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SOME FACTORS IN THE GARMENT INDUSTRY AFFECTING THE ENVIRONMENT

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Abstract: In recent years, alongside the rapid development of technology, the material and spiritual life of people has been continuously improved; key areas such as science, economy, culture and art have all seen remarkable growth. However, this development process has also put a huge pressure on the global environment in general, and in Vietnam in particular, including contributions to pollution from the Garment and Fashion industry. The Earth is gradually warming with many alarming signs and environmental pollution in all aspects: water, air, soil, light, noise... directly affect all creatures. So how does the fashion industry truly impact the world's living environment? Garment and Fashion industry related activities, such as production processes and manufacturing materials, also contribute to environmental harm. In the context of global calls for raise awareness of environmental protection and climate change, what should we, as fashion creators and consumers, do to protect the environment, reduce waste and contribute to addressing environmental challenges as well as envisioning a sustainable future? From both practical observations and reliable data resources, Research-writer by collecting, analyzing, and describing to highlight the issues related to the current state of garment production and usage that impact the environment. From there, we provide feedbacks and solutions for the Garment and Fashion industry in general and consumers to give a hand for a more sustainable, eco-friendly Garment and fashion industry.

Keywords: the harmfulness of fabric dyeing, waste from clothing overconsumption, fashion and the environment, eco-friendly textiles, zero waste, upcycling

Problem Statement

In today's era, as everything has became more modern and abundant, people are increasingly paying attention to their own appearance or even to the appearance of others, using it as an initial basis to evaluate one another. Clothing and fashion have become more important than ever because they are the first things that catch the other person's eye in any encounter. Author Sofi Thanhauser wrote, “Virginia Woolf remarked that clothes change both our worldview and how the world views us” (Sofi Thanhauser, 2022, p.16, [1]). Beauty, and the role that fashion plays in it, is something humans relentlessly pursue and invest in. Especially in the 4.0 era, with machines and devices supporting fast and intelligent production processes, many clothing designs have emerged. Alongside that, e-commerce platforms such as Lazada, Shopee, or TikTok have developed significantly, making it easier for people to purchase affordable and diverse fashion items. In other words, the development of fashion stimulates and attracts people to shop more, and human consumption and demand, in turn, further drive the growth of fashion.

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However, proportional to this development are the negative impacts of fashion on society and the environment. Fast fashion brands are rapidly expanding, with fashion trends constantly changing and being updated almost daily or weekly; production factories and fashion businesses operate continuously without rest, and environmentally unfriendly materials are commonly used to meet the immediate demands of fast fashion. As a result, the fashion industry has been named one of the top two contributors to environmental pollution in the world, second only to the petrochemical industry.

The goal of the writer is to synthesize and analyze the environmental impacts of fashion to clearly highlight its harmful effects. This understanding aims to promote awareness and develop appropriate solutions, ensuring that fashion not only enhances human appearance but also truly contributes to the beauty of life and the environment.

The current state of the production and use of textile products affecting the environment

The mass production of fast fashion products, with a wide variety of designs and prices suitable for all types of consumers, along with diverse and fast purchasing methods made possible by modern applications, has attracted customers to spend large amounts of money to use these items. According to Environmental Magazine:

"Between 2000 and 2014, the number of garments purchased by consumers increased by 60% annually. The clothing industry grew by 8% each year (except during the outbreak of the pandemic in 2020), with fast fashion leading the garment industry". However, "20% of these garments are not sold. On average, about 85% of textiles are discarded in landfills annually, which is equivalent to one truckload of clothing being burned or thrown away every second" (Nguyen Hang, 2022, [2]).

In 2021, many articles around the world highlighted the environmental impacts of fashion, pointing out that "The fashion industry accounts for 8-10% of global carbon emissions due to the energy used in production, manufacturing, and transportation" (Nguyen Hang, 2022,[2]; Giai Kỳ, 2021, [3]).

From the above data, it can be seen that fashion in general, and fast fashion in particular, has developed rapidly, accompanied by the consequence of environmental destruction in many ways.

Figure 1, source:[18]

Figure 2, source:[2]

Clothing and excess fabric create overwhelming waste that pollutes the environment

Figure 3: The Earth is warming and could be destroyed due to environmental pollution, source:[19]

The Excess of Clothing, Waste of Fabric Resources, Leading to Overload of Waste and Pollution

According to Environmental Magazine:

"The 'world's clothing landfill' is located in Accra, the capital of Ghana, a country in Africa (part of the Atacama Desert), with 60% of this landfill consisting of clothing. Each week, it receives 15 million pieces of used clothing. Every year, about 39,000 tons of discarded clothing are dumped in this desert" (Nguyen Hang, 2022, [2]).

Similarly, Chile has long been a hub for old and unsold clothing. It is estimated that "Every year, around 59,000 tons of clothing arrive at the port of Iquique in the city of Alto Hospicio, northern Chile" (Nguyen Hang, 2022, [2]).

Figure 4: Used clothing is often discarded in the Atacama Desert, Chile. Only a few items are bought by traders, (Photo: AFP), source:[2]

Reflecting on daily life, we can easily observed that people today, especially young adolescents, both men and women, often wear outfits just once or twice. The mindset of wanting to avoid wearing the same clothes as others or constantly wanting to change and look fresh means that some outfits, after being worn and photographed to post on social media like Facebook, Zalo, or the popular app TikTok, are only worn once or twice. After that, they only want to appear on these platforms in different and better outfits. As a result, their wardrobes quickly become filled with excess clothing.

