

## **USING WATER FOOTPRINTING ON A REGULAR BASIS - PROBLEMS AND CURRENT DEVELOPMENTS FROM AN INDUSTRY PERSPECTIVE**

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### **ABSTRACT**

Water footprinting is still in its infancy. So far, an accepted general framework and various water footprint impact assessment methods have been developed. SCA performed a case study to evaluate the usefulness and applicability of water footprinting in industry. For water footprinting becoming a useful tool for decision making there are several problems: data is lacking and of poor quality. In addition, some impact assessment methods are not operational yet. Different operational impact assessment methods might lead to different conclusions because of different pathways or endpoints modelled or different characterisation factors. On-going improvements will solve some of those problems and will hopefully allow to use water footprinting as a robust basis for decision making in industry.

### **INTRODUCTION**

SCA performed a case study on water footprinting for four selected tissue products. The main focus of the project was the identification and analysis of existing and proposed water footprint methods and their possible application in industry. The results of the study will be used internally to identify hotspots and possible future improvement areas in terms of water use as well as for educational purposes within the company. The study will also be used to identify the advantages and challenges of water footprinting and the appropriateness and applicability of the various methods related to SCA's product portfolio.

### **MATERIALS AND METHODS**

A screening of existing water footprint methods has been performed. The methods found in literature range from simple indexes to sophisticated endpoint methods. While only the most recent simpler methods have been selected, all midpoint and endpoint methods have been applied in the case study.

Simple indexes can be based on water scarcity or vulnerability. The index methods applied in this study are the water stress index (Pfister et al., 2009) and the water impact index (Veolia water, 2010). Going beyond indexes, midpoint and endpoint methods for water footprinting exist. As midpoint methods, we have chosen the WFN scarcity method (Hoekstra et al., 2009), the ecological scarcity method (Frischknecht et al., 2009), and the methods according to Milà i Canals et al. (2009), Bayart et al. (2010), and Boulay et al. (2011). As endpoint methods we have selected: Pfister et al. (2009), Bayart et al. (2010), Boulay et al. (2011), Verones et al. (2010), Van Zelm et al. (2011), Bösch et al. (2007), and Motoshita et al. (2008, 2009).

## RESULTS

### *Water flows and water balance*

A water balance including water inputs and outputs of each process of the life cycle of the products was compiled. Typically, many different databases and data sources are used in LCAs performed by industry and are mixed in a life cycle model (e.g. Ecoinvent database, ILCD/ELCD database, data from industry associations, primary data). Nomenclature and the way of how water is modelled vary between databases. Sometimes, only water withdrawals are accounted for while water returns are documented only sometimes. Incorporation into products and evaporation are usually not reported.

Often, water inputs and water outputs are not balanced in datasets with generic data. In addition, some water flows are not specified (e.g. an input flow is just named ‘water’) which makes the calculation of impacts impossible if we go beyond water volume accounting. In the case study, for every individual process, an in-depth investigation had to be performed to complete the water balance involving many assumptions and estimations. To perform a water footprint assessment, it is also necessary to identify the location of water use for every process. This is especially difficult for aggregated and generic datasets from databases that are usually used for upstream data (e.g. “Diesel mix at refinery, EU-27”).

### *Water footprint assessment results*

The results for the four products of the different water footprint methods have been compared by establishing a ranking. Interestingly, all methods that are operational come to the same conclusions regarding the ranking of the products. We also analysed the contribution of each life cycle step to the results for each method applied (Figure 1). The results differ between the methods. Most methods show highest impacts for raw material supply, followed by the production process. For some methods, the water footprint is dominated by raw material supply, for example the WFN scarcity (Hoekstra et al., 2009), Pfister (Pfister et al., 2009) and Boulay endpoint (Boulay et al., 2011) methods. Those ‘outlier’ methods have very high characterization factors for those countries where some of processes for raw material supply are located.

## DISCUSSION

### *Data gaps and data quality*

Data gaps exist for primary data but also in databases for secondary or generic data. Data collection systems on water use upstream the supply chain are usually not in place. For secondary data from databases, water inventories are not complete and not transparent. A typical data gap is that only water withdrawals or water inputs are accounted for while information on the fate of water is missing. Incorporation into products and evaporation are usually not reported. Another problem of secondary data is that often the geographic location of water flows are not known.

Data quality for water flows from existing databases is not very good. Data quality of primary data collected by industry for own operations and from suppliers is better, however, in some cases, questions on water flows cannot be answered since there are no measurements done. Compared to energy there are fewer water meters installed, for example, split between production lines cannot be done. So, there are many assumptions and estimates needed to get

a dataset as complete as possible. In addition, data quality for evaporation from industrial processes also has to be improved.

