in less developed countries. Some apparel companies are more discerning in their choice of sources and factories, while others choose economical options over ethically sound ones. Better industry regulation, oversight, and transparency is required by governing bodies and companies alike to mitigate these problems.

Animal Welfare

For textiles such as wool, fur, and leather, another ethical element becomes a factor: animal welfare. Most leather is a byproduct of meat production, which ties it to the inhumane treatment of animals in the beef industry, such as factory farming, breeding mistreatment, endless health and physical issues, and inhumane slaughter (Pachirat, 2013; Quinn, 2018). Leather can be categorized as “hides” or “skins,” with hides being made from large animals like cows, buffalo and horses, and skins coming from smaller animals such as pigs, goats, and sheep (Maina et al., 2019). Despite leather’s association with animal welfare concerns, as of 2019 leather had a global trade value of \$100 billion per year (Maina et al., 2019). Fur can originate from mink farms, which are also associated with inhumane breeding and killing, and environmental contamination from waste (Conti, 2018). Despite these implications, fur is a \$30 billion industry (Conti, 2018).

Synthetics

While cotton, leather, wool, and fur are naturally derived textile types, polyester has a very different sourcing process. Polyester is an oil-based material, comprised of Polyethylene Terephthalate (PET). It is accompanied by all the environmental concerns of the oil industry, including emissions, spills, and resource depletion (Palacios-Mateo et al., 2021). To make polyester, PET pellets are melted then spun into filament. This filament is then made into yarns of various structure and strength, which are then woven into textiles (Palacios-Mateo et al., 2021). Polyester made up 50% of the world’s synthetic textile manufacturing in 2018. Its global market is worth \$106 billion and is expected to continue to grow (Dottle & Gu, 2022).

Producing the Textiles

Each fiber has a different process for making it into a textile for fashion use, but there are a number of recurring concerns in the production process: emissions, water and land contamination, microfiber and microplastic release, and social concerns.

There are also a number of actions that are currently being taken, or could be adopted in the future to mitigate these harmful effects.

Emissions

The textile industry released 1.7 billion tons of CO₂ in 2015, and by 2030, textile consumption and emissions could increase by 50% (Palacios-Mateo et al., 2021). One major source of carbon emissions is transportation, as many stages of the production process occur in different locations. For instance, in Martin and Herlaar's (2020) assessment of supply chain options for production of a single wool sweater, at least four locations were used for different steps in every stage, including shearing, scouring, spinning, and assembly. These locations varied from more condensed supply chains such as Sweden, Gotland, Lithuania, and Estonia, to others farther away in Australia and Uruguay (Martin & Herlaar, 2020). When only accounting for the processing of wool into a sweater, the more condensed supply chains produced about six kilograms of CO₂ per sweater, while spread out supply chains produced 14 kg per sweater (Martin & Herlaar, 2020).

Emissions are also a factor during the actual production of textiles. For instance, when producing polyester, 27.2 kg CO₂ is emitted for every kilogram of woven fabric (Palacios-Mateo et al., 2021). One major source of emissions is dyeing, as it requires heat (Palacios-Mateo et al., 2021). For cotton, yarn production emits the most CO₂, with the production of the textile itself a close second (Better Cotton, 2021). A 2021

study for The Better Cotton Initiative (BCI), stated that member farms of the BCI produce an average of 2.93 tons of CO₂ per ton of cotton fiber per year. This statistic does not include the actual production of textiles and garments from this fiber.

The high level of emissions produced by the textile industry is a concern for both land and air contamination, global warming, and human and wildlife health. Methods for reducing harmful emissions may require the restructuring of supply chains and application of more advanced production techniques. Though there is an expense associated with adopting new practices, the fashion industry must consider reducing emissions a non-negotiable requirement for all apparel companies and producers.

Water and Land Contamination

Water and land contamination during production are equally concerning. Textile dyeing and finishing accounts for 20% of the world's water pollution, which primarily is a result of contaminants in effluent (wastewater) from textile factories (Palacios-Mateo et al., 2021). Polyester, for example, uses over 15,000 chemicals by the end of production (Palacios-Mateo et al., 2021). Batch dyeing is the most common dyeing method used for polyester, achieved by soaking the textiles in a mixture of chemicals and dye, and the wastewater from this process is hazardous when released into the environment (Palacios-Mateo et al., 2021).

