



*Cleansing the Oceans of Plastic
Pollution*

WHITE PAPER

Fast Fashion and Ocean Pollution: Exploring Problems and Potential Solutions

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1. ABSTRACT

Fast fashion is the production of clothing for extremely low prices. It is intended to follow current trends and runway looks. This industry has multiple diverse impacts on the current and future state of the world. These impacts include environmental damage from clothing microfibers killing marine life as well as clothing dye in wastewater polluting the oceans. Adverse health effects are also prevalent in the clothing production process, which raise ethical issues such as the infringement of workers' rights. Many fast fashion products are poorly made with materials and processes that promote their quick turnaround rate and early disposal. Recommended solutions are included to help mitigate these adverse effects, such as thrifting and buying sustainably sourced clothes. By addressing the adverse effects of fast fashion consumption, consumers can promote better working conditions, restoration of marine biomes through the reduction and mitigation of microfiber pollution, and a more inclusive environment supporting small designers in the fashion industry.

1 INTRODUCTION

1.1 The Growing Fashion Industry

Fast fashion is a highly profitable business supplemented by replicating catwalk trends while also mass producing clothing. This clothing is then sold at a fraction of the cost of the high-designer items. Although this may be socially and financially attractive for the consumer, it results in many ethical, health, and environmental issues. The expansion of globalization has promoted the exponential growth of the fast fashion industry. Global retail sales of apparel and footwear in 2019 reached a new high of 1.9 trillion U.S dollars--this number is expected to nearly double to three trillion U.S. dollars by the year 2030 (Shahbandeh, 2020). As a result of this growth, the fast fashion industry is also growing to meet the new consumer “demand.”

Fast Fashion	Designer
 \$67 	BALENCIAGA \$1000+ 
MNML \$70 	 \$6000+

Table 1: Comparing prices of knockoff designs between fast fashion and luxury brands.

1.2 The Ocean Plastics Problem

Marine plastic pollution is ubiquitous and detrimental to ocean life, as detailed in the UN Environmental Program’s Report on Microplastics published in 2018. In 2010, anywhere from “4.8-12.7 million metric tons of [land-based] plastic” ended up in the ocean, negatively affecting ecosystems and organisms (Beaumont et al., 2019). Animals mistake plastic for food, which leads to poisoning, organ damage and starvation. Fish ingest microplastic, these fish are then preyed upon and the plastics get concentrated up the food chain until they are eventually eaten by humans and other top predators. Moreover nets discarded by commercial fishing vessels continue to catch sea birds, turtles, pinnipeds, dolphins, whales and game fish. These ghost nets drift about and entangle, strangle and eventually drown these animals. Plastic pollution has now been found from the sea surface to the deepest seafloor, in all ocean basins, and along all shorelines. In other words it is wreaking havoc in all marine ecosystems (Gibbens, 2019).



Pinniped caught in discarded commercial fishing net

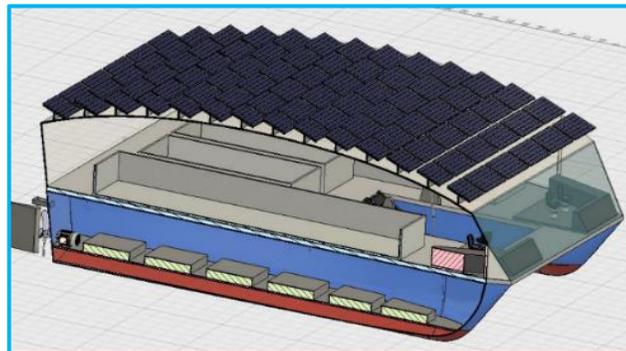
The earth has five major ocean basins with circular oceanic surface currents called gyres. These gyres concentrate floating plastic pollution in their centers, creating what we call garbage patches. This is a human-made problem generated by the ever-increasing production of plastic in combination with society’s improper plastic disposal and inadequate recycling efforts. These gyres contain floating plastic ranging in size from miles-long fishing nets to nanometer-sized microplastic particles. Plastic is a constant presence in the daily lives of many people, but due to improper disposal and incomplete methods of management, it may end up in the ocean where it causes widespread harm within marine ecosystems.

