Unit 3.3 Environmental impact of sourcing fibres worldwide

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3.3.1 Environmental Impact of sourcing fibres worldwide.

Environmental Impact (**EI**) Fibres introduction

- As we saw on the last module nº2, the sector has one of the highest **EI** globally, mainly due to its high carbon and water footprint.
- Also, textile sector is one of the sectors that generates the highest amount of greenhouse gases per unit of material produced.
- One tone of textiles generates 17 tones of CO_2 equivalent.[1]
- This unit will be more specific on how different fibres cause environmental impact.

Different Fibres

- Natural Fibres:


Cotton


Wool


Cellulosic without cotton

- Man-Made Fibres:


Polyester


Polyamide

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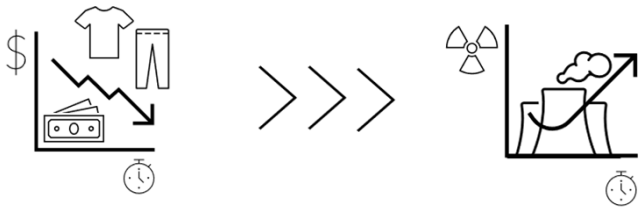
3.3.1 Environmental impact of sourcing fibres worldwide.

Key points on the environmental fibres impact

- Increases in **EI,** and the growing awareness of these impacts, can be related to substantial rise in clothing consumption and the underlying textile production.
- The supply chain of the textile and fashion industry is long and complex, including agricultural activities, petrochemical production of fibres, manufacturing, logistics, and retail.
- Each production step has an **EI,** related to water, material, chemical and energy use.
- Between 1996 and 2012 the price of clothing has increased only 3%, whereas general consumer prices rose by about 60%.
- In the consumption basket of EU consumers, the contribution of clothing fell by 36%.[2]



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3.3.2 Environmental impact of natural fibres.

- The production of raw materials, especially **natural fibres**, **have a larger impact on the environment than man-made fibres**.
- Most of the fashion industry's global **water use is associated with cotton cultivation, bleaching, dyeing, printing and finishing processes**.
- In general, the production of **natural fibres tends to use less energy than synthetics**.[3]

- Point 3.3.2 highlights the most used natural fibres in the textile sector and, consequently, their **EI**. They are classified into two main groups:
- Natural plant fibres:

Cotton

Cellulosic fibres (without cotton)

- Animal fibres:

Wool

Silk

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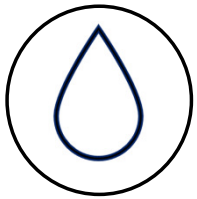
3.3.2 Environmental impact of natural fibres

Natural plant fibres:

Cotton Fibres

- More than 43% of all fibres used for clothing in the EU market are cotton fibres.
- Cotton production has a huge **EI** as it requires huge quantities of land, water, fertilisers and pesticides.[2]
- Natural fibre production is responsible for about 3% of the world's irrigation water use, 95% of which is associated with cotton production.[1]

- In order to obtain 1 kg of cotton fibre, the traditional cultivation requires[4]:



1559
Freshwater consumption
(l per kg)

2,2
CO_2 emissions
(kg per kg fibre)

48
Energy consumption
(kWh per kg fibre)

Pesticide, fertilizers and other chemicals

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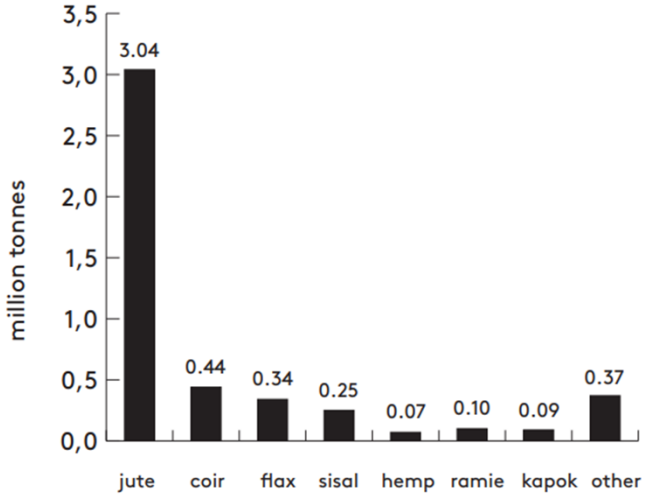
3.3.2 Environmental impact of natural fibres

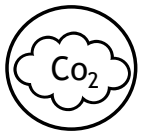
Cellulosic fibres (without cotton)

- Annual production volume of natural fibres other than cotton[5]:



- In order to obtain 1 kg of cellulosic fibre, the traditional cultivation requires[4]:

92
Freshwater consumption
(l per kg)



3,3
CO_2 emissions
(kg per kg fibre)

92
Energy consumption
(kWh per kg fibre)

Pesticide, fertilizers and other chemical

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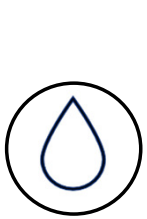
3.3.2 Environmental impact of natural fibres