Faux leather and faux fur, if traditionally processed, have similar chemical and effluent contamination issues as polyester, as the materials originate from petroleum-based sources (Conti, 2018). This sparks debate among activists, as fur supporters argue that faux leather comes with too many environmental concerns to be considered a viable alternative to authentic fur (Conti, 2018). As Libby Purves wrote for *The Times*

of London, “Take one specie’s hide or condemn another to slow poisoning” (Conti, 2018).

Leather has numerous processing steps, all of which utilize chemicals and materials that dissolve into water, which is released into the environment. Salt is a major concern during the preservation and pickling stages, and other steps utilize chemicals such as calcium hydroxide, ammonium chloride, chromium shavings, formaldehyde, oil, and synthetic dyes (Maina et al., 2019). These can be toxic to humans and animals alike, and if materials aren’t reused for multiple batches, a large amount of them are wasted (Maina et al., 2019).

Fur undergoes similar production processes to leather and faces similar environmental implications. This is an important consideration when comparing real fur and faux fur, as both have negative environmental impacts at different stages of their lifecycle. Ultimately, a choice must be made as to which factors are the most important to consider. Ideally, a synthetic alternative would be developed that has a lower environmental impact than both real animal hides and the current form of synthetic alternatives, while also eliminating the need for animal casualty. This is not an unrealistic goal, and will be discussed in greater detail later in this paper.

Another particularly concerning effect of polyester production, as well as cotton and faux fur, is the release of microfibers and microplastics into the environment. Microfibers are a type of microplastic, and are defined as “fibers that are 1 μm to 5 mm in length, with a length to diameter ratio greater than 100” (Palacios-Mateo et al., 2021). Microfibers that have escaped from factories or during the production and use phases of garments’ lives have been found in every part of the world and can increase

death rates in aquatic life, affect aquatic reproduction, and eventually make it up the food chain to humans (Palacio-Mateo et al., 2021).

Social Concerns

The labor issues present in the apparel industry are not limited to the sourcing of materials. Workers in textile factories also face numerous health and safety concerns. Textile and garment factory workers have a higher incidence of health issues from the microfibers, dyes, and chemicals that they come into contact with (Palacios-Mateo et al., 2021). Another concern in textile factories is fire safety resulting from hazardous physical conditions, machinery, and highly flammable fibers (Venkataramanan et al., 2019). The blame for this is placed on a lack of understanding of health and safety protocol for workers, and it is up to factory management and regulatory bodies to ensure protocol is communicated, understood, and overseen in every factory (Venkataramanan et al., 2019). This is particularly relevant in developing countries, which is unfortunately a consistency in regards to labor concerns across the entire industry.

Solutions For Improving Textile Production

There have been numerous solutions developed to improve the textile production processes and decrease negative social and environmental impacts. One promising technology for polyester, for example, is called dope dyeing, which creates pigments and fibers simultaneously, which results in a 30-50% lower environmental impact and less overproduction of materials (Palacios-Mateo et al., 2021). For dyeing of all textile types, naturally derived dyes biodegrade more easily, are quickly expanding in color options, and are significantly less harmful if they escape into the

environment (Palacios-Mateo et al., 2021). By moving towards more efficient dyeing procedures and incorporating naturally derived dyes, the apparel industry can decrease the amount of toxic chemicals released in effluent, as well as decrease the amount of materials that are wasted during the dyeing process. Since textile dyeing and finishing is a major contributor to water pollution, just applying these changes could make a major difference in the industry's impact.

To address concerns regarding leather production and contaminated effluent, a number of measures can be taken, such as reusing processing formulas and replacing salt with boric acid or silica gel for preservation (Maina et al., 2019). Additionally, enzymes are significantly less impactful in both the soaking, liming, and unhairing processes (Maina et al., 2019). The tanning stage, which is the culprit for chromium release, can be reworked to use plant-based tanning solutions, or use chrome exhaustion methods (Maina et al., 2019).

To decrease emissions released during transportation, factories can be chosen that are geographically closer together (Martin & Herlaar, 2020). Additionally, the type of transport vehicle can affect the level of carbon emissions released into the environment. For instance, though distance had a clear impact on CO₂ emissions in Martin and Herlaar's 2020 sweater analysis, utilizing trucks more often than boats increased emissions, which is important to keep in mind for any supply chain. Palacios-Mateo et al. (2021) also supports shorter supply chains between the industries involved, which would improve traceability.

Microplastics and microfibers can be controlled during the production process as well. Textiles cut with lasers instead of scissors release fewer airborne fibers both

during production and use phases (Palacios-Mateo et al., 2021). For polyester specifically, fiber structure can make a difference in microfiber release during all phases of its lifecycle. Shorter fibers (called staple fibers) cause more fuzz and fiber release, while longer filaments produce fewer fibers (Palacios-Mateo et al., 2021).