1.3 Clear Blue Sea Solution

Clear Blue Sea (CBSea) is a nonprofit organization that is responding to the global crisis of ocean plastic pollution. CBSea’s goal is to operate a fleet of unmanned, solar-powered, semi-autonomous marine robots called the Floating Robot for Eliminating Debris (FRED) to clean up marine plastic. Clear Blue Sea has developed and demonstrated several FRED prototypes in San Diego and is developing a mid-scale FRED for local cleanup



Turtle Mistakes Plastic for Jellyfish



operations.

FRED Conceptual Rendering

This 501c3 nonprofit was founded in 2016 by Susan Baer with a mission to “cleanse the oceans of plastic pollution.” Ocean plastic is a global crisis that requires a global set of solutions. Clear Blue Sea is not only developing a robotic solution, but also performing outreach, sustainability, and educational initiatives to spread awareness and garner support for ocean conservancy.

2 PROJECT PURPOSE AND SCOPE

2.1 Purpose

The purpose of this paper is to inform consumers about the fast fashion industry and its contributions to environmental pollution. Using existing literature, the paper will explore the current issues of marine pollution and the ethics of the fast fashion industry. The paper

recommends solutions to prevent and remedy the adverse environmental, ethical, and health impacts of the fast fashion industry, as well as the benefits of such solutions.

2.2 Scope

The scope of this paper focuses on the environmental, ethical, and health aspects of the global fast fashion industry. The issues explored primarily concern larger-sized textile waste, microfiber, and chemical pollution in marine biomes. Solutions will focus on recommendations for consumer shopping habits.

3 THE PROBLEM

The clothes that consumers buy and love to wear are made of tiny fibers that range in size from two to 46 centimeters in width, and are made of many different materials such as wool, cotton, polyester, and nylon (Dai & Li, 2006). These fibers make sweaters soft and warm. However, when these fibers break down and become microfibers, they have an enormous impact on the planet. After being washed, clothing fibers enter the environment through wastewater that gets carried throughout waterways.

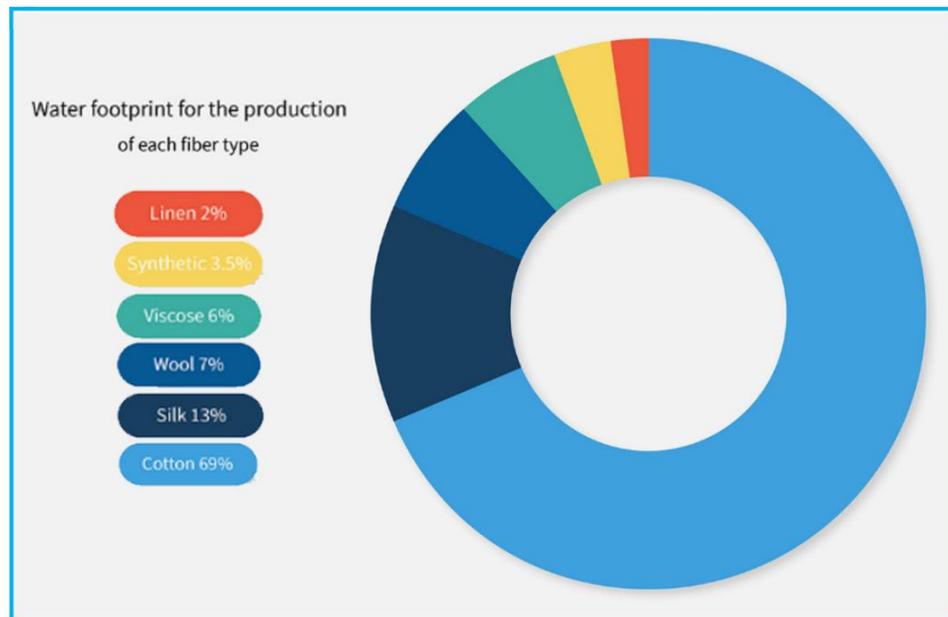
Researchers have proposed that a single load of laundry has the potential to release hundreds of thousands of microfibers into the water supply (Resnick, 2018). These tiny microfibers eventually reach the ocean, where an accumulation can lead to marine animals mistaking them for food and ingesting the fibers. Upon being consumed by another animal, it can result in the fibers moving up the food chain. Microfibers have even been found in human organs, which may cause reproductive problems, cancer, and DNA damage (O'Connor, 2018).