Figure 5, 6: Image of clothing at a girl's house in Ho Chi Minh City with many outfits worn only once or twice, source: Huynh Le NT

New designs are continuously launched by brands with limited quantities, heightening people's desire to own them due to the fear of falling behind global fashion trends. They feel compelled to buy immediately, even if they may never use the items.

On average, a person in 2014 owned 60% more clothing than in 2000 [2], while their wearing time was cut in half due to the overwhelming production of low-quality, low-durability products. Consequently, clothing is produced excessively, and consumers purchase items to keep up with

trends, not to mention the tons of unsold inventory in fashion retailers' warehouses. The surplus clothing of wealthier individuals, even if donated, often includes items unsuitable for recipients. Poor individuals cannot wear revealing outfits or extravagant dresses to work, as they struggle daily for basic necessities. The excess clothing will likely end up in public landfills or incinerators. Fashion managers and environmentalists are concerned that the Earth may soon become overwhelmed due to the inability to manage the waste generated from surplus clothing.

Figure 7, 8: Fashion clothes discarded by the youth cannot be donated to the poor because they are not suitable, source:[20]

Abuse of Harmful Chemicals

To meet market demand and provide consumers with products continuously at much lower prices than high-end fashion, fast fashion brands have used low-quality materials made from non-biodegradable fabrics or even harmful chemicals to create brightly colored, eye-catching fashion products. Dyeing chemicals are the second-largest contributor to global water pollution. In addition to garment factories, weaving and dyeing factories have been established with significant investments and are found in abundance. Fabrics containing thousands of chemicals, when in regular contact with the skin, can cause various health issues such as infertility, respiratory problems, dermatitis, and cancer.

Figure 9: Dyeing chemicals, source:[21]

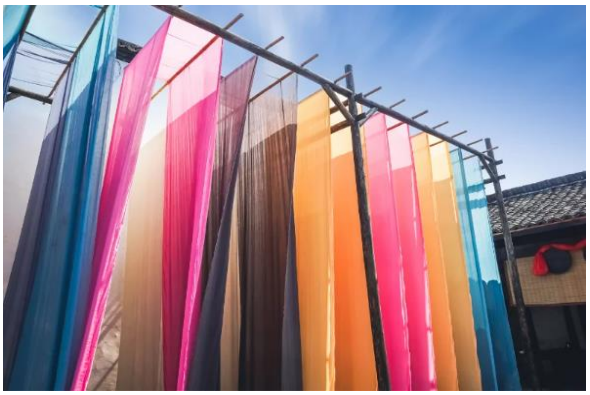

Figure 10: Brightly colored dyed fabrics attract attention, source:[22]

The increasing quantity of fabric produced has led to a corresponding rise in cotton cultivation for the textile industry, requiring large amounts of water and pesticides to minimize damage during cotton harvests. The overuse of chemicals has resulted in most cotton grown worldwide being genetically modified, pest-resistant, and high-yielding. However, the cost of this is the emergence of 'super weeds' that are resistant to conventional herbicides, forcing farmers to use even more toxic chemicals despite being aware of the serious threats these substances pose to the health of livestock and humans.

In 2015, the documentary The True Cost highlighted:

"The devastating impact of using harmful chemicals in cotton farming, from the cancer-related death of a farmer in the U.S. to numerous cases of severe birth defects among children of cotton farmers in India" (Tuoitre.vn, 2018, [4]).

This popular yet impactful film has raised awareness about the dark side of the fashion industry and its effects on the environment and human health.

Figure 11, 12: "The True Cost" reveals heartbreaking truths about fast fashion, source:[23]

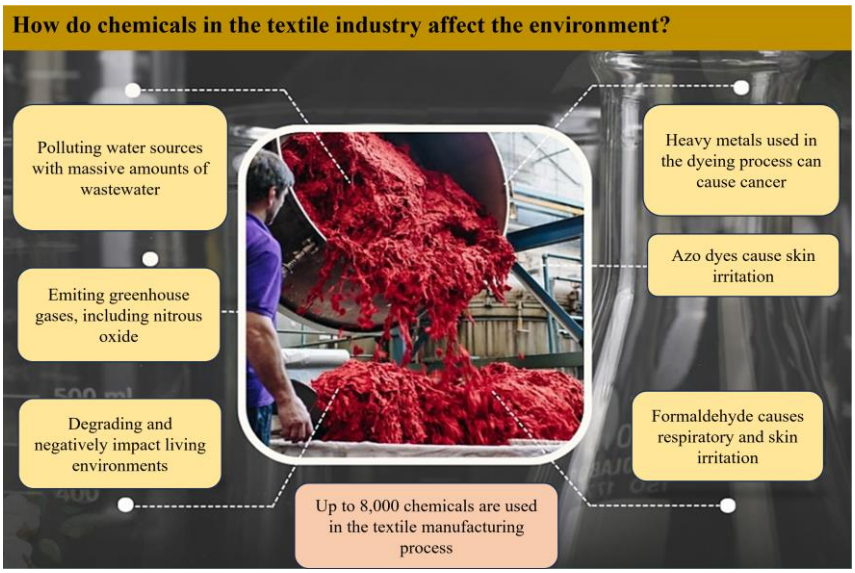

Figure 13: Hazards from chemicals in the textile industry, source:[24]

Water Pollution

It can be said that the harmful impacts of the fashion industry on the environment follow a chain of reaction. The use of toxic chemicals, as mentioned earlier, also leads to consequences in the form of wastewater discharge into the environment.