There have also been numerous calls for more industry regulations for workers, both on a national and global scale. For instance, in relation to the sourcing stage, the organic cotton industry has long called for better federal regulation and enforcement regarding chemical drift, with strict penalties for non-compliance (Delate et al., 2021). In the polyester industry, regulatory issues begin with the oil industry, by reducing spills and increasing regulations (Palacios-Mateo et al., 2021). In relation to fire hazards, producers could install better automatic fire alarms, encourage responsible placement of equipment, and better manage the promotion of “Occupational Health and Safety” in the textile industry (Venkataramanan et al., 2019). By implementing these necessary regulations, governing and regulatory bodies can force change in an industry that has previously valued profits over impact. While it is important to note that some companies have taken the initiative to improve their social and environmental impact of their own accord, more action is needed for widespread change to occur within the fashion industry.

Retail and Distribution

The retail and distribution phase is the first time that consumers come into contact with garments, and is one of the first points of contact companies have with consumers. In this stage, companies have the choice as to whether they will educate their customers on responsible consumption, or simply pursue profits. In order to

adopt a more responsible approach, companies must rethink their concept of “success” and refocus their priorities towards sustainability efforts (Jutidamrongphan et al., 2021). This is important because even if consumers support sustainable products and call for more responsibly made garments, companies must balance meeting these demands with earning the profits necessary to sustain more expensive production methods (Jutidamrongphan et al., 2021).

Companies have a unique opportunity to connect with customers, promote their own responsible practices, and encourage consumers to make positive consumption choices. Unfortunately, greenwashing has become an issue in the fashion industry. Greenwashing occurs when companies advertise as being “green” or “eco-friendly” when they aren’t, which misleads consumers (Timmins, 2021). Fashion brands that have been accused of such practices include Asos, H&M, and Zara (Butler, 2022). Despite these allegations, these brands continue to be fashion powerhouses worldwide. Because of phenomena such as greenwashing, it is a necessity that more transparency be asked of companies when they advertise their products, and consumers must make discerning fashion choices.

The use of digital information tags is an emerging technology that is gaining momentum in the retail environment. These tags support transparency, allowing consumers to access information about garments they might buy. According to Dana Thomas for *The New York Times* (2022), companies that are currently developing or incorporating this technology include Sheep Inc., Prince Charles’s Sustainable Markets Initiative Taskforce, Provenance, and Nisolo. Each of these companies utilizes different formats, such as NFC tags, QR codes, webpages, and hangtags that provide

consumers with information about supply chains, authenticity, resale tracking, social and environmental impact, and more (Thomas, 2022).

By incorporating these new tools, along with sharing more information on products throughout stores and online, retailers can assist consumers in making ethical and environmentally-driven apparel choices. Each tag that has been created builds on the progress of the one before it, and all of them have different qualities that are useful for both companies and consumers, but eventually a universal format will make these labels more accessible (Thomas, 2022). Moving towards a standardized labeling system will allow consumers to make a habit of checking the impact of the clothing they buy, just as they check the nutrition facts of the food they eat. By providing consumers with transparent facts about apparel, companies will also face a higher level of accountability. If consumers begin to shop based off of these tags, company profits will reflect those choices, which will likely result in an improvement of production practices to maintain sales.

Use Phase

Once a piece of clothing leaves the store, it enters its use phase. One of the primary sustainability concerns during this phase is the washing and drying process. In addition to using significant amounts of energy and water, the wearing and washing of garments contributes to microfiber and microplastic release into the environment (Palacios-Mateo et al., 2021). Cotton textiles release more microfibers than polyester, and for most garments the first wash is when the most microfibers are released, which eventually plateaus (Palacios-Mateo et al., 2021). These microfibers travel up the food chain, leading to ingestion by humans through food and the surrounding environment.

Though the statistics on the amount of ingested microfibers vary, humans may ingest up to 73,600 particles via food and dust per year, and inhale as many as 69,000 (Palacios-mateo et al., 2021). As mentioned previously, microfiber and microplastic ingestion can be harmful to aquatic life, which can also be said for human health. Though research is still emerging on the detrimental effects of microfiber ingestion in humans, hormonal and reproductive issues, as well as cell abnormalities can occur. In short, microplastics are comprised of the toxic materials used in synthetic fabric production, none of which are meant to be ingested by humans.

