Module 2

Sustainable Materials

Sustainable Fashion Design

Module 2: Sustainable Materials

- **2.1** Materials and Sustainability
- **2.2** Sustainable Fibers & Fabrics
- **2.3** Organic Fibers
- **2.4** Alternative Materials

2023-1-CY01-KA220-HED-000160668

Co-funded by the European Union

Frederick University

FUTU RES DESIGN ED/

2.1 Materials and Sustainability

- Materials play an major role in our current understanding of the ways in which fashion and textiles can contribute towards sustainability. Materials are in fact the starting point for change and a valuable commodity for farmers, designers, manufacturing industries, consumers and recyclers.

- Materials have been the focal point to recent waves of interest in sustainability issues in fashion and textiles.

- Materials seem to dominate our ideas about the environment and social responsibility. This is not surprising as the fashion and textile industry is all about the fiber, the fabric, the textile product and the final garment.

- When designers are making decisions for materials they must consider the fiber, fabric and the final textile garment.

- They must also consider all sustainability issues associated with textiles. This includes resource consumption, energy use, pollution potential and social impact of textile fibers.

- The knowledge and understanding of how fiber production effects our ecosystem will help in designing textile products that are sustainable.

Required Reading: NRDC: *Fixing the Fashion Industry*

Diversity of Materials

- The fashion and textile industry are dominated by a large number of similar, ready-made products in a limited range of fibers.

- In 2024, Global Textile Production by Fiber Type stated that:

  - Polyester is the most widely produced textile fiber globally, with an annual production of 63 million metric tons.
  - Cotton ranks second in global textile fiber production, with 24 million metric tons produced annually. (World Stats 2024)

- The dominance of two fibers in material choices leads to concentrated impacts in specific agricultural or manufacturing sectors, this heightens ecological risks and reduces the sector's resilience to changing global conditions, and limits consumer options.

- Developing a sustainability-focused strategy that promotes material diversity doesn't imply zero pollution. Instead, it encourages the growth of more alternatives and the use of resource-efficient, culturally responsive fibers.

- This includes the use of organic cotton as well as renewable and biodegradable fibers such as wool.

- This will reduce our dependency on petrochemicals including oil, as well as the use of pesticides and vast amounts of water usage.

2.1 Sustainable Fibers

- Synthetic fibers have always been associated to chemicals and pollution while natural fibers have always been seen as the better fiber for our environment. This in fact is not so.

- The cultivation and processing of natural fibers have also had a substantial impact on our environment.

- Sustainable materials in the fashion industry are those that minimize negative environmental and social impacts during production, use, and disposal.

- These materials often require fewer resources, such as water and energy, and are typically biodegradable, recyclable, or renewable.

Natural and Organic Fibers

These materials are derived from plants or animals and are often more eco-friendly when produced organically, without synthetic chemicals.

ORGANIC COTTON

TENCEL

LINEN

HEMP

BAMBOO

Recycled Fibers

Materials created from waste products, reducing the need for virgin materials and lowering overall resource consumption.

Photo by Brian Yurasits on Unsplash

Recycled Nylon: Often sourced from discarded fishing nets, fabric scraps, and industrial plastic waste.

Recycled Wool: Made by repurposing old wool garments or wool scraps,.

Recycled Polyester (rPET): Fibers made from recycled plastic bottles or old polyester garments.

Recycled Cotton: Made from post consumer cotton waste or scraps from production,

Animal-Derived Sustainable Fibers

Animal-derived fibers with the focus being placed on the welfare of the animal and a production process which has minimal impact on the environment.

- **Responsible Wool (RWS-certified)** is wool from sheep that has been raised in ethical conditions. A focus has also been placed on sustainable land management. Wool is durable, biodegradable, and renewable.

- **Peace Silk** also known as **Ahimsa Silk** allows the moth to naturally emerge from its cocoon without harming the silkworm.

- **Responsible Leather** is leather which has been processed using less water and fewer chemicals, as well as ensuring ethical animal treatment (e.g., Leather Working Group certified leather).

Innovative Sustainable Materials

Innovative materials that have been designed to address the fashion industry's environmental challenges through innovative science and technology.