"The textile industry discharges a large amount of wastewater, averaging about 70 million cubic meters of wastewater per year. The textile industry requires up to 20,000 liters of water just to produce 1 kilogram of cotton fiber, equivalent to one t-shirt and one pair of jeans. This industry is responsible for 20% of the total global wastewater discharge" (Linh Chi, 2022, [5]).

However, the current situation of environmental pollution in the textile industry, particularly in terms of wastewater pollution in many areas, is still not being tightly controlled. Maintaining a globally standardized waste treatment plant is very costly, so factories often use a simpler method of dyeing fabric just once, after which the wastewater full of chemicals is discharged into nearby rivers and lakes. The waste in the water becomes so concentrated that sunlight cannot penetrate the surface, reducing the ability of plants to photosynthesize. The lower oxygen levels in the water result in the death of marine flora and fauna.

Most remaining businesses still only use rudimentary wastewater treatment methods, and the treated wastewater still contains a large amount of harmful substances that severely pollute the environment. This not only affects water bodies but also contaminates the surrounding air, impacting the quality of life for local residents.

Figure 14: Chemicals discharged from fashion production factories severely pollute water, source:[25]

Incidents such as the Citarum River in Indonesia or the Pearl River in China, or cases of factories discharging wastewater into rivers in Vietnam, are not uncommon. These rivers have become so polluted that fish and other aquatic life cannot survive, and the pollution even affects drinking water, bathing water, irrigation, and the fisheries that local residents rely on. The rate of cancer and other diseases among communities living near polluted rivers or wastewater sources from garment factories is reportedly alarmingly high.

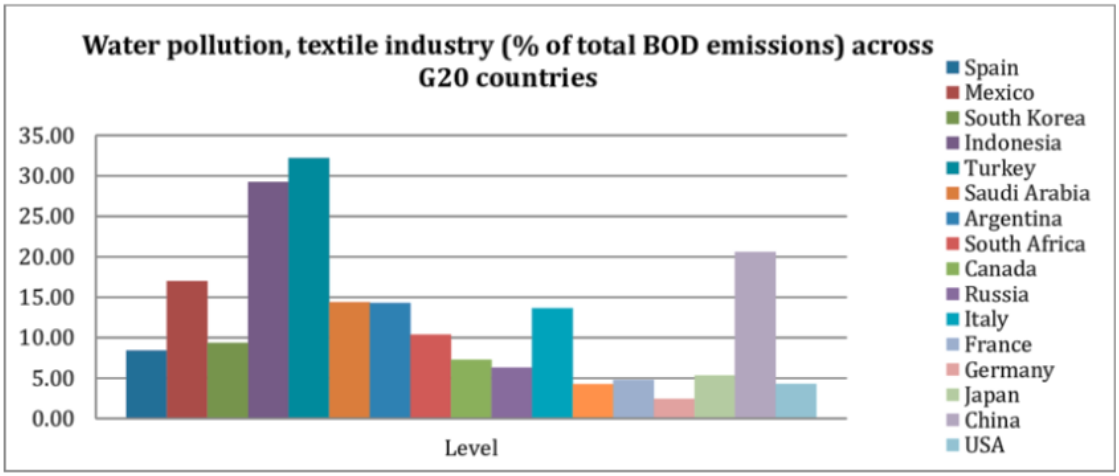

Figure 15: Chart showing the water pollution caused by the textile industry in G20 countries, source [26]

Air Pollution

Second only to wastewater, air pollution caused by the fashion industry in general and the textile industry in particular is also a highly alarming issue. Air pollution occurs in various ways. The water pollution caused by the fashion industry also leads to another significant consequence: the air is negatively impacted by odors and gases rising from these severely contaminated water sources.

Figure 16: Residents report pollution behind a textile industrial zone in Hung Yen, Viet Nam, source:[27]

Ms. Dang Hong Hanh, Technical Expert of the SPI-NDC Project, shared:

"Due to the industry's characteristics of high energy, raw material, and chemical usage, it results in significant greenhouse gas emissions. The wet processing of textiles (yarn, fabric, and garments) has the largest 'carbon footprint' because of the intensive use of water in washing, rinsing, pre-treatment, dyeing, and finishing processes" (Khanh Ly, 2023, [6]).

Additionally, according to the Vietnam Textile and Apparel Association (VITAS), the textile industry emits approximately 5 million tons of CO2 annually. That's in terms of production. On the product usage side, as mentioned earlier, the overconsumption of clothing is continuously rising. Tons of

clothing are sent to global fashion landfills or even unregulated dumps. The long-term accumulation of these landfills generates foul odors in the air, comparable to the stench of other decomposing waste materials. If not dumped in landfills, discarded clothing is often buried or incinerated. Polyester, the most commonly used fiber in fast fashion, is made from plastic and never fully decomposes. When burned, it easily releases toxic gases into the air. These are indeed alarming, distressing, and globally concerning facts for the environment.