In summary, laundering clothes releases microfibers into wastewater. Because of the size of these fiber particles, they are not screened out in wastewater treatment plants and therefore enter downstream aquatic environments including lakes, rivers and oceans. These microfibers are known to affect human health and contribute to marine ecosystem degradation.



Using fluorescence, researchers have been able to prove that plankton frequently ingest microfibers and other microplastics. The neon green color in the photograph is micromaterial inside this plankter (O'Connor, 2018).

Pollution from wastewater containing chemical dyes is able to enter waterways, which can be detrimental to the environment and living organisms. Producing fibers from cotton requires tremendous amounts of water and pesticides. Anywhere from 2-50% of dye used can be left behind in the water effluent, all of which leaves the mill (Khan et al., 2014, p. 64). As stated by The World Wildlife Fund (WWF), traditional processing takes more than 20,000 liters of water to produce just a single kilogram of cotton, which is the amount of cotton required to make one t-shirt and a pair of jeans (Newell, 2016). This equates to about 1.5 trillion liters of water every year to make clothing (Newell, 2016).



This graph shows the water consumption for the production of each type of fiber. Cotton consumes much more water compared to synthetic fibers; however, synthetic fibers consume oil rather than water (Hawthorn, 2020).

Additionally, clothing production poses a health risk to humans and other living organisms. Cotton farmers use some of the most hazardous pesticides on the market. Seven of the fifteen pesticides commonly used in cotton agriculture are listed as human carcinogens (Cubie, 2006). These pesticides have the potential to runoff from cotton fields into nearby lakes and rivers, contaminating drinking supplies and introducing harmful chemicals into humans. Ultimately, all rivers and other bodies of water lead to an ocean, where ocean currents eventually converge into gyres. The ocean is also where microfibers, plastic waste, and other pollutants amass, growing into larger and larger garbage patches.

One of the primary issues with the fast fashion industry is the poor quality of clothing, which leads to its limited lifespan and high rate of disposal, causing ongoing and increased consumption. The average consumer throws away 70 pounds of garments per year, or 13 million tons of clothing globally (Freeman, 2020). With new fashion trends emerging almost

every month, more than 100 billion items of clothing are produced each year with no sustainable method of disposal (Thomas, 2019).

According to the United States Environmental Protection Agency, only 14.7 percent of all textiles produced in 2018 were recycled by Goodwill and other thrift shops (EPA, 2020). This waste is exacerbated by the poor quality of clothing from many fast fashion brands. Some products only last a few wash cycles before being discarded or dropped off at second hand stores, where their low quality may dissuade customers from purchasing them. (Zarroli, 2013). These low quality garments lead to an increased amount of clothing waste in comparison to purchasing clothes that are produced with higher quality materials and processes, many of which will be worn throughout a person's lifetime. This is one of the primary issues with the fast fashion industry: poor quality leads to increased consumption. In addition, when fast fashion companies have clothes remaining after a trend has run its course, they often discard these clothes, only adding to the amount of clothing piling up in landfills each year. Rachel Bick et al. (2018) estimates 3.8 billion pounds of clothes are thrown out each year by Americans alone (p. 1). The poor quality of clothes produced in each fashion season results in consumers purchasing new seasonal outfits to replace their discards.