Orange Fiber
Made from citrus juice by-products

Piñatex®
An alternative to leather made from pineapple leaf fibers.

Algae-Based Fabrics
Made from Algae and Seaweed often blended with natural fibers

Apple Leather
Made from apple waste including peels and cores.

Mycelium Leather
Lab-grown leather made from mushrooms.

Required Reading: *Harnessing the power of the ocean to create materials.*

Low Impact Synthetic Materials

- **Bio-based Polyesters** are made from renewable biological sources like sugarcane or corn rather than using fossil fuels. They are not biodegradable but bio-based and reduce reliance on petroleum.

- **Closed-loop Rayon** such as **Modal** and **Lyocell** are semi-synthetic fibers made from wood pulp using a closed-loop process that recovers and reuses water and chemicals hence making them more eco-friendly than traditional rayon.

Challenges of Sustainable Materials

- Sustainable materials are often more expensive as it **costs** more to produce, making them less accessible to consumers.
- Some eco-friendly materials, especially next-gen innovations, are not available in large **scale**, in order to make a significant impact on mainstream fashion.
- Some sustainable fabrics, particularly recycled ones, can be **less durable** affecting their longevity.
- Brands are not always **transparent** making it more difficult for consumers to verify whether a material is truly sustainable, leading to issues like greenwashing.

Certifications for Sustainable Materials

To avoid greenwashing, many brands and consumers rely on certifications such as:

- **Global Organic Textile Standard (GOTS)** for organic fibers.
- **OEKO-TEX Standard 100** for fabrics tested for harmful substances.
- **Fair Trade Certified** for ensuring fair wages and working conditions.
- **Cradle to Cradle Certified™** for circular production practices.
- **Forest Stewardship Council (FSC)** for responsibly sourced wood-based fabrics.

Required Reading: *What Does GOT Stand For?*

2.3 Organic Fibers

- Organic Fibers can be **plant-based** such as cotton, linen and hemp, or **animal based** like wool, silk and cashmere.

- These organic fibers are derived from organic agriculture. They restore and regenerate the soils while protecting the health of the wider community.

- Organic fibers are grown on farms where strict guidelines are placed, and prohibit the use of pesticides, herbicides, and synthetic fertilizers, as it has been proven to have harmful effects on the human health as well as all the natural environment (GOTS, 2024)

- The **Global Organic Textile Standards** prohibits the use of Genetically Modified Organisms. Organic fibers must derive from an agricultural system that promotes biodiversity and supports ecosystem functions. (GOTS,2024)

Organic Cotton

ORGANIC COTTON	PRACTICES
FARMING PRACTICES	• Use of non synthetic pesticides and fertilizers. • No GMO seeds • Follows recommendations set by GOTS • Use crop rotation, to preserve soil health
ENVIRONMENTAL IMPACT	• No synthetic chemicals means less water pollution. • Produces fewer greenhouse gases • The use of no harmful chemicals allows beneficial insects, birds, and microorganisms to thrive.
HEALTH SOCIAL BENEFITS	• Farmers are not exposed to toxic chemicals, improving their overall health. • Fair Trade Organic Cotton, ensure that workers receive a living wage and work in safe conditions. • Organic garments are safer for people with sensitive skin and allergies.

Uses of Organic Cotton

Organic cotton is used in a wide range of products, including:

- Clothing (t-shirts, jeans, dresses, underwear)
- Baby products (blankets, diapers, baby clothing)
- Bedding (sheets, pillowcases)
- Towels
- Personal care items (cotton pads, swabs)

Photo by Clayton Malquist on Unsplash

Organic Wool

- Organic wool comes from sheep that has been treated responsibly, and has been fed organically grown feed, from a farm that has not been treated with harmful pesticides.

- In 2016 the Responsible Wool Standards (RWS) introduced a voluntary global standard that addresses the welfare of sheep and the land they graze on. (Blum,P:2021)

- Their purpose is to ensure that organic wool comes from farms which have managed their land according to standards set by the RWS, and the sheep have been treated responsibly.