Figure 17, 18: A clothing landfill in Accra, Ghana, source:[28]

The Dangers of Microplastics in Clothing

In clothing, synthetic fibers such as nylon, polyester, and acrylic dominate due to their durability, softness, light weight, affordability, and extreme flexibility. However, these fibers contribute to pollution in a subtle way and pose a threat to human health. When these fabrics are washed in household washing machines, they release microfibers, which can easily pass through wastewater treatment plants into waterways, infiltrating soil and nearby water sources. These microfibers are difficult or even impossible to degrade, increasing the amount of plastic in the ocean. They pose a serious threat to marine life. These microfibers enter the food chain of fish and predatory animals, and eventually end up in human stomachs. It is estimated that a single wash can release hundreds of thousands of fibers into the water.

Imogen Napper, a marine scientist at the University of Plymouth, stated:

"Think about how many people are washing their clothes every day, and how much clothing we all have. Even when we're simply moving around, without washing our clothes, tiny fibers still fall off. It's everywhere" (Bubaby, [7]).

Figure 19: Microplastic Pollution from Clothing, source:[7]

Solutions to the Environmental Pollution Caused by the Fashion Industry

Almost any activity related to the apparel and fashion industry causes significant harm to the environment. Yet, this is one of the most profitable industries globally and in Vietnam specifically, making it extremely challenging to solve the environmental problems caused by the fashion industry. While it may take less than 10 seconds to discard a piece of clothing, it can take over 10 years for it to decompose. The environmental crisis has raised alarm bells around the world, especially in the post-COVID-19 period, as consumers are increasingly concerned about health. As a result, in their fashion choices, they tend to lean towards sustainable fashion. This trend encourages fashion creators, such as designers, product developers, buyers, and sellers, to opt for sustainable and eco-friendly alternatives. Globally, various solutions have emerged, notably the trend of "Sustainable Fashion" or "Eco Fashion"—fashion that is eco-friendly and humane towards the environment. The goal is to extend the life cycle of fashion products to reduce their negative impact on the ecosystem. The reuse and recycling of garments and accessories are expected to become more prevalent in the future.

Fashion creators, such as designers, product developers, buyers, and sellers, are coming together to find solutions that allow the fashion industry to continue developing while minimizing environmental pollution. As a result, all related aspects, such as production processes, materials, and design, are now focused on environmental protection.

Solutions for Material Conservation

a. Material Recycling

Recycling is considered one of the most practical solutions for environmental protection, making full use of materials that would otherwise be discarded, thus reducing a significant amount of waste released into the environment. Recycled fashion is not just about reusing old materials but also about creating new products by repurposing used resources. From old clothes, fabric scraps, and newspapers to plastic, all of these can become primary resources for recycled fashion, transformed into a variety of products such as bags, shoes, clothing, hats, and stuffed animals. Recycling used materials not only reduces waste but also helps conserve resources and protect the environment.

Materials for recycling: denim cotton, khaki, canvas, etc.

Figure 20, 21: Figure 20, 21: Adorable designs made from recycled denim materials, source:[29]

For recycled materials that have been damaged through use, the patchwork technique—stitching together multiple small fabric pieces—is widely employed by many fashion designers. This technique creates impressive patterns and styles that are aesthetically pleasing for consumers. This approach allows the reuse of leftover fabrics and existing materials to create a new product that is both cost-effective and environmentally friendly.

Figure 22, 23, 24: Patchwork style is full of artistry, source:[30]

b. Freesize Clothing

Similar to the two types of clothing mentioned above, freesize clothing can also be considered a solution for material conservation. By not distinguishing between different body shapes and sizes,

freesize garments can be worn by a wider range of consumers for an extended period. This helps reduce the amount of clothing produced for the market, contributing to material savings. This approach helps conserve resources and limits potential environmental pollution.

Figure 25: Loose-fitting, Comfortable Clothing for Various Body Shapes and Weights, source:[31]

Solutions Utilizing Techniques in Design

a. Zero Waste Fashion

In the movement to minimize the amount of fabric waste released into the environment, Zero Waste fashion is a design philosophy characterized by the absence of leftover fabric during the design process. This approach has been around for a long time, but it seemed to be forgotten with the rise of fast fashion trends.

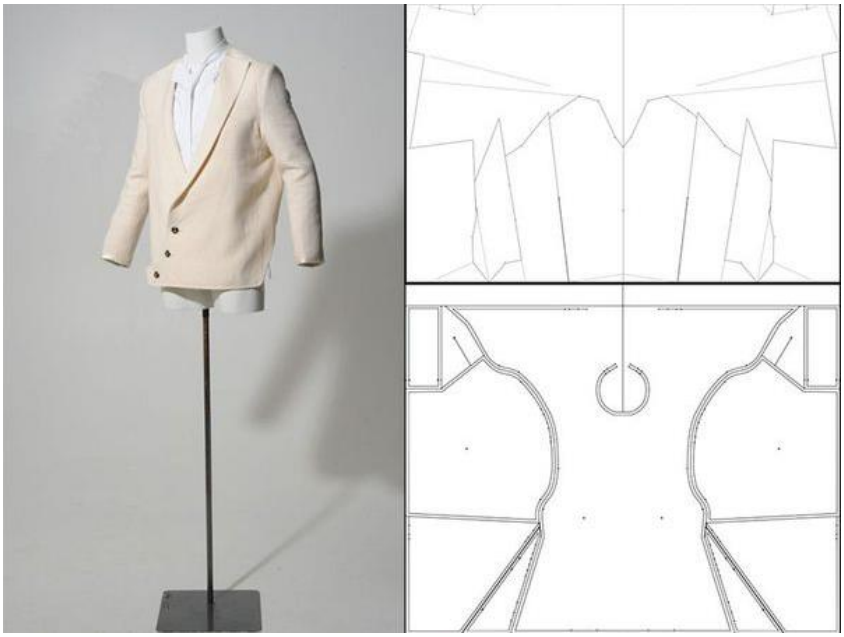

Figure 26, 27: Materials must be carefully calculated and come from experienced designers, aiming for the real purpose of zero-waste fashion, source:[32]