Animal fibres:

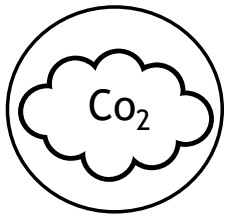
Wool fibres

- Wool requires scouring that causes an effluent with a high suspended solids content and a high pollution index.
- Overgrazing does not allow enough time for vegetation to regrow and can cause the soil to weaken, making it vulnerable to erosion and desertification.
- Sheep also release methane, a gas that is 25 times worse for global warming than CO_2.[6]

- In order to obtain 1 kg of wool fibres, it is required[4]:



530
Freshwater consumption
(l per kg)



17
CO_2 emissions
(kg per kg fibre)

120
Energy consumption
(kWh per kg fibre)

Pesticide, fertilizers and other chemical less than cotton fibres.

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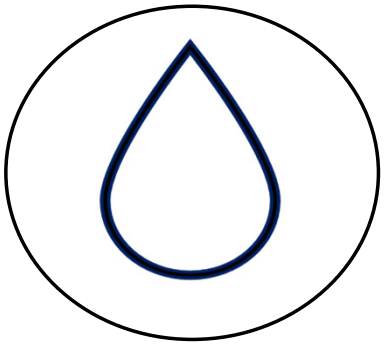
3.3.2 Environmental impact of natural fibres

Animal fibres:

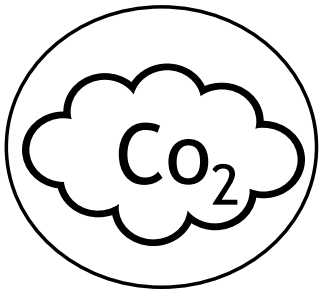
Silk Fibres

- The EI of silk can be attributed to inefficiencies in agricultural infrastructure, specifically electricity supply and irrigation.
- Climate conditioning for the rearing of the silkworms increases energy consumption.
- The wastewater is usually discharged to ground water acting as a low-level pollutant.
- Silk fibres are a much higher value textile material than other natural fibres, with very different mechanical properties.[7]

- In order to obtain 1 kg of silk fibre, it is required[7]:



54000
Freshwater consumption
(l per kg)



80,9
CO_2 emissions
(kg per kg fibre)

516
Energy consumption
(kWh per kg fibre)

Pesticide, fertilizers and other chemical less than cotton fibres.

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3.3.3 Environmental impact of man-made fibres

Man-made fibres

- Polyester makes up 82% of man-made fibres and dominates the textile market, followed by polyamide (nylon), polypropylene and acrylics.[5]
- EI concerns are the contamination of groundwater and process emission with high amounts of heavy metals, manganese salts, sodium bromide, antimony oxide and titanium dioxide.
- In general, the water consumption is much lower than natural fibres, while energy consumption is much higher.[7]

- The point 3.3.3 highlights the most used man-made fibres in the textile sector and their **EI**. Here the two principle man-made fibres are investigated further, namely:

Polyester

Polyamide

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3.3.3 Environmental impact of man-made fibres

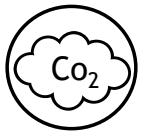
Man-Made fibres:

Polyester Fibres

- Polyester is the most widely used fibre in the world, mainly in clothing production.
- Polyester is a synthetic fibre derived from petroleum, a non-renewable fossil fuel. Crude oil conversion into petrochemicals releases hazardous toxins into the atmosphere that impact on humans as well as the environment.
- It is not bio-degradable and will persist in the eco-system even when it eventually breaks apart.[2]

- In order to obtain 1 kg of polyester, it is required[4]:

21
Freshwater consumption
(l per kg)



3,3
CO_2 emissions
(kg per kg fibre)

108
Energy consumption
(kWh per kg fibre)

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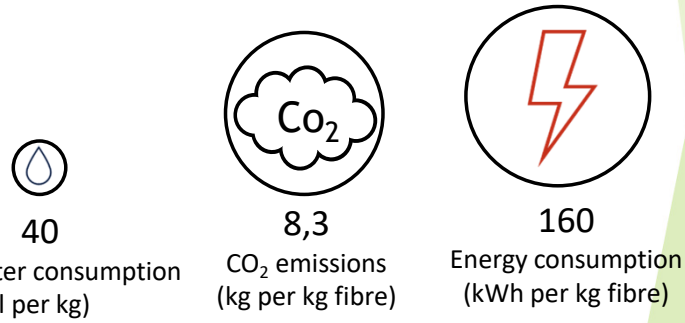
3.3.3 Environmental impact of man-made fibres

Polyamide Fibres

- Polyamide fibres are also known under the brand name Nylon.
- The production of polyamide fibre emits nitric oxide, which is 300 times more potent as a greenhouse gas than CO_2 and 15 times more than methane.
- Polyamide fibres are not biodegradable or compostable. They increases our consumption of and dependency on fossil fuels.[2]

- In order to obtain 1 kg of polyamide fibre, it is required[4]:



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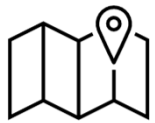
3.3.4 Methodologies & tools to measure the EI

Key Points to consider for the environmental impact assessment (LCA) of textile fibres[8]



- The production of raw materials is responsible for a large share of the environmental impact of the textile sector.
- Beyond the type of fibre, the method of fibre production is also of great importance.
- The energy source used throughout the production chain also influences the environmental impact.
- The country of fibre production is important for determining the EI.

