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Fashion with Sustainability: A Conscious Approach Towards Green Wardrobe

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ABSTRACT
The ravenous hunger of fashion for emerging trends and contemporary styles has contributed significantly to ecological carbon footprint resulting in massive environmental degradation. Fashion from past few decades is undergoing a transformative shift towards sustainable practices and approaches. This study investigates the multifaceted perspective to green wardrobe through a comprehensive review on sustainable fashion approaches such as sustainable raw materials, ethical production practices and circular economy including recycling and upcycling. This study explores the extent to which the adoption of sustainable materials, including recycled fabrics and biodegradable fibers, contribute in reducing the industry's carbon footprint. It also covers go green practices such as zero waste pattern making and sustainable denim. It also highlights the role of technology such as digital design tools in reducing the use of energy and resources during production. Additionally, it addresses the potential of new fashion models practiced by designers such as slow fashion, rental services, capsule wardrobe and upcycling to promote responsible consumption and minimise waste generation.

Keywords: Sustainability, Green Wardrobe, Circular fashion model, Slow fashion, Recycling, Upcycling.

Introduction:

Fashion is dynamic in nature. The cutting-edge technologies and wide spread dissemination of information has jointly abated the shelf life of a style resulting in promotion of fast fashion. This fast fashion culture exacerbates environmental condition leading to generation of massive textile waste that end up in the landfill. This in turn increases the global carbon footprint resulting in emission of greenhouse gases. In order to tackle this situation with a greener approach, it is the need of hour to infuse sustainability with fashion. Sustainable practices refers to adaptability of habits and behaviour that fulfil the requirement of present generation without negotiating the probability of future generation to fulfil their needs (Kustenkova, 2017). In a lay man's perspective, sustainability means fulfilling one's own needs in a conscious way without depleting the natural resources, in turn, preserving it for future generation. In context with textile and fashion, it refers to initiatives within the fashion and textile industry to reduce its environmental impact, implementing ethical practices, protection of rights of workers and uphold animal welfare. According to Geneva Environment Network, the second largest water consuming industry in today's scenario is fashion industry that emits nearly 2-8 % of global carbon emission (Environmental

Sustainability in the Fashion Industry, n.d.). The contagious aspect of the fashion industry can be foreseen by the following facts:

- It has been estimated that if fashion industries continue its trajectory of emitting carbon at the rate of 2-8%, it will contribute to nearly 26 % of total global carbon emission by 2050. (Fashion and the Circular Economy, n.d.)
- According to the report of World Bank, fashion industry contributes nearly 20% of total water pollution worldwide.
- Reports revealed that less than 1% of total used clothes are recycled into new clothes and rest dumped in to landfill contributing to land pollution.
- Fashion is a resource intensive and polluting industry having huge environmental and social imprint throughout the entire lifecycle of garment production (Joy & Peña, 2017)

There are some criteria to analyse the sustainable approaches in fashion. These criteria are sustainable raw materials, sustainable design and patternmaking approaches, circular economy and utilization of waste textiles.

Sustainable fashion approaches towards Green Wardrobe:

Green Wardrobe is a concept of developing a wardrobe consciously to reduce the global carbon foot print caused due to pre-consumer and post-consumer textile waste. It is a transubstantiation towards responsible production and consumption of fashion. The major principles lie behind the concept of green wardrobe emphasises majorly on sustainable raw materials, circular economy, capsule wardrobe, zero waste pattern making methods and many more. After a comprehensive review of literature, the approaches to green wardrobe through sustainable fashion approaches are classified under following categories:

Sustainable Raw Materials: It includes fibers that are produced sustainably with no or less use of chemicals and fertilisers. The water consumption in production of these fibers is comparatively less than other synthetic and natural fibers. Virginija. D. in her study, reported that the use of organically grown cellulose fibers such as Cotton, Linen and Hemp have a reduced impact on environment as compared to fibers grown using fertilisers and pesticides (Daukantienė, 2023). The study also revealed that the biopolymers developed from modified Kombucha bacterial cellulose have properties similar to clothing fibers and became a valuable source of sustainable raw materials for fashion and fabric sectors. The consumption of virgin resources was remarkably reduced and replaced by utilising novel cellulose-based fibers, repurposed materials and recycled fibers. In their study, Konwar and Boruah stated that the biodegradable and non-carcinogenic properties of natural fibers reintroduced them into the world of fashion (Department of Textiles and Apparel Designing, College of Community Science, Assam Agricultural University, Jorhat, Assam, India & Konwar, 2018). They also highlighted the intrinsic properties of natural fibers such as mechanical strength, anti-bacterial and comfortability which makes it more attractive. They suggested a few sustainable and ecofriendly fibers such as Pineapple, Bamboo, Kenaf, Banana and Jute with their benefits. Pineapple fiber is an ecofriendly fiber as it is extracted from the leaves of pineapple, which is an agricultural residue. It is appropriate for textile fiber as it has desirable attributes such as outstanding cellulose content, indomitable tensile strength and filament fiber structure (Jose et al., 2019). Pineapple leaf fiber (PALF) is characterised by its length, lustre, softness, strength, spinnability and whiteness (Lalhruaitluangi & Mandal, 2024). Bamboo has the potential to minimise the percentage of CO_2 released in the environment and generates up to 35% more O_2 than any other plant species. As bamboo regrows from its own root system, it doesn't require replanting. It requires minimal

water for its growth and unlike cotton, it doesn't require pesticides and insecticides (Munjal & Kashyap, 2013). Bamboo textiles do not release microplastics during washing, unlike synthetic fabrics. Due to its versatility, it is an excellent substitute of cotton when it comes to prepare protective, healthcare and hygienic textiles. Other than pineapple and bamboo, Kenaf fiber is also a sustainable alternative to textile fibers due to its excellent carbon sequestration, low resource requirements, biodegradability and versatility to variety of textile application. Its durability and adaptability make it perfect for promoting long-lasting textiles (Saba et al., 2015). Viscose, modal, and lyocell are examples of regenerated cellulosic fibers that blend the benefits of natural and synthetic fibers and provide special qualities for use in textile and nonwoven applications. It is possible to produce them in a way that is both eco-friendly and pollution-free. The production line for viscose based on dissolution of cellulose, at Lenzing AG, Austria is inherently a pure method of producing regenerated fibers (Schuster et al., 2004). Chitin blended with viscose, gives a biodegradable, hypoallergenic and antibacterial fabric. It is extracted from the shells of crustaceans', which can be obtained as a residuals of food industry without directly harming the carbs and shell fish. Other sustainable sources of fiber include lotus flower, nettle plant and banana (www.fibre2fashion.com, n.d.).

Slow Fashion: It is well documented that fast fashion has enormous impact on environment as it emits substantial carbon footprint. Fast fashion is the perfect epitome of planned obsolescence with very short lifetime and tend to break after predetermined sets of wear. The goal of fast fashion is quantity over quality due to which it has significant environmental and social issues. To address this issue, concept of slow fashion was introduced in fashion. Slow fashion is a term used to represent sustainability, high quality, durability, low carbon footprint and low impact production (THE IMPACT OF SUSTINABILITY ON FASHION INDUSTRY | Journal Of Business Strategies, N.D.). It is an approach that focuses on quality rather than quantity as a means of achieving sustainability. Kate Fletcher, inspired by slow food movement on responsible food production and consumption, developed the concept of slow fashion which is known for its longevity, ecofriendly operations, responsible stewardship, fine craftsmanship and high-quality goods (Brewer, 2019). It focuses on high quality materials and longevity which reduces the frequency of replacement and waste. It is also reported that a mere nine months of extension of garment life can reduce 20-30% of water, waste and carbon footprints (Fashion and the Circular Economy, n.d.). Slow fashion model has less environmental impact as compared to fast fashion business model as it encourages consumers to buy and discard less clothing. It also promotes localism, thus have a tremendous potential to support local economy. In their study, Lenka Svajdova and Jana Mikolasova stated that recently, slow fashion has gained popularity as sustainable replacement to fast fashion as it reflects an interim progression in consumer behaviour and societal values. In their study, they demonstrated that how the consumers of Czech Republic are conscious about the impact of their clothing choices on environment. The inclination of consumers towards recycled clothing material reflects the growing interest towards sustainability (Švajdová & Mikolašova, 2023)