Sari and Chiton are examples of ancient garments that embody the principles of zero-waste fashion, adhering to the rule of leaving no more than 1 cm² of fabric unused. This practice not only helps save production costs and reduce pollution from fabric manufacturing but also minimizes the release of fabric scraps into the environment after production.

b. Subtraction Cutting Technique

Similar to the Zero Waste approach, the Subtraction Cutting technique is a highly fabric-efficient method in garment making. This technique operates on the principle of creating garment structures based on pre-cut holes and maximizing the fabric's width to make the most of the material. While the level of fabric savings may not be as absolute as with Zero Waste, the amount of fabric discarded in the creative process of Subtraction Cutting is considered to be significantly reduced compared to traditional cutting methods.

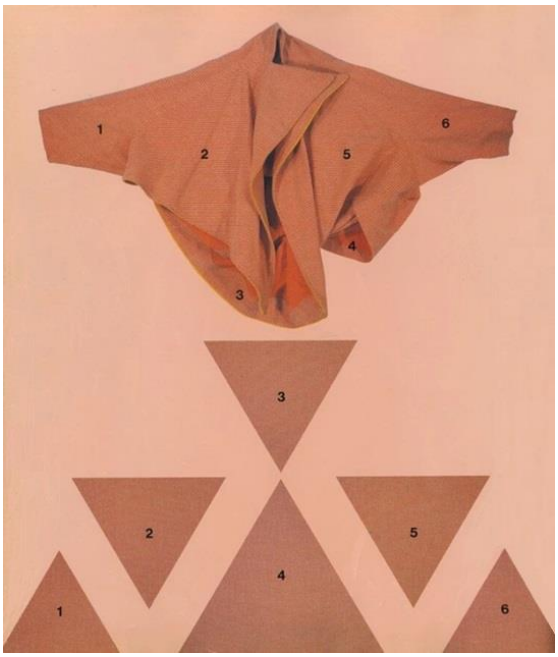

Figure 28: The design is entirely made from equilateral triangle fabric pieces (Photo by Yoshiki Hishinuma), source:[33]

Effective Application of Technology

a. Plasma Technology

"*Plasma technology is applied in the textile and garment industry to treat fibers, applicable to most textile materials for surface treatment. It aims to improve dyeing functions or remove excess chemicals from the materials (plasma etching). This is considered a 'green' process, as it does not produce chemicals, solvents, or harmful substances for the environment*" (Nguyen Thi Hien, 2022, [8]).

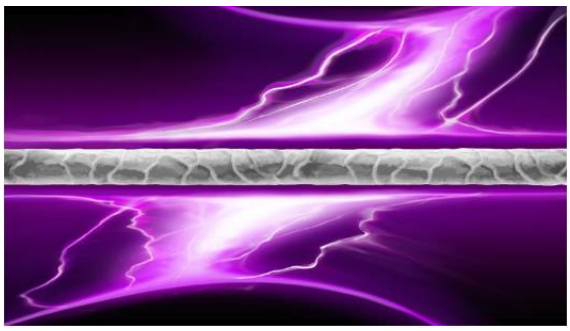

Figure 29: Ionization process: wool passes through A plasma field, source:[8]

Additionally, cold plasma technology is also being applied in the treatment of textile dyeing wastewater. Recently, scientists from Ho Chi Minh City National University have experimented with this technology on a laboratory scale and have shown very promising application potential:

"*Cold plasma technology has the ability to treat pollutants in water quickly and effectively, with a non-selective approach and minimal chemical additions during the treatment process. It is highly effective in treating colored organic compounds that are difficult to biodegrade*" (tapchicongthuowng.vn, 2019, [9]).

b. Dye Production Technology from Bacteria

The use of natural dyes combined with traditional dyeing methods is inherently environmentally friendly but may require more time and effort.

"*Natsai Chieza, the biologist behind the Faber Futures project and one of the experts at Ginkgo Bioworks, is researching methods to transform bacteria into clothing dyes, helping to minimize water usage. Additionally, bacterial dyes are entirely eco-friendly and harmless to the human body, with the expectation that this will soon become a significant achievement in modern science*" (caodangvietmy.edu.vn, [10]).

Figure 30: Ionization process: wool passes through A plasma field, source:[10]

c. Lab-Grown Artificial Leather

In the fashion industry, leather tanning is one of the most environmentally harmful processes due to the highly toxic wastewater it produces. Additionally, those animals have been killed severely for their skins has a significant impact on the ecosystem. Even faux leather is made from various chemicals that are equally harmful to the environment. To meet human fashion demands while protecting the ecosystem, scientists are researching lab-grown leather:

"*Using animal-derived cells to recreate the structure of leather and the same type of collagen, lab-grown leather can closely resemble natural leather in properties, color, and scent. This allows for the creation of perfect leather products without harming animals*" (Vinnie, 2023, [12]).