Fast fashion also contributes towards environmental degradation through carbon emission during production. Carbon emissions are the primary contributor to global warming. In addition, many fast fashion products are made from polyester, a synthetic material made from fossil fuels. Fossil fuel mining is an environmentally invasive process, promoting greenhouse gas emissions and destruction of natural environments (Foster, 2019) . In addition, many clothing products are shipped via air cargo due to its increased speed compared to boat transport. Air freight can take a few days to get to its destination whereas ocean shipping may take multiple weeks (Chi, 2020). But this leads to environmental damage through carbon emission; it is even estimated that a transfer of 1% of transport from ship to air “could result in a 35% increase in [these] emissions” (Niinimaki et al., 2020). The global ocean is an enormous carbon sink, essentially absorbing carbon from the atmosphere in the form of carbon dioxide; 25% of human-based carbon emissions produced every year are absorbed by the ocean (Heinze et al., 2015, p. 327). Unfortunately, this process of absorption increases ocean acidity, slowly making it uninhabitable for important ocean organisms, including coral.

The fast fashion industry has had many instances of questionable ethics of worker rights. Working conditions in the fashion industry have had a history of being dangerous and continue to epitomize this. Two examples include the horrific Triangle Shirtwaist Factory Fire in 1911 and the more recent building collapse in Dhaka, India, an event that killed 1100 factory workers. These are just two of the major tragedies to affect textile industry workers (Hobson, 2013, p. 317). Bangladesh is home to nearly 5,000 garment factories as of 2014 and has a fashion workforce composed of approximately 85% female employees, many of whom

experience a multitude of workplace occupational hazards; upon hiring, these workers have been subject to increases in illness-related leave, while receiving less money on average than what is required for their medical expenses (Sikdar et al., 2014). Many workers also work overtime and are living in poverty (Sikdar et al., 2014). There are 40 million garment workers around the world, and 90% of them are based in low and middle-income countries (Bick et al. 2018).

4 PROJECT FINDINGS AND RECOMMENDATIONS

This section presents remedial solutions and preventative measures to mitigate the negative impacts of fast fashion.

The fashion industry has contributed to a culture of consuming the “new” and discarding the “old,” creating an endless cycle of waste. This nurtures a society of consumerism. There are various potential remedial solutions which could address the environmental, ethical, and health issues related to fast fashion. These preventative recommendations extend from inexpensive thrifting, to purchasing sustainable clothing from environmentally conscious brands, to simply keeping clothing for as long as possible.

4.1 Sustainable Fibers and Fabrics

A principle component of sustainable clothing production is sourcing environmentally-friendly clothing material. There are various sustainable fiber and fabric options available, which can help alleviate the quantity of synthetic material in circulation. The use of artificial clothing materials releases toxins and other heavy metals into the environment. However, fabrics such as organic cotton are grown free of synthetic pesticides and artificial ingredients, making these fabrics essentially free of potentially harmful contaminants. Although organic cotton isn't the perfect solution, it remains an adequate alternative to synthetic cotton which is grown with harmful synthetic pesticides and artificial ingredients.

As sustainable fashions have emerged, there have been immense developments in new sustainable fibers within the fashion industry. Natural cellulose and protein fibers have a much smaller environmental impact compared to their artificially manufactured counterparts. For example, Lyocell fabric consists of bamboo cellulose—a fabrication that allows for almost 99% of the chemicals used to create fabric fibers to be recycled (Bick et al., 2018). Lyocell is produced in a closed system in which producers reuse previously manufactured material waste. Therefore, this fabric can be repeatedly recycled through the closed system, eliminating the creation and deposition of vast quantities of waste. Purchasing clothing from retailers that have implemented these new forms of sustainable clothing production can lead to drastic reductions in the output of contaminants which end up in the environment.

4.2 Sustainable Clothing Brands

The emergence of ‘green’ fashion—environmentally friendly clothing—has presented a new avenue for sustainable fashion. Sustainable clothing includes products composed of environmentally friendly materials such as recycled polyester, organic cotton, and repurposed clothing. Additionally, there has been an emergence of new prosperous eco-friendly clothing brands such as Pangaia, American Apparel, and Noctu. These forms of fashion limit the environmental pollutant aspect of clothing manufacturing. As more sustainable clothing emerges, people should take into account that many products of the fast fashion industry are created with low quality materials which may only last several years, thus purchasing clothing made with higher quality materials and processes makes good sense. Though this may not be a widely accessible option due to the increased prices of so-called “slow fashion,” it is an important consideration for all shoppers.