Circular Economy: Circular economy in fashion is a strategy that aims at waste minimization, encouraging sustainable and eco-friendly practices in production and extending the life cycle of fashion products. It is based on closed production and utilisation system where products are used for longer period of time. The key principles of circular fashion model are design for longevity, rental clothing, recycling and upcycling. According to the Ellen MacArthur Foundation, rental, resale, repair and repurpose are the key principles of circular economy that help fashion businesses to generate income without producing new apparels and thus enabling a sustainable work environment in fashion sector (Fashion and the Circular

Economy, n.d.). It also ensures reduction of waste generation in each and every step of garment production right from sourcing raw materials to the creation of end products. Circular economy can be defined as "an economic model wherein planning, resourcing, procurement, production and reprocessing are designed and managed, as both process and output, to maximize ecosystem functioning and human well-being" (Murray et al., 2017). It is an economic model which has its roots in indigenous beliefs to maximise resource utilisation and reduce waste generation. It varies from Linear economy that operates on the concept of "take-make-dispose" approach. In the Linear economy, resources are collected, transformed into products & used, then they are disposed as waste into landfill or water resources (What Is Circular Fashion?, n.d.). The main aim of circular economy is to make maximum use of resources, thus extracting its highest value while in use and then recycling the products at the end of their shelf life. Consumers can also reduce their fabric consumption by selecting well-crafted and long-lasting apparels, and furnish more sustainable and eco-friendly fashion industry.

Recycling and Upcycling:

Recycling is the process of using re-processed raw materials to create new products. According to EU Science Hub, recycling can be defined as "any recovery operations by which waste materials are reprocessed into products, materials or substances whether for the original or other purposes." (Definition of Recycling - European Commission, n.d.). It saves resources as well as energy as compared to the production of new materials. There are two ways of recycling textile waste: Mechanical and chemical. Recycling increases the life of material and decreases the waste disposal cost. Thus reducing the landfill pollution in a more sustainable way. (Käitluses, n.d.). An effective way to address garment waste and fashion supply chain issue is garment to garment recycling. The high environmental repercussions caused due to water intensive farming and resource intensive fibers like cotton and synthetics can be reduced by recycling. It shrinks the need of virgin raw materials, thus limits the production of greenhouse gases. Approximately 20 tons of CO_2 emissions can be circumvented depending upon the type of material and process involved for every ton of recycled textile. Upcycling is a process of ingeniously using the discarded apparels into new useful products or adding value to the products by refurbishing. It is an innovative and necessary process to meet the increasing demands. It is even greener way of reducing carbon footprint than recycling. In their study, M.D. Teli and his team had prepared a few samples of upcycling and used multiple process for refurbishing the old garments. The process involved were dyeing, printing, enzyme wash and stitching. The upcycled apparels were then evaluated for efficiency and effectiveness in terms of its performance in addition to its aesthetic attractiveness and acceptability. Results showed that by upcycling, a sustainable fashion can be fostered by significantly reducing the environmental impact of clothing lifecycle.(Teli et al., 2015). Examples of upcycling includes converting old denim into jackets or handbag, repurposing a saree in to kurta or frock, redesigning and embellishing obsolete outfits into trendy one.

Zero Waste Fashion Design: Timo Rissanen is a renowned personality in the field of sustainable fashion. His work "The Fashion System through the Lens of Zero Waste Fashion Design" is a benchmark and offers a transformative frame of reference on addressing the environmental challenges caused by traditional fashion system. Zero waste fashion focusses on supressing the textile waste produced during the cutting process popularly known as cutting floor waste or pre-consumption waste (Nursari & Djamal, 2019). It is a practical and experimental method that is capable of creating aesthetics pairing with ethics. It is a compelling example of merging sustainable pattern making method with the skill and aesthetics of

fashion. Pattern cutting in zero waste fashion design is a process in which design ideas are generated on trial and error basis (Rissanen & McQuillan, 2023). In their research project exploring the dimensions of "User Modifiable Zero Waste Fashion", McQuillan, Martin, Menzies, Bailey, Kane and Derwin, addresses the use of textile prints and parametric matrix as the cognitive process involved in converting 2-dimensional fabric to 3-D garment (McQuillan et al., 2018).