End of Life Phase

As a garment is worn over time, it will eventually come to the end of its life, which can be dealt with in a few different ways. Unfortunately, many garments are simply thrown away as production waste, pre-consumer waste (disposal by retailers), or when a consumer is done wearing them (post-consumer waste) (Palacios-Mateo et al., 2021). If clothing is not disposed of properly or is not sorted for recycling, it will likely be landfilled or incinerated (Palacios-Mateo et al., 2021). Two-thirds of clothing is incinerated, producing toxic ash, gases, and 230 kg of CO₂ per ton of textiles (Jutidamrongphan et al., 2021; Palacios-mateo et al., 2021). Landfilling takes up a significant amount of space and materials from the decomposing clothing can be released back into the environment (Palacios-Mateo et al., 2021). A potential upside of incineration is a redirection of the energy produced towards electricity and heat in the local area (Jutidamrongphan et al., 2021).

The better option for disposing of clothing is to utilize the 3 R's: reuse, reduce, and recycle (Jutidamrongphan et al., 2021). Reusing can take the form of secondhand

resale, which helps to employ more people and extend the life of clothing (Jutidamrongphan et al., 2021). A potential roadblock of resale is that it can carry a negative connotation. Companies must remove the stigma of recycled and resale clothing, applying innovative solutions such as selling it alongside new products (Palacios-Mateo et al., 2021). Reducing is another way to extend the life of garments by reimagining them via up-cycling, which could potentially increase the products' value (Jutidamrongphan et al., 2021).

Recycling can be conducted in a number of ways, depending on the garment. For each type of textile, there are different options that yield varying results. Mechanical recycling and chemical recycling are the two primary methods, along with enzymatic and thermal methods (Jutidamrongphan et al., 2021). Mechanical recycling methods can be used for synthetic and natural fibers and are also more eco-friendly (Jutidamrongphan et al., 2021). Despite the reduced environmental impacts of mechanical recycling, it is a form of down-cycling, decreasing fiber quality, making them only useful for applications such as filling for pillows or furniture (Jutidamrongphan et al., 2021).

For synthetic materials such as polyester, methods have been developed that better retain fiber quality, allowing it to be recycled into similar-quality products. Thermal recycling of polyester produces lower quality PET pellets (Palacios-Mateo et al., 2021). Chemical recycling methods have been developed to produce like-new PET, allowing it to be reused for products of the same quality (Palacios-Mateo et al., 2021). Enzymatic recycling is a method that is still developing, but allows textiles composed of a blend of materials to be recycled by separating the fiber type, saving some for

recycling while disposing of others (Palacios-Mateo et al., 2021). Methods have also been developed to transform the PET materials from plastic bottles into fibers useable for textiles and garments.

When it comes to fur, faux fur, leather, and faux leather, the end-of-life phase is a topic of great debate. Leather and real fur biodegrade more quickly than synthetic alternatives (if traditionally produced). According to a 2019 independent study, fur has the ability to biodegrade in 30 days, while standard faux fur may take over 300 years (Conti, 2018). Because of this, pro-fur activists claim fur is the more environmentally responsible option, and that the durability of real leather and fur allows for better resale, decreasing the need for the production of new garments (Conti, 2018). Because of the numerous methods that have been developed to successfully recycle and repurpose garments, consumers must dispose of their clothing responsibly, no matter the material. Consumers can also adjust their shopping habits to look at pre-owned clothing before brand-new garments. This will help to improve the circularity of the entire industry. Finally, designers and companies can continue to promote recycling and resale to raise awareness of the options available to consumers.

Regulation, Support, and Innovation

Regulation

In order to effect real change in the apparel industry, regulation is vital. Internationally, one organization that is working to change the apparel industry, among many others, is the UN Alliance for Sustainable Fashion. According to the organization's website (n.d.), it is an "initiative of United Nations agencies and allied organizations designed to contribute to the Sustainable Development Goals through

coordinated action in the fashion sector.” The Alliance is also “promoting projects and policies that ensure that the fashion value chain contributes to the achievement of the Sustainable Development Goals’ targets” (UN Alliance for Sustainable Fashion, n.d.).

Though the United States is farther behind the UN in regulation practices, important steps have been taken to change how fashion brands can operate and sell clothing. Starting in 2023, new animal fur garments will not be allowed to be sold in California, excluding leather (Allen, 2019). Another major bill was signed in California in 2021, called The Garment Workers Protection Act, which will, according to Rachel Deeley for *Business of Fashion* (2021), “ensure hourly wages for California’s garment workers in lieu of piece-rate pay,” and “hold brands accountable for labour violations such as wage theft and underpayment in their outsourced supplier factories.” Laws and bills such as these are the first steps in creating a more fair and just fashion industry.