Photo by Oksana Maselko on Unsplash

ORGANIC WOOL	PRACTICES
FARMING & PRODUCTION	• Organic wool comes from sheep that graze on organic land, where synthetic fertilizers, pesticides, and herbicides are not used. • Organic farming means no synthetic chemicals are used on the sheep. • Emphasizes high animal welfare standards • Natural breeding methods are used with no hormones to induce reproduction or speed up growth allowed.
ENVIRONMENTAL IMPACT	• Farmers often use organic compost, natural fertilizers, and crop rotation practices to maintain soil fertility. • No risk of water contamination, organic practices help maintain clean water sources in farming communities.
ANIMAL WELFARE & ETHICAL STANDARDS	• Organic wool standards require that sheep live in natural stress free conditions. • Mulesing is prohibited. This involves removing parts of the skin to prevent flystrike. • Humane shearing practices are essential.

Uses of Organic Wool

Photo by Jørgen Håland on Unsplash

Organic wool is used in high end products and were sensitive skin is a concern.

- In apparel such as jackets, sweaters and accessories.
- Children’s clothing and accessories.
- In bedding including mattresses, pillows and quilts.
- In interior décor, rugs, upholstery and cushions.

2.4 Alternative Materials

- Traditional fibers and their production process, have had an enormous impact on our environment. The excess use of energy, water and chemicals is what has lead us to the need of alternative fibers and fabrics. Fibers which can reduce the need for virgin resources and minimize waste.

- New alternative fibers made from leaves, by-products and food waste have been developed and used for fashion apparel and accessories. The use of waste products contributes to a more circular economy.

- The production process of these fibers generally use less water, less energy and less chemicals.

LEAF LEATHER

Leaf Leather is a bio-based leather alternative which uses teak leaves. It is strong, flexible and water-repellant which features the natural design of leaves

The making process:

- Fallen leaves are collected from the ground hence no damage is made to the tree.
- The leaves are soaked in water, dyed and laid flat together to dry. This helps bond the leaves together so larger sheets of material are made.
- Cotton is stitched as a backing in order to give strength and structure.
- BOPP film is applied to make material waterproof and durable.
- Leaf leather is used for making bags and wallets.

MUSHROOM LEATHER

Mushroom leather is an eco-friendly alternative to leather. It has been designed to be carbon neutral with minimal environmental impact. It is soft and supple yet strong and durable making it suitable for the making of garments, accessories and upholsteries. **Bolt Threads** being the primary developer.

The making process:

- Made from mycelium cells. The cells connect together to form a root-like structure made from fuzzy treads.
- The material is extracted upon maturity, it is then tanned and dyed which then it is transformed in to a leather like material.

Please refer to required Video :
Stella McCartney And Bolt Threads: The World's First Mylo™ Vegan Mushroom Leather