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3.3.4 Methodologies & tools to measure the EI

Life Cycle Assessment (**LCA**) Methodology

- As shown in module 2, LCA is a useful methodology to determine the EI of textile fibres.
- As could be seen, cotton is one of the most used fibres in the textile sector, so it will subsequently be described what steps are necessary to determine its impact on the whole value chain.

- The stages of cotton production[9]:

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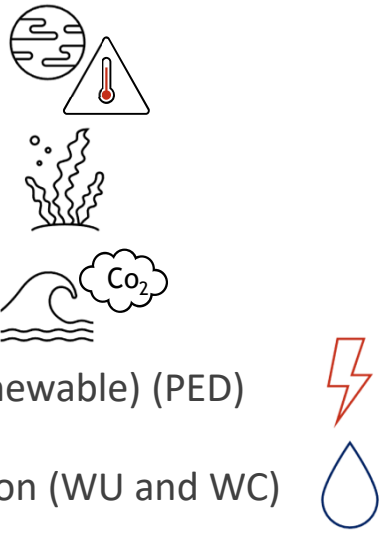
3.3.4 Methodologies & tools to measure the EI

Comparative LCA

- To understand the uses and advantages of the LCA methodology, this unit shows a comparative LCA between conventional and organic cotton.
- First it is important to define the impact categories that will be measured. In this case, the focus will be on[10]:
  - Global Warming Potential (GWP)
  - Eutrophication Potential (EP)
  - Acidification Potential (AP)
  - Primary Energy Demand (non-renewable) (PED)
  - Water Use and Water Consumption (WU and WC)



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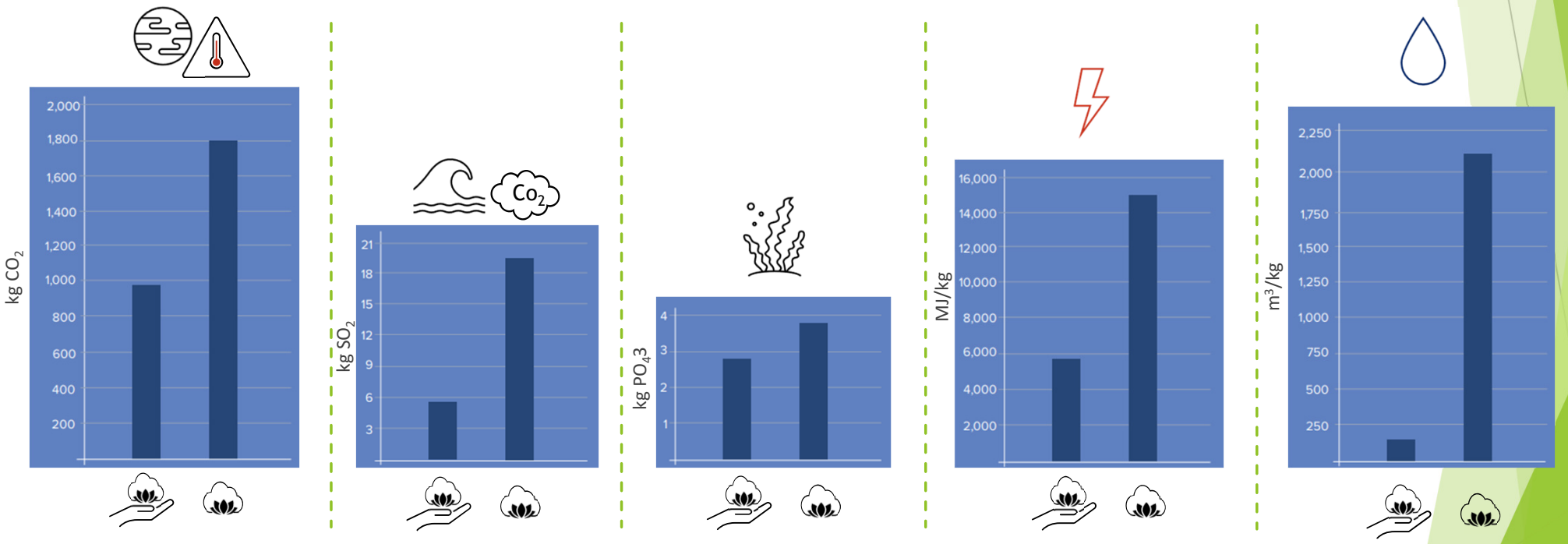
3.3.4 Methodologies & Tools to measure the EI.

- Comparative LCA between conventional and organic cotton[11]:



[Impacts per 1,000 kg of cotton fibre produced]

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