ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

Design Project - SIE 2014

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CYCLeco Analyse du Cycle de Vie

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The goal of this study was to compare the environmental impact of the T-shirt production from standard, organic and recycled cotton yarn with the help of life cycle assessment. For this purpose two new life cycle inventories for organic and recycled cotton have been set up.

Life Cycle Assessment of a Cotton T-shirt

System Overview

Conventional Cotton

vs.

Recycled Cotton

Textile collection data was taken from the UK and Switzerland. The unit function is 1kg of recycled yarn (20% recycled cotton and 80% conventional cotton).

Organic Cotton

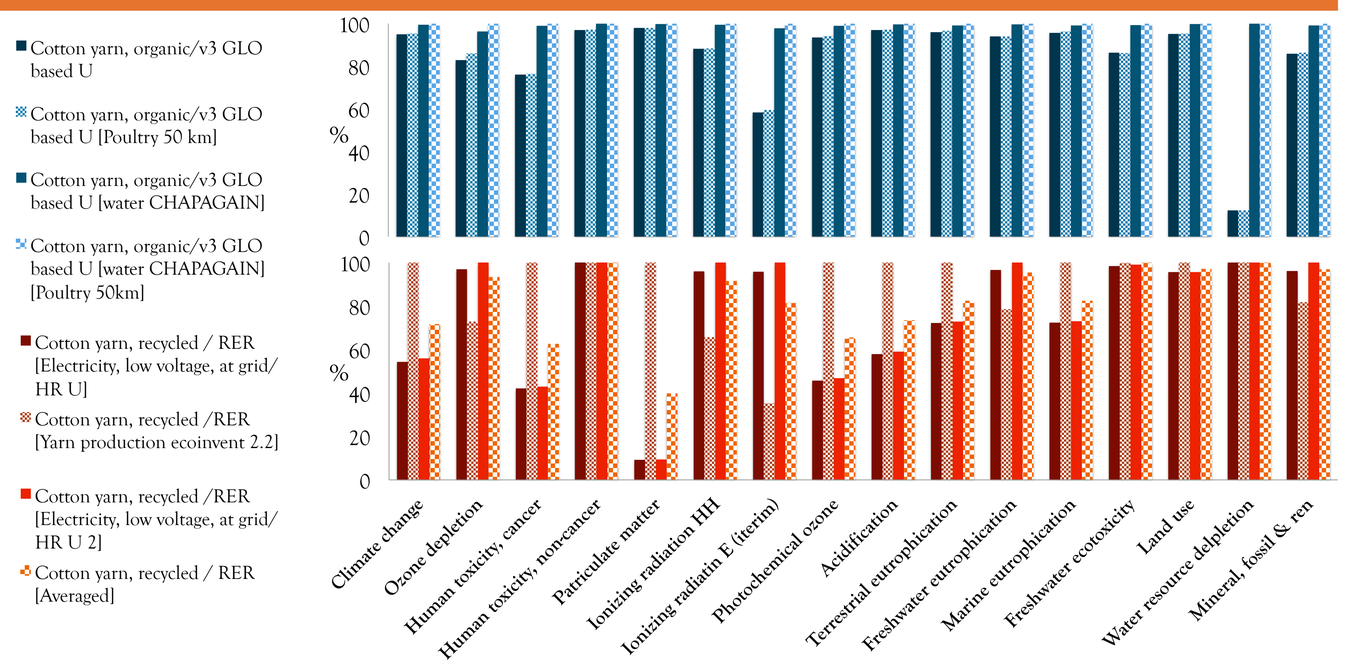
Data from India, China and the USA has been chosen, covering 81% of the global organic cotton market. For each country an individual dataset has been produced. The unit function is 1kg of organic cotton yarn.

Methods

All processes needed to transform old textiles and organic cotton respectively to cotton yarn are listed in the life cycle inventory, as well as resources and emissions to air, water and soil. These are then combined to quantify environmental impact categories, as indicated on the bottom of the table. The quantification method of choice in the Simapro 7 program was **ILCD 2011 midpoint**, which includes an own impact category for water resource depletion.

With the sensitivity impact analysis **on organic cotton**, two major factors could be identified: Firstly, the data source for water use, as the **water use data** from the ecoinvent 3.0 cotton process was included. Newly available data on the green and blue water consumption of cotton was added. Secondly, the **transportation** distance for **manure fertilizer**, which was set to either regional (20km) or supraregional (50km).

For **recycled cotton** the **location** of **yarn spinning** and the spinning **process efficiency** have a significant ecological impact.



Conclusions

Organic cotton does not show better performance in all impacts categories. This comes from the energy intensive cotton irrigation and, as the marketshare of a country's standard cotton differs from its organic cotton share, the composition of the **energy mix for irrigating organic cotton** differs, too. This leads to the worse performance of organic cotton in seven impact categories. The adverse result for organic cotton in the "Land use" category has been expected, due to **lower yields** per ha cultivated land.

The temporal boundary systems are not in favor for organic cotton. Probably, a scope of study that included long-term effects, would reflect reality more accurately. It has been shown that organic cotton production enhances soil quality (i.e. SOM and nutrients), which buffers stress on the plants to some extent, whereas conventional cotton does not have this buffering protection. Furthermore, conventional cotton can deteriorate the soil on the long term, including decreasing yields. Another limitation in ecoinvent 2.2 is the water flows. Problems occurred implementing the green water consumption properly. The authors argue that for further studies a **regional comparison** between the environmental performance of standard against organic cotton is **more suitable**.

Recycled cotton performed in all but one category by far better than conventional cotton, because the cotton recycling process is solely **based on energy** consumption for spinning and transport. Thereby the regional differences of the energy mixes between a global conventional cotton and the European energy mixes for the recycled cotton show a big influence on the category "Ionization radiation HH". This can be explained by the higher nuclear power share of European countries compared to the global energy mix.