



# Sustainability, Recyclability and Smartability in Textile Development

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## Abstract

The fashion and textile industries evolved over the years, adjusting to societal needs and preferences. Research has been assisting tremendously by finding solutions to the challenges faced by the textile industry the last years. Among these challenges is the increase in production of textiles and clothing because of population growth enhanced by publicity in social media on one hand and the desire to have better quality and environmentally friendly clothing on the other hand. These two factors were triggered for an explosion in changing the raw materials and developing advanced type of knitting of the textiles able to create a better look at a high quality and lower cost. The purpose of this paper is to review the latest trends in the textile and fashion industry with emphasize on the historic role of the natural fibers in society and how the advanced technologies enable inspirational concepts in designing new sustainable, recyclable, and smart textiles.

## Role of Natural Fibers in Textile Evolution

Natural fibers have traditionally been used in all cultures of the world to manufacture clothing, storage, building materials, and for items of daily use such as ropes and fishing nets. People in old times used various kinds of natural fibers depending on their local availability. One example are the bricks of the Egyptian Pyramids which used for the first time a combination of two distinct materials for achieving higher mechanical properties – nowadays called composites. Another example is wild flax fibers, which are 30,000 years old, as Eliso Kvavadze et al. note in their Science paper [1]. Later, mathematics and agriculture evolved leading to an intensification of flax production which was found in Mesopotamia (a site of Neolithic Revolution around 10,000 BC). As Joy McCorriston's [2] mention, flax plants were planted in Mesopotamia for food and clothes. The intelligence of human being figured out manufacturing tools for processing plant fibers. For example, molds made of ceramics shown that in 7,000 BC were used woven using complex techniques of manufacturing. This fiber revolution played an important role in increasing the wealthiness of some regions, which were rich in agriculture. Moreover, access to such resources lead to. This important evolution brought disparities in the society through alienation of women in a labor-intensive domain of agriculture. The main workforces in textile factories were made up of female, juveniles, prisoners of war and enslaved wives and children of debtors. Thus, plant transformation in goods for society advanced the knowledge in agriculture, crops

and products but generated polarization and further richness base segregation of the society. Nowadays, contextual factors such as the need for reducing the carbon footprint and the awareness of the discrepancies created by advancing technologies only in privileged areas of the world, open new opportunities to recover their negative impact by advancing the use of technologies in stimulating natural – based materials (Figure 1).



**Figure 1:** Plant-based textiles could save the Earth through reducing the carbon footprint. Graphic created by Jessica Sommerville.

## Trends in Textile Development: Sustainability and Smartability

Today, digitized and smart technologies combined with advanced understanding of natural fibers contributes to create new attributes of the natural-based textiles through designing sustainability, predicting their recyclability and providing more societal acceptance through developing smartability – the capacity of a material to react to different stimuli either is temperature, electricity of mechanical loadings.

Sustainability is one of the main trends in industries worldwide focused on advancing natural resources for being used in various applications. The most influential fashion houses are now focusing on natural fibers. Fruits, vegetables, lignin, and other organic materials are being used as natural fiber resources to produce textiles which are lighter, low cost, and do not require extensive chemical processing [3]. Sustainable materials in the textile industry have not only positively impacted the fashion industry, but the environment as well. This helps reduce carbon dioxide emissions, promising a greener and safer environment for the future generations to live in [4]. Thus, obtaining sustainability through advancing technologies for cost efficiently transformation of plant-based materials in haute couture products is the next priority in textile industry. Moreover, advancing the technologies in multi- and inter-disciplinary fields such as electro-conductor, chemistry and mechanics allows adding smart attributes to plant-based materials such as changing the color, sensing, thermoregulation etc. The authors name this group of attributes as a trend in smartability and societal acceptance.

Another trend that is becoming increasingly popular is textile recyclability. A large portion of the garment industry is using recycled materials in their base production. The recycled textiles are not limited to used textiles, they can be produced by other materials as well such as bio-polymer bottles. It is interesting to see how these processes take place and how it is possible to produce brand new clothes. In the beginning, most of consumers did not like the idea of buying clothes that have been used before and recycled afterwards and because of that, companies started thinking of ways to raise the appeal towards recycled materials. They decided to offer discounts, advertise the positive impact of using clothes made recycled materials or collaborating with influencers to attract people to buy them [5]. Recycling has been key for most of clothing companies as it can reduce production costs and therefore, they can use that surplus to create new designs and clothes. It has also helped with reducing waste which ultimately, contributes to the efforts made towards lean manufacturing and sustainability. Social media has a determining factor on these choices as brands, designs, textiles, shapes of clothes. Most people care about their looks and the clothes that they will wear. Social media has a determining factor

on these choices as brands, designs, textiles, shapes of clothes. The new generation of textile is promoting more eco-friendly resources. It tries to show that it is a better version of textile that can be more beneficial for the communities than before.

With innovations concerning textiles becoming more commonplace, there has also been a push towards innovative fabric structures and products, testing and materials analysis, and textile manufacturing. Testing and material analysis has been a focus in most of the fashion industries as they aim to better understand the properties of all-natural materials and their most appropriate use. For example, it is important to know which material is better fit for clothing, bag, jewelry or shoes. Regarding textile manufacturing, we have seen that 3D printing is starting to become the latest sustainable production trend in fashion [6]. 3D printing is a great option for manufacturing designs that are intricate and hard to produce as it keeps production costs down and allows for rapid prototyping. New technological methods of manufacturing have improved the quality of the textile as well as the designs of the clothes which we can now see on fashion catwalks.

## Conclusions

It is inspiring to see how many new methods and processes have been developed to improve textiles and their designs these past few years. Science and research have come together and are behind these new discoveries, creating low-cost, sustainable textiles as well as looking for the new generation of textiles. Lastly, additive manufacturing is helping and innovating the design and manufacturing process as well, giving the opportunity to designers to depict their vision on their clothes. Fashion and textiles are truly great industries where technology and art can come together.

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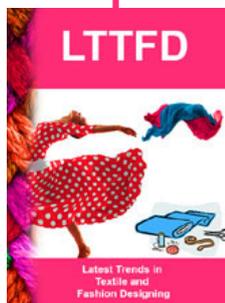


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