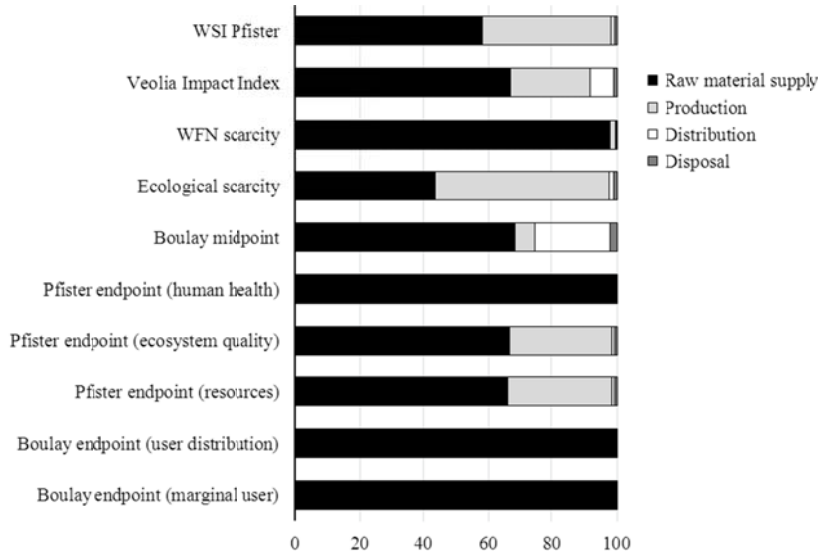


Figure 1. Percentage of life cycle steps of total water footprint according to selected methods

### *Impact assessment*

Concerning the water footprint methods, many midpoint and endpoint methods are not operational yet but only propose a framework (e.g. Bayart et al., 2010). Some authors like Verones et al. (2010) or Van Zelm et al. (2011) only provide characterisation factors for selected case studies (e.g. selected watersheds or countries).

When looking at the methods that were applied in this case study, the following conclusions can be drawn: the WSI according to Pfister et al. (2009) is an index that is very easy to understand. It can be used as a first screening indicator as also proposed by the authors. The Boulay midpoint indicator (Boulay et al., 2011) is very easy to use. The ecological scarcity method (Frischknecht et al., 2009) can be easily applied but is probably best to use when water footprint is integrated into a full LCA with also the other impact categories being calculated using the ecological scarcity method. The endpoint methods that have been proven to be most operational are the Pfister et al. (2009) and Boulay et al. (2011) endpoint methods.

## **CONCLUSIONS**

Several conclusions can be drawn from this case study. The first findings indicate that data quality for water flows from secondary data is not very good. Many data gaps exist. For primary data, usually, data quality is better, however, data quality should be improved by installing water metering systems or improving them (e.g. allowing for disaggregated measurements).

We expect that the accounting of water flows will be improved in secondary databases soon and some progress can be seen already now. If we want to improve data quality and to close data gaps, it is important to consider that demands on data differ for various impact assessment methods. It is thus often difficult to decide what data to collect. What we would need is an agreement on what data to collect (e.g. what types of water, what information on location and water quality, which temporal disaggregation to use). We hope that the ISO



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standard 14046 on water footprinting will help in defining what should be the minimum requirements regarding data collection.

Concerning the impact assessment methods, many midpoint and endpoint methods are not operational yet but only propose a framework while others provide characterisation factors for selected case studies. In addition, the case study has shown that different operational impact assessment methods might lead to different conclusions.

From our case study, we have seen that water footprinting is possible, however, not at all straightforward. A lot of manual data handling, assumptions and estimates are needed that all have to be done on a case-by-case level. This will hinder water footprinting to be applied (or added to more traditional impact categories) in industry for larger product portfolios, or for regular performance tracking on assortment level. Data quality issues and the differences between IA methods make it extremely difficult to use water footprinting as a robust basis for decision making in industry.

### REFERENCES

- Bayart, J.B., Bulle, C., Deschênes, L., Margni, M., Pfister, S., Vince, F., Koehler, A. (2010). A framework for assessing off-stream freshwater use in LCA. *The International Journal of Life Cycle Assessment*, 15, 439-453
- Bösch, M.E., Hellweg, S., Huijbregts, M.A.J., Frischknecht, R. (2007). Applying Cumulative Exergy Demand (CExD) Indicators to the ecoinvent Database. *The International Journal of Life Cycle Assessment*, 12, 181-190
- Boulay, A.M., Bulle, C., Bayart, J.B., Deschênes, L., Margni, M. (2011b). Regional Characterization of Freshwater Use in LCA: Modeling Direct Impacts on Human Health. *Environmental Science & Technology*, 20, 8948-8957
- Frischknecht, R., Steiner, R., Jungbluth, N. (2009). The Ecological Scarcity Method Eco-Factors 2006. Bern, Switzerland: Federal Office for the Environment
- Hoekstra, A.Y., Chapagain, A.K., Aldaya, M.M., Mekonnen, M.M. (2009). Water Footprint Manual. State of the Art 2009. Enschede, The Netherlands: Water Footprint Network
- Milà i Canals, L., Chenoweth, J., Chapagain, A., Orr, S., Antón, A., Clift, R. (2009). Assessing freshwater use impacts in LCA