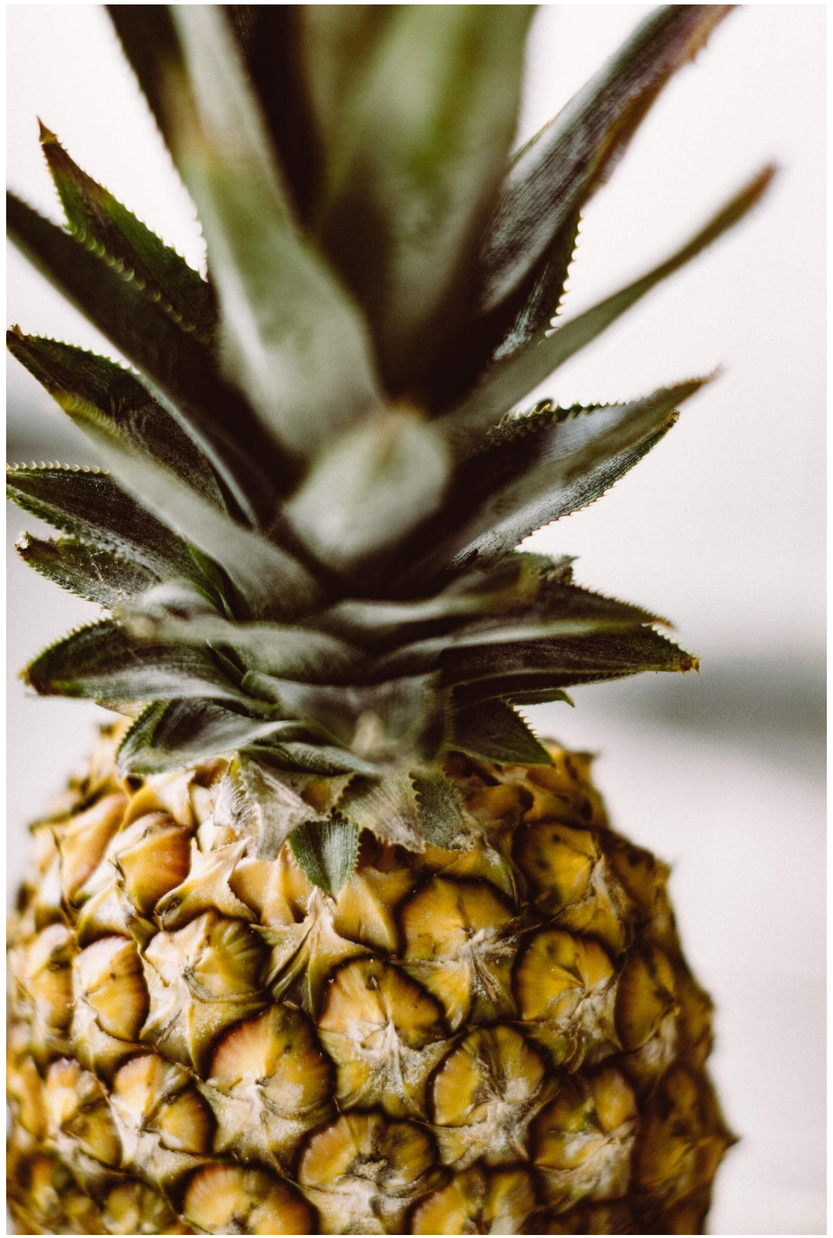

Photo by Bruno Nascimento on Unsplash

PINEAPPLE LEATHER

Pineapple leather is a vegan leather made from the pineapple plant leaves which are considered as agricultural waste. It has been invented by Dr. Carmen Hijosa. The rights of Pinatex are owned by her company Ananas Anam.

Piñatex can be used for fashion, accessories & upholstery

- For further required reading visit: '*Ananas Anam: the pioneers of innovative natural textiles from waste pineapple leaves.'*

BANANATEX

Bananatex is a durable, biodegradable fiber made from the Abaca banana plant. It is renewable and sustainable as there are no chemicals used in the making process and very little waste. Being biodegradable, products can be composted at the end of their lifecycle.