A more recent development in US legislation took place in New York in January 2022, with the Fashion Sustainability and Social Accountability Act. It is designed to hold major fashion brands accountable for socially and sustainably responsible practices (Friedman, 2022). This bill was introduced by Senator Alessandra Biaggi and Assemblywoman Anna. R. Kelles, and will require any apparel and footwear companies that “do business in New York” with revenues over \$100 million to map their supply chains, share “material product volumes,” and establish plans for reducing social and environmental impact (Friedman, 2022). This information will be posted online publicly, and violators will be fined and listed (Friedman, 2022).

Since New York is one of the fashion capitals of the world, this bill has the potential to spark widespread industry change. If major companies are forced to adhere to these new regulations or stop selling their clothing in New York, it is likely they'll opt for adherence. By making this information available to the public, consumers can continue to educate themselves on which companies genuinely behave responsibly, and which do not, which could affect sales. This act could also inspire other states and regulatory bodies to create similar regulations. If passed, the Fashion Sustainability and Social Accountability Act could be a catalyst for positive change.

Support

A number of organizations work to improve the textile and fashion industries by providing companies, designers, and manufacturers with tools to help them develop responsible practices. Some of these groups include The Microfibre Consortium, Sustainable Apparel Coalition, The Better Cotton Initiative, Furmark, and the Leather Working Group. Some examples of developed tools include the Microfibre Consortium's "TMC Test Method" that allows for testing of microfiber release from textiles (Microfibre Consortium, n.d.). The Higg index suite of tools measure value chain sustainability, and the Leather Working Group developed audit standards to improve accountability for sustainable leather production (Leather Working Group, n.d.; Sustainable Apparel Coalition, n.d.).

These resources can help companies of all sizes through sharing consistent technologies that have already been developed. Not only will this save companies from having to develop their own equivalent tools, but there will be a cohesive, consistent way to gather and communicate data across the industry. The specific tools are

generally not available to individual consumers, but by seeing that an apparel company utilizes them, a consumer can know that it is doing its part to improve its sourcing, production, and retail practices.

Innovation

While some companies follow the recommendations and evaluations of supporting organizations, others have chosen to independently work on developing new technologies. For example, Stella McCartney, a trailblazer in sustainable and ethical practices in luxury fashion, has created a new faux fur made from plant-based materials and recycled polyester (Conti, 2018). This “Koba fur-free fur” developed by Ecopel, debuted in McCartney’s 2019 lines, uses 30% less energy in production than other synthetic fur, and can be recycled at the end of its life (Axworthy, 2019).

Another company, Galy, has worked on innovation within the cotton industry. This Boston-based startup has developed lab-grown cotton that grows ten times faster and emits significantly fewer greenhouse gases than regular cotton (Kart, 2020). This technology was still in development in 2020, but according to *Forbes*, Galy’s goal is to use this cotton for garments and textiles (Kart, 2020). This innovation may serve to produce a more reliable cotton yield that does not depend on environmental factors for growth and minimizes negative environmental impacts associated with growing (Kart, 2020). Galy’s progress, McCartney’s faux fur, and the many developing technologies not mentioned here, are all signs of significant progress towards a progressive and more responsible apparel industry.

Consumer Responsibility

Shopping Research

Consumers have the ability to influence the direction of the apparel industry. As previously mentioned, fast fashion is a concerning trend that lowers the standard of the apparel industry's social and environmental practices. The fast fashion trend is perpetuated by consumers, who continue to opt for quantity and trendiness over quality and longevity (Jutidamrongphan et al., 2021). If consumers change their mindset from desiring trendiness to one of investment, where they are willing to spend more for quality clothing with better resale potential, they can make a big difference (Jutidamrongphan et al., 2021).

Consumers can also make informed shopping decisions by paying attention to what companies share about their products, and which companies have opted into the various movements to improve responsibility. In store, consumers can utilize informational signage and tags to make informed choices. Though it might take more time to shop, by paying attention to this information consumers can avoid purchasing products that don't support ethical consumption. Organizations such as the Microfibre Consortium list companies that utilize their tools and have achieved various environmental benchmarks promoted by these groups (Microfibre Consortium, n.d.). This information is accessible to consumers, and can be considered when choosing where to shop.