Unfortunately, many clothing manufacturers have begun the process of “greenwashing,” in which they utilize the appeal of eco-friendly and fair trade products to exploit customers into purchasing their “sustainable” products, which actually don’t adhere to the criteria (Lyon, 2015). The danger of greenwashing lies in deceiving people into purchasing unsustainable products by making false environmental claims. One recommendation to consumers is to research the brands they purchase from in order to avoid receiving clothing from fast fashion companies attempting to greenwash. By performing simple research, consumers can avoid being manipulated by the false advertisements of greenwashing. The image below lists some labels that certify a product’s sustainability. These certifications are awarded by credible third-party organizations proving the sustainability of a product.



Common ecological certifications verify the validity of environmentally conscious practices of a brand (Dahl, 2010).

4.3 Second-hand Clothing

Increased use of second-hand clothing is a potential solution to the environmental issues caused by increased clothing production. People refer to shopping at a thrift store, flea market, or garage sale as “thrifting” where one can purchase mildly used pieces at a reduced price. The concept of purchasing and donating second-hand clothes is beneficial for both clothing consumers and producers. This option allows for fewer resources to be used and wasted in the process of clothing production and transportation.

Oftentimes, large clothing corporations focus solely on the business side of production and ignore the environmental repercussions of unsold or defective clothing being discarded. In a report measuring how Ontario residents dispose of their clothing, roughly 34% of the residents reported throwing away jeans displaying holes or rips (Claudio, 2007). Manufacturing brand new clothing is frequently reliant on the use of harmful materials such as pesticides; however, by purchasing second hand clothing, this cycle is able to be mediated.

Furthermore, donating old clothing once it has concluded its personal use is just as impactful as purchasing second-hand clothing. Donating old clothing prevents matured items from

contributing to the vast amounts of clothing that have been deposited into landfills. In 2018, almost 11,300,000.0 U.S. tons of textiles were deposited into landfills (EPA, 2020). Donating clothing prevents garments from contributing to the large amounts of waste in landfills, instead these articles of clothing are able to be repurposed and recycled for further usage. Purchasing clothes second-hand is an important option for relieving many of the issues emerging from fast fashion.

In addition to the other remedial solutions, there are also various simple applications people can integrate into their lives to address the issue of fast fashion. One of the most important resolutions to fast fashion is to simply “buy less” (EESI, 2020). Purchasing less clothing helps to reduce the amount of garments in circulation while also cutting down the resources needed for clothing production such as transportation, labor, and fabric. Additionally, donating old clothing to local shelters and nonprofits is a critical component in undertaking the issues created through fast fashion. Donating old clothing ensures that clothing ends up in the hands of people in need rather than accumulating in the landfill. However, education is by far one of the most important aspects of dealing with fast fashion. Learning about how to shop for and dispose of clothing sustainably is crucial in preventing more environmental harm from the fashion industry. Therefore, there are many uncomplicated adjustments people can integrate into their life to help tackle the issue of fast fashion.



Thrifting can be a fun way to mitigate the effects of the fast fashion industry (Schneier, 2019).

5 PROJECT FINDINGS: BENEFITS OF AVOIDING FAST FASHION

Greenhouse gas emissions, pollution, and worker rights are all various problems associated with fast fashion, and the benefits of avoiding them through the aforementioned solutions and recommendations are numerous (Figure 1). Shopping sustainably or reducing consumption of fast fashion clothing can produce a plethora of environmental, economic, health and ethical benefits.