Refer to required reading: *Bananatex® A Textile Revolution*

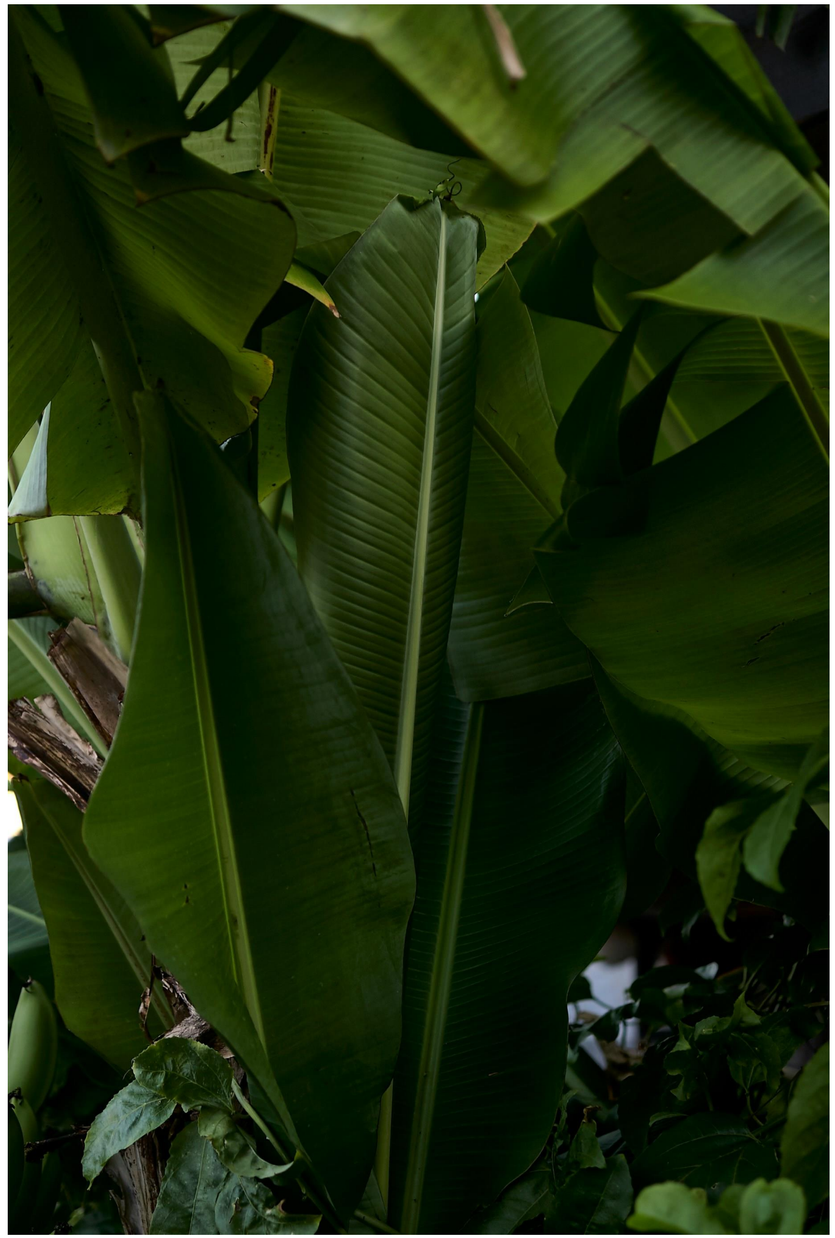

Photo by Tevei Renvoyé on Unsplash

Reference List

- Ananas Anam (2017) Ananas Anam: *The pioneers of Innovative Natural Textiles from Waste Pineapple Leaves.* Available at: www.ananas-anam.com/about-us/
- Bossi, A. (2024) Fashionista: The Most Exciting Advancements in Fabric Innovation Right Now. Available at: www.fashionista.com/2024/04/fashion-material-fabric-innovation-bio-based-alternatives
- Gadey, K. (2024) Fibers 2 Fashion: *Textile Fibers of the Future: Sustainable Innovations in Fashion.* Available at: www.fibre2fashion.com/industry-article/10121/textile-fibres-of-the-future-sustainable-innovations-in-fashion
- Murray, S. (2016) NRDC: *Fixing the Fashion Industry*. Available at: www.nrdc.org/stories/fixing-fashion-industry
- Textile Sustainability Hub (2023) *Decarbonizing the Textile and Apparel Industry*. Available at: www.textilesustainability.com
- QWSTION International GmbH (2024) *Bananatex®: A Textile Revolution.* Available at: www.bananatex.info
- Worldstats. (2024). *Global Textile Production By Fiber Type.* Available at: www.worldostats.com/global-textile-production-by-fiber-type-2024/

Reference List

- Saha, N. (2023) *18 Most Innovative Fabrics in Sustainable Fashion.* Available at: www.yoursustainableguide.com/most-innovative-fabrics-in-sustainable-fashion/#:~:text=These%2018%20most%20innovative%20fabrics%20in

- Keellabs (2024) *Harnessing the power of the ocean to create materials.* Available at: www.keellabs.com

Books

- Blum, P. (2021) *Circular Fashion: Making the Fashion Industry Sustainable.* UK: Laurence King Publishing

- Fletcher, K. (2014) *Sustainable Fashion and Textiles: Design Journeys*. 2nd edition. NY: Routledge