The same approach can be taken with current and future regulations that list company practices publicly, such as New York's Fashion Sustainability and Social Accountability Act. Finally, many companies such as Nike, Patagonia, and Gap Inc. have dedicated, easy to access websites that explain what they are doing to improve

their sustainability and social practices. These can be accessed by potential customers and used to determine which brands should be supported, depending on the priorities of the consumers. Though consumers do have access to numerous resources that can help to educate them about which brands to support, it is still the responsibility of apparel companies to improve their practices and transparency. Ultimately, consumers should not need to go out of their way to identify “safe” brands to purchase, and should be able to shop everywhere with the knowledge that the industry as a whole is working in a socially and environmentally responsible way.

Post-Consumption

Once the clothing has left the store, social and environmental responsibility shifts to the consumers. How a garment is treated and how consumers take care of their clothes can greatly affect their environmental impact, and can also affect the garment’s potential for its post-consumer stage. One of the main factors consumers can control is how it is washed and dried. Horizontal axis machines used significantly less water than vertical axis, and washing full loads is more efficient than half loads, since half loads only use 21.2% less water, instead of 50% or more, which then would make them more efficient (Palacios-Mateo et al., 2021). Temperature also affects energy usage during washing. According to the US Department of Energy (n.d.), using cold water to wash laundry can reduce washing energy use by 50%. When drying, the release of microfibers and microplastics is significantly decreased by hang drying (Palacios-Mateo et al., 2021). Finally, if the choice is available, rainwater recycling could require up to 62% less detergent, and consumers should consider using bio-based detergents when possible (Palacios-Mateo et al., 2021).

A few companies have developed tools to capture the microfibers released during washing before they can escape into water systems. Two tools that have been released in recent years are Xfiltra and Guppyfriend. Xfiltra is a filtration system that can be attached to home and commercial washing machines, and is designed to be attached by the manufacturer (Xeros Technology Group, 2020). Guppyfriend is a washing bag that collects microfibers to be disposed of responsibly, and does not release any microplastics itself (Guppyfriend, 2022). When tested, Xfiltra was the most efficient and successful filter, reducing microfiber escape by 78%, and Guppyfriend was the second most successful, reducing microfiber release by 54% (Napper et al., 2020). Though these tools provide an excellent option to control microfiber release, how to safely dispose of the collected microfibers is not clear, creating a potential roadblock for consumers. If collecting the fibers is made convenient, it must be just as convenient to safely dispose of them.

End of Life Phase

Though companies carry a responsibility to promote recycling, reuse, and reduction, consumers must make sure clothing does not negatively impact the environment in its end-of-life phase. If consumers choose to resell their clothing, they are helping to extend the life of these clothes. If they choose to recycle clothing, they should deposit it in the appropriate facilities (Palacios-Mateo et al., 2021). To find these facilities, consumers should look up the locations of collection sites near them, such as those in retail stores. Brands that promote resale and recycling include American Eagle and Levi's, both of which partner with I:CO, which recycles or repurposes used denim and other clothing (Wichard-Edds, 2019). Patagonia has its own "Worn Wear" program

that allows consumers to return gently used Patagonia apparel for store credit, recycling unwearable clothing (Wichard-Edds, 2019). Other brands that run resale or recycling programs include Nike, Eileen Fisher, H&M, The North Face, and more (Wichard-Edds, 2019). Consumers can also search for facilities sponsored by groups such as the American Textile Recycling Service, which collects clothing for reuse or down-cycling (American Textile Recycling Service, 2021). These resources ensure that clothing is safely collected and properly recycled at the end of its lifecycle, without placing any extra burden of inconvenience on consumers.

Conclusion

Look again at the outfit you are wearing today. Check the inner tag and see what it is made of, or even where it was made. What are the washing instructions? Where did you purchase the garment? There are endless levels of complexity to the apparel industry, and consumers are rarely privy to the complicated production processes and environmental and social impacts of their clothing. From the designing of the garment to the sourcing of fibers and the weaving of the textiles, there are numerous details companies and designers must consider to ensure they operate in a responsible way. A change in companies' philosophy and mindset must occur, from one emphasizing profits and newness to one of consideration for social and environmental impacts. Only then can companies ensure that they can apply best practices to every stage of a garment's life, including its eventual disposal.

Consumers carry a responsibility as well: to make smart, informed shopping choices, properly take care of the clothing they buy, and make sure that the clothing is recycled, resold, or repurposed in the most responsible way possible. Once designers,

producers, retailers, and consumers begin to work together to improve practices in every phase of a garments life, the fashion industry will become one that creates positive social and environmental impacts on the world.

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