WATER FOOTPRINT CALCULATOR FOR JEANS

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1. Aim and approach

The MANGO Chair in Corporate Social Responsibility has developed a calculation method that allows companies account for the total amount of water used in producing a pair of jeans. This Water Footprint Calculator for Jeans is an Excel-based tool that helps garment companies to estimate the water footprint of produced or sourced jeans.

The development of the water footprint calculation method was approached by

- focusing on the main water-consuming processes in the jeans supply chain,
- considering the countries where these processes take place,
- differentiating between various cotton types (conventional, BCI, organic and recycled),
- using publicly available data for the water consumption linked to the production of the different cotton types, and
- asking companies to gather real data on the water consumption of denim and jeans manufacturing from suppliers.

On the one hand, this approach aligns with the water footprint assessment method of the Water Footprint Network (Hoekstra *et al*., 2011) since it considers the location where the water consumption occurs ("spatially explicit water footprint"). On the other hand, this approach follows the LCA guidelines, as it only accounts for the consumption of so-called "blue water", that is surface water and groundwater that is withdrawn from a watershed.[1]

2. Scope of the water footprint calculation

For simplicity reasons, we assumed that jeans are made from 100% cotton. The scope of the water footprint calculation includes the three water-relevant processes of cotton production, denim fabric production and final jeans production (washing/finishing), and thus can be considered as a "cradle to gate" analysis. We exclude the use phase which according to existing studies has a significant water consumption related to consumer washing (Levi Strauss, 2015; Vos, 2019).

[1] The water footprint assessment of the Water Footprint Network also accounts for "green water" (water added via rainfall) and "grey water" (water needed to dilute the polluted water back to a suitable state for return to the watershed).

We account for the water withdrawals through direct water use in the considered processes to produce cotton, denim and jeans. We exclude the indirect water use embodied in other materials (e.g., zipper, buttons and leather label), packaging, consumables, chemical applications, electricity consumption and transportation.

3. Structure of the Water Footprint Calculator

The Water Footprint Calculator is an Excel workbook with different spreadsheet: "Basic data", "Supplier 1", "Supplier 2", "Supplier 3"…, Supplier 10" and "Results". The white cells are for data entry, while the coloured cells perform automatic calculations.

The "Basic data" sheet contains basic jeans production data, conversion factors and water use data.

4. Locating the water-consuming processes in the jeans supply chain

In the sheets "Supplier n", data should be introduced for the different jeans suppliers, indicating the number of produced jeans, the country jeans manufacturing takes place and the location of denim suppliers and sourced cotton.

If you do not have data about the denim suppliers, a reasonable assumption is that fabric mills are located in the same country as garment suppliers (Vos, 2019).

If you do not have data about the countries of origin of the cotton, you can estimate the countries relying on cotton global trade data (Vos, 2019).

5. Calculating the amounts of denim fabric and cotton

The amounts of required denim fabric and cotton are estimated from the company data about the units of jeans produced with the help of conversion factors.

Denim fabric production is usually measured in linear metres (ml) with a width of 1.5 metres. If you do not have data about the average fabric area per jeans, you can consider a conversion factor of 1.50 m^2.

To estimate the cotton consumption we need the average weight of jeans. If you do not have data about the average weight of your produced jeans, you can consider an average figure of 500,000 g. To estimate the amount of consumed cotton we use the End-Product-to-Fibre Multiplier for denim provided by the Better Cotton Initiative (2020).

6. Calculating the water footprint

Water consumption figures for cotton production were taken from publicly available literature. It should be noted that these data were retrieved from LCA studies[2] and thus include indirect water use (however, this represents less than 1% of the overall reported water consumption). In a simplified estimation we assumed that there is no water use for recycled cotton fibres, following some existing references (e.g. Akı *et al*., 2020).

Water use data

Average water use in jeans production [L/garment]	63.6	Source: Vos (2019)
Average water use in denim production [L/m²]	28.2	Source: Vos (2019)
Average water use in conventional cotton production [m³/t]	1,559	Source: Thinkstep (2017)
Average water use in BCI cotton production [m³/t]	523	Source: Average from Shah et al. (2018) and Thinkstep (2019)
Average water use in organic cotton production [m³/t]	182	Source: PE International (2014)
Average water use in recycled cotton production [m³/t]	0	Source: Simplified estimation

Data on the water consumption of denim fabric production and jeans manufacturing (washing/finishing) should be collected directly from jeans and denim suppliers

To consider the environmental impact of water use, we use the Available WAter REmaining (AWARE) method developed by the Water Use in Life Cycle Assessment (WULCA) working group of the UNEP-SETAC Life Cycle Initiative (Boulay *et al*. 2018).[3] The AWARE method is based on the quantification of the relative available water remaining per area in a watershed once the demand of humans and aquatic ecosystems has been met, and provides scaling factors that reflect the scarcity of water in a location. The proposed AWARE factors range between 0.1 and 100 and characterise the water scarcity relative to the world average; they are expressed in m^3 world equivalents (m^3 world eq). We used the

[2] Whereas data for conventional and organic cotton were taken from global LCA studies, for BCI cotton we only found studies conducted in the Indian context.

[3] The AWARE method is recommended by the UNEP-SETAC Life Cycle Initiative, the Product Environmental Footprint and Organisation Environmental Footprint Program of the European Commission, and the International Environmental Product Declaration system.

latest available version of AWARE country level values (WULCA, 2019). For the cotton production calculations we took the agricultural activities (irrigation) factors, while for the manufacturing stages (jeans and denim production) we used the non-agricultural activities (non-irrigation) factors.

7. Unweighted and weighted water footprint results

The last sheet of the Excel workbook is the sheet called "Results".

It shows the unweighted and scarcity-weighted results of the water footprint for jeans, both totally aggregated and disaggregated regarding

- Stage of production (jeans production, denim fabric production and cotton production - conventional, BCI, organic and recycled-)
- Country

It also offers some summary tables and an automatic graph that shows the contribution percentage of each stage of production.

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