Figure 31: Lab-grown leather helps reduce animal cruelty, source:[12]

Eco Dye Solution (Natural Dyes)

In the garment industry, fabric dyeing is considered one of the most environmentally polluting stages due to the amount of chemicals used and the waste released into the environment. Therefore, the discovery of natural dyes to replace chemicals, as well as the use of natural dyeing processes, is highly welcomed in the trend towards sustainable fashion.

Figure 32, 33: These 'artworks' of natural and handcrafted dyeing by the author and students

The materials used for eco dyeing – natural dyeing – are very diverse, as people have traditionally used natural resources for dyeing, such as the leaves of the mahogany tree, almond tree, indigo leaves "Chàm", fruits of the murasaki plant "Mạc Nưa", tubers of the brown yam "Củ Nâu", turmeric, and more.

Figure 34, 35: The author's students with diverse natural materials used for dyeing

Globally, traditional fabric dyeing techniques such as Japan's Shibori or tie-dye, which involve immersing fabric into vats of natural dyes, are still widely used due to their eco-friendly nature.

Figure 36, 37: The author performs the Japanese shibori dyeing and tie dye technique, with the process of tying, binding, folding, or twisting fabric, then immersing it in Cham dye to create the finished product.

Use of Natural Materials

While leaves such as mahogany, almond, indigo, brown yam, and turmeric are used to create natural dyes, some fabrics are made from natural fibers to replace those made from synthetic or plastic fibers, such as polyester, which harm the environment.

Spider Silk

Natural spider silk possesses outstanding qualities such as being warm in winter, cool in summer, extremely lightweight, and as durable as steel. However, harvesting spider silk has always been

challenging. Scientists have developed lab-grown fibers that replicate the properties of natural spider silk. Fabrics woven from artificial spider silk are still beautiful and even stronger than other natural fibers. The most remarkable aspect is that this spider silk is fully biodegradable. If produced in large quantities to replace synthetic fibers like nylon, it could significantly reduce the pollution burden on the environment.

Figure 38, 39: The robe made from Madagascar spider silk source:[13]

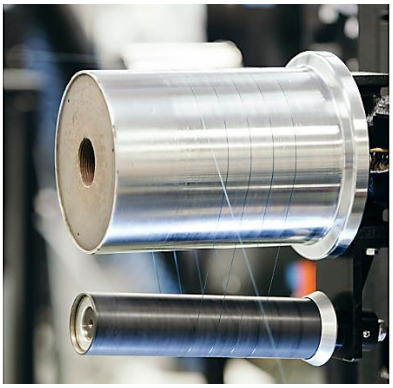

Figure 40: Aboratory-grown silk threads by Bolt Threads, source:[13]

Figure 41, 42: Shift dress and tie woven from synthetic spider silk by Bolt Threads, source:[13]

Fabric made from orange and tangerine peels

Oranges and tangerines are those popular fruits worldwide due to their many health benefits, affordability, and ease of cultivation. Particularly in Italy, it is estimated that hundreds thousands tons of orange and tangerine peels are discarded into the environment every year. Therefore, design students Adriana Santanocito and Enrica Arena found a way to extract cellulose from orange and tangerine peels, spin it into fibers, and weave it into fabric, either 100% pure or blended and dyed with cotton, polyester, and other materials to create fabric.

Figure 43, 44: Cellulose is extracted from orange peels and then spun into fiber, source:[14]

Orange and tangerine fiber fabric offers many advantages, such as being ultra-lightweight, ultra-cool, yet highly durable; soft and smooth, making it especially suitable for people with sensitive skin; good moisture absorption; excellent odor control; and, most importantly, this fabric is environmentally friendly and biodegradable. Thus, orange and tangerine peels are considered a free resource that benefits the garment industry, bringing a 'new wave' to the fashion industry while also addressing environmental waste.

Figure 45: The application of orange fiber fabric in the textile industry today, source:[14]

Leather made from cactus leaves

Just as orange and tangerine peels can be extracted to create fabric, cactus leaves have been used by two Mexican entrepreneurs, Adrián López Velarde and Marte Cázarez, to create organic leather.

"They use the Nopal cactus, which grows abundantly throughout Mexico. Cacti are very easy to grow, needing only rainwater to thrive and develop. As a result, the process of producing cactus leather saves a significant amount of water compared to animal leather" (Vietcetera, 2021, [13]).

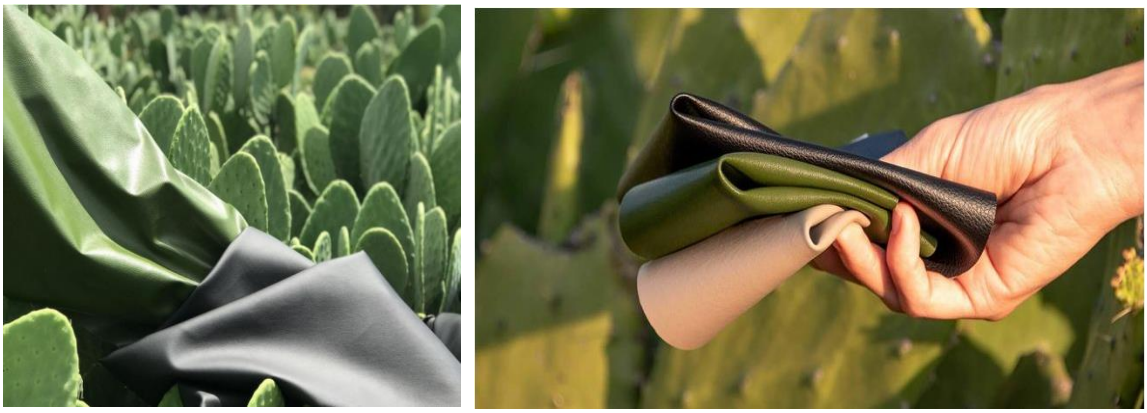

Figure 46, 47: Transforming rugged cactus into smooth, durable, and colorful leather fabric, source:[15]

Bamboo

Bamboo is a very eco-friendly plant crop because it grows quickly, is resistant to pests, and doesn't require harmful fertilizers or growth chemicals, nor does it need genetically modified seeds, making it easy to cultivate. Bamboo fiber fabric is produced by crushing the bamboo plant to extract cellulose,

which is then combined with certain compounds to form a complete fiber. The key point is that this fabric is biodegradable, reducing waste and protecting the environment.

Figure 48, source:[34]

Figure 49, 50, 51: Different types of bamboo fiber fabrics, all environmentally friendly, source:[34]

Pineapple Fiber Fabric

Pineapple is a fruit that is relatively easy to grow and is widely cultivated in many countries around the world, especially tropical countries such as Vietnam, India, and the Philippines. During harvest, a large amount of pineapple leaves is often discarded, causing waste. These leaves are difficult to use as compost due to their long fermentation time and are also unsuitable as animal feed due to their sharpness and spiky nature. Therefore, using pineapple leaves to produce textile fibers is an excellent solution that helps reduce environmental waste.

Pineapple fiber fabric is highly durable and requires minimal care during washing and drying, helping people save a considerable amount of time on cleaning and maintenance.

Figure 52, 53: Pineapple fiber extracted from pineapple leaves, source [35]

Finished pineapple fiber fabric:

Figure 54, source: [36]

Figure 55, source:[37]

Banana Fiber Fabric

Banana plants only bear fruit once, and after harvesting, instead of cutting down the entire plant, the banana peel can produce thicker fibers, while the inner part of the banana stem can yield finer fibers.

Banana-derived fibers are known for their breathability, natural absorbency, exceptional strength, and flexibility, as well as their excellent biodegradability. From a sustainability perspective, banana fiber fabric can serve as an alternative to cotton and silk.

Figure 56: Banana fiber, source:[38]

Figure 57, 58, 59: Application of banana fiber fabric, source:[38]

Lotus Silk

The lotus is a plant that grows abundantly in Vietnam and many other countries around the world. When its stem is broken, fine threads can be drawn out and woven into fabric. Therefore, the lotus has become an eco-friendly material that designers are turning to in order to create soft and cool fabrics.

Figrue 60: Cutting on the lotus stem must be just right—if it's too deep, the silk fibers inside will break; if it's too shallow, the stem won't twist to extract the fibers, source:[39]

Figure 61, Lotus silk fabric, source:[39]

Figure 62, Lotus silk fabric, source:[40]

The Contribution of Fashion Creators/Developers

Behind the solutions mentioned above, we can clearly see the role of humans in driving and promoting their implementation. However, the author still wants to dedicate a part of this article to further emphasize their role in environmental protection. This includes the contributions of fashion creators or developers, such as scientists, designers, manufacturers, and even educators in the fields of clothing and fashion.

In recycling discarded materials into useful ones, fashion brands have collaborated to turn plastic waste into fashion. Parley for the Oceans continues its mission to protect marine environments by partnering with the prestigious French fashion house DIOR. This collaboration is regarded as a green-conscious initiative:

"The project aims to develop recycled fabric fibers from plastic debris and fishing gear collected from coastal and island regions around the world, such as the Maldives, the Dominican Republic, and Sri Lanka. The first Dior x Parley for the Oceans collection, launched in 2022, won the Green Ecological Transformation Award" (Harper's Bazaar Viet Nam, [16]).

Figure 63: The Dior x Parley for the Oceans collection made from plastic waste harvested from the ocean. Photo: Dior, source:[16]

As mentioned in the section on eco-friendly materials, although many natural materials are already being utilized for fabrics to protect the environment, scientists and designers continue to explore and research even more environmentally friendly materials, such as coffee fiber fabric, and bio-based Tencel fabric. They are also further developing the natural materials already discovered to make them even more advanced. Undoubtedly, in the future, the fashion industry will see the emergence of many more sustainable materials.

Figure 64: Designer Tran Hung created a vinegar-made dress for a contestant in the Miss Universe Vietnam 2022 competition, source:[41]

Figure 65, 66: Artisan Phan Thi Thuan continues to passionately pass on the craft, teach, and share inspiration with the younger generation, source:[42]

In Vietnam, many fashion brands have emerged that only sell fabrics made from natural materials, such as the pineapple fiber brand Ecosoi or Vietnam's sustainable fabric brand Greenyarn. Designers also enthusiastically support these eco-friendly materials, creating practical collections to bring environmentally friendly fabrics closer to the public. This is an opportunity for consumers to "green" their wardrobes and contribute to protecting nature.

Figure 67, 68: The banana silk Ao Dai collection by designer Vu Viet Ha, source:[43]

The lecturers at universities offering fashion design programs also devote significant effort to researching and incorporating lessons into their curricula that teach students how to use natural materials, natural dyeing techniques, and more, with the hope that they will continue and develop sustainable fashion, fostering greater respect for the environment.