Digital Design Tools: With the association between sustainability and technology advancement, fashion industry is transforming rapidly, driving it towards more efficient, eco-friendly and socially responsible methods. Digital design tools facilitate fashion and textile designers to create virtual protypes and assist in simulating various material types, designs and patterns. This enables to test a number of iterations, optimize designs for efficiency and limits material waste. The indispensable necessity of physical samples for design, purchasing and selling process in garment manufacturing industry has been replaced by virtual sampling using 3D technology. Earlier for realistic depiction of products, the designers and retail buying teams require more than 20 samples before production, but with the advancement of 3D technology, it is possible to take digital full line review by virtual sampling, thus reducing the waste generation during designing and product development stage. (Christou, 2021). Innovative production techniques like digital pigment printing, 3D printing in textiles and digital weaving and knitting help in reducing material waste, chemical usage, water and energy consumption. With augmented reality app, now consumer can make their choices from the comfort of their home and analyse the fit and look of the garment before purchasing them. The presence of artificial intelligence in textile industry has facilitated the textile companies in increasing production and streamlining the manufacturing process. It not only increases the production but also reduces the overall operating expenses and manufacturing error which in turn minimize the discard ratio of mal-manufactured apparels. Some other clothing technologies for sustainable fashion comprises of laser system for textile defects, laser application for positioning, cutting and engraving, adhesive bonding,

Sustainable denim: Denim is acknowledged for its worn-out effect all over the world. It is manufactured by blending cotton with elastomeric fiber but it has great environmental impact. The conventional method of distressing denim involves sand blasting, stone washing and chemical usage which has hazardous impact on environment. Discharge of toxic chemicals in to water bodies contaminates it and have harmful effects on local communities and aquatic animals and plants. Workers involved in sandblasting process of distressed denim were reported to suffer from silicosis, a life-threatening lung disease. It is also a resource intensive process as it requires a large amount of water during the process. Laser technology is a substitute of resource intensive sand blasting process of creating distressed denim. The distressed finish of denim can be created ethically by laser finish without polluting the environment and emitting the greenhouse gases. It is a quick process and water free technology. In this process the highlighted part of denim is subjected to intensive heating that results in phase change and burns the surface of the fabric creating an amazing distressed look.

Capsule Wardrobe: A smart and conscious approach to achieve green wardrobe is to make maximum use of available closet, responsible selection of high-quality outfits and embracing minimalist fashion. Capsule wardrobe often referred as Minimalist wardrobe, is an effective means to attain green wardrobe as it aligns with sustainability by fostering aware buying, receding textile waste and making ethical fashion choices. A conscious consumption of clothing by preferring quality over quantity and mindful paring of available closet in an innovative way to furnish a trending look not only reflects the wearers' personal style efficacy, efficient wardrobe organisation but also contributes to financial savings. Capsule wardrobe

can be achieved by possessing most of the wardrobe essentials in neutral colours and buying classic timeless, versatile and functional outfits (Martin-Woodhead, 2023). Versatility in clothing choices help in refurbishing chic pairs of clothing articles. Prioritising green initiative of minimalist wardrobe may annihilate the cheap, non-biodegradable polymer plastic clothing to end up in landfill. This in turn minimises the emission of greenhouse gases. This concept is based on the principle of circular fashion and slow fashion, making it crucial towards attaining green and ethical fashion.

Conclusion:

The sustainable textile innovation has the potential to alleviate the emission of carbon footprints of textile industry. Recyclable materials, sustainable natural dyes, eco-friendly pattern making methods like zero waste cutting, digital design tools, circular economy, capsule wardrobe and advanced sustainable technologies are some approaches of reducing the emission of greenhouse gases, landfill pollution and carbon footprints. It is suggested that whenever it is possible, go for low-impact materials like sustainably produced and recycled materials that use few or no natural resources such as energy and water in their transportation and processing, and whose use does not contribute to the destruction of biodiversity. A long-term view on quality that encompass an investment in longer and better functioning products reduce the need to change a product due to aesthetic factors. Products should be designed in a way that they can be reused, recyclable or compostable. Laser technology in textiles has also contributed in reducing the emission of greenhouse gases and contamination of water bodies. Embracing minimalistic approach in fashion choices have long term environmental benefits, creating a community where fashion is not only stylish but also sustainable.

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