SOLUTIONS	BENEFITS
- Purchasing clothing composed of sustainable fibers and fabrics	- Resource use reduction (i.e. water & petroleum)
- Shopping from sustainable clothing brands	- Plastic and chemical waste reduction - Reduction of intellectual property theft
- Purchasing clothing secondhand	- Improvement of worker rights - Promoting better health

Fig. 1: Table shows a summarized breakdown of benefits arising from following recommended solutions

5.1 Resource Use Reduction

Reducing the resources used in the fashion industry can promote sustainability by preserving them for other uses. Switching to sustainably manufactured materials such as the aforementioned Lyocell fabric, can be beneficial by reducing the utilization of materials that can have adverse environmental effects. The majority of clothing is made from polyester and cotton, which respectively require oil for production and immense amounts of water for growth (Bick et al., 2018, p. 2). In addition to the water required to grow materials, the textile industry uses massive amounts of water in totality, with a single “average-sized textile mill” using more than 1.5 million liters per day (Khan et al., 2014, p. 63). Freshwater is increasingly becoming a scarce resource, and this will inevitably have adverse side effects on humanity. Even now, 4 billion people around the world are experiencing severe freshwater scarcity (Mekonnen et al., 2016, p. 3). Freshwater is crucial for sanitation, agriculture, drinking, and more; conserving it is included as one of the United Nations’ Sustainable Development Goals (United Nations). A reduction in reliance on and production of fast fashion will help save some of the water that goes into growing cotton and all clothing production, and may even reduce the dependence on crude oil used to produce polyester, both of which can help protect the environment in the future.

5.2 Plastic and Chemical Waste Reduction

Reducing production and consumption of fast fashion helps offset the total chemical seepage into the environment, and it is beneficial to keep the oceans and land free of synthetic chemicals and textile pollution. Improving water quality by removing harmful chemicals will improve the livelihoods of the people who benefit from those water sources and the living organisms who exist within them. Reducing textile waste, including post-consumer waste of poorly-produced clothing, will prevent clothes from becoming microfibers in the ocean or degrading in landfills and emitting greenhouse gas emissions.



Dye and pollution in waterway with child walking through it (Rydzek, 2018).

5.3 Health

Just as fashion affects environmental health, it also affects human health. By purchasing clothing that utilizes organic cotton, the carcinogenic pesticides often found in inorganic cotton can be avoided and kept from human contact. In addition, dangerous chemical effluent can flow from textile mills into local waterways, and by limiting consumption of fast fashion products that perpetuate this pollution, harmful human contact with chemicals can be mitigated.

5.4 Workers' Rights Improvement

Workers' rights in the fashion industry are closely tied to environmental health and justice. Buying from fashion businesses that actively promote positive work environments and living wages for their workers will improve worker rights in the fashion industry. There are currently 40 million garment workers around the world (Bick et al. 2018). Three million of them are concentrated in several Eastern European countries. Employees are subject to sexism and poverty-level wages, though this is not an issue isolated to these countries (Luginbühl & Musiolek, 2014). If companies and factories are able to improve worker conditions, the lives of these workers can be positively benefited, improving their quality of life and human rights. Promoting more sustainable shopping habits and avoiding fast fashion companies will allow consumers to shop consciously and promote companies that properly treat their garment employees, many of which are overwhelmingly women and people of color.

6 CONCLUSION

Environmental pollution will carry on as people continue to buy poor-quality garments produced by the fast fashion industry. Millions of tons of textile waste are thrown out each year, with clothing comprising approximately "5% of landfill space" (Bick et al., 2018). Mass consumption, often promoted by the fashion industry, encourages consumers to purchase with greater frequency and volume, driving the constant production and output of clothing. Not only does the production of these clothes contribute to great waste, such as old clothing being discarded in landfills and chemical waste flowing into waterways, but the process of

washing and rewashing clothing repeatedly inputs carcinogenic fibers into waterways and ultimately into the bodies of both animals and people. Additionally, clothing production is also linked to vast quantities of atmospheric carbon pollution: an estimated amount of “8-10% of global CO₂ emissions” (Niinimaki et al., 2020). Fast fashion is not only damaging to the environment and organisms in it, but also to the people subjected to its intensive labor demands. Fortunately, the remedial solution range is wide—and includes sourcing clothing from ethical and sustainable brands, to getting involved in the second-hand clothing cycle. As a result, there are a multitude of benefits that can result from sustainable consumption of fashion, including resource conservation and pollution reduction. Together, it is possible to tackle the issue of fast fashion, while simultaneously improving the quality of life for fashion industry workers and mediating the damage done to the Earth.

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