Figure 69, 70: The author of the article alongside students and naturally dyed products after a class session

Consumers also contribute to environmental protection

In addition to businesses, garment manufacturers, and fashion designers gradually becoming aware of the fashion industry's impact on the environment and supporting the sustainable fashion trend, consumers also need to take positive actions to contribute to this humane cause. This can be done by limiting excessive and trend-driven clothing purchases and reusing old clothes as much as possible.

According to Fashion Magazine, "In fact, 73% of Millennial customers have shared that they are willing to pay higher prices to own products from sustainable fashion brands and designs with a vintage style" (ELLE Fashion team, 2024, [17]).

This forms the foundation for the development of eco-friendly materials not only in clothing but also expanding into shoes, accessories, and more.

Figure 71: Popular fashion products made from undyed clean cotton by the brand Waight, source:[15]

Figure 72: Sneaker models made from cactus leather fabric attract many consumers, source:[44]

Thus, today's consumers have begun to gravitate toward choosing sustainable fashion brands; prioritizing quality over quantity; and purchasing designs and clothing made from natural materials, supporting the sustainable fashion trend that manufacturers and fashion designers have passionately pursued, as they become increasingly aware of climate change and the negative impact of human activities on the natural environment.

Actions from authorities: Strict control over production processes and waste management

Environmental issues are no longer just individual concerns but a societal crisis. Therefore, alongside changes from fashion companies, the governments of some countries are planning a fashion revolution for the environment.

In the future, "All clothing items sold in France will be required to include labels detailing the exact environmental impact of each product: Where and how were the raw materials grown? What was used to dye the product? How far did the product travel? Was the factory powered by solar energy or coal?" (Bnews, 2022, [18]).

As a result, brands need to prepare to make their products traceable and implement automated data collection systems.

Figure 73: Fashion brands have begun labeling products with carbon consumption indicators, source:[18]

Additionally, to help minimizing environmental pollution, countries around the world, including Vietnam, need to strictly enforce regulations controlling the production and waste discharge processes of garment factories or manufacturing facilities. These entities are required to have waste treatment systems that meet environmental standards for wastewater.

Results and Discussion

Topics for Discussion:

a. Fashion Industry and Environmental Pollution

The fashion industry is one of the most polluting industries globally, spanning from raw material production and fabric dyeing to product disposal. Its activities consume significant natural resources (water, land) and involve hazardous chemicals, leading to air, soil, and water pollution. Chemicals used in fabric production and dyeing contaminate water and soil and cause health problems, such as skin diseases and endocrine disorders. Furthermore, production activities (especially in the supply chain) and product disposal contribute significantly to greenhouse gas emissions.

Fast fashion accelerates the production and consumption of fashion products at a rapid pace and low cost. The trend of "buy fast, discard fast" results in substantial textile waste, exerting pressure on the environment through greenhouse gas emissions and waste management challenges. Additionally, fast fashion products have a short lifespan, creating significant textile waste. The difficulty of recycling or biodegradable decomposition of clothing leads to soil and water pollution.

b. Solutions to Minimize Negative Impacts

To reduce the negative environmental impacts of the fashion industry, several viable solutions can be implemented. First, promoting "sustainable fashion" or "eco-fashion" is becoming a major trend. This includes using environmentally friendly materials, such as recycled fabrics, natural fibers, and minimizing the use of harmful chemicals during production. For example, fabrics made from bamboo, cactus, or citrus plants have proven to be sustainable solutions due to their high renewability and chemical-free production process. Additionally, adopting new technologies to minimize resource consumption and waste is essential. Technologies such as Plasma treatment and bacterial dyeing represent advancements in reducing the use of harmful chemicals in production. At the same time, the fashion industry should encourage consumers to choose products made from sustainable materials and reduce unnecessary purchases, prioritizing high-quality and durable products.

Moreover, fashion brands can adopt "Zero Waste" design techniques to minimize fabric waste during production which approach maximizes material utilization and reduces waste generated. Reusing and recycling old clothing is one of the most critical measures to reduce fashion waste and extend the lifecycle of products.

Recycling policies and textile waste management must also be tightened. Brands should commit to using recycled materials and participating in programs for collecting and recycling old clothing. This will enable the fashion industry to develop while mitigating its negative environmental impacts. Additionally, contributions from fashion creators and producers include using environmentally protective materials and incorporating sustainability education into training programs for future generations, emphasizing the connection between fashion and the environment. Regulatory agencies should also enforce strict policies regarding fashion materials to ensure sustainable practices.

Conclusion

As living standards get higher, people are rising their concerns with the life quality. Therefore, environmental pollution, in general, and the impact caused by certain aspects of the production and use of garment products, in particular, have influenced society’s awareness. Many famous fashion brands such as Stella McCartney, Viktor & Rolf Couture, Tribe Alive, People Tree, Kowtow, and others have adopted sustainable, eco-friendly fashion methods. Numerous Hollywood celebrities like

Anne Hathaway, Emma Watson, Jessica Alba, Gwyneth Paltrow, Natalie Portman, and even Duchess Kate Middleton have recognized the importance of the environment and have used their influence to pioneer and call on their fans to support "sustainable fashion" with the principle: Life still needs beauty, but it should be a friendly and sustainable beauty.

Therefore, now more than ever, the collaboration of scientists, fashion designers, brands, and consumers—indeed, everyone in society—working toward a green, clean, and sustainable fashion industry will soon help achieve a cleaner, greener environment.

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Declaration of Interest Statement

The author declares that they have no conflict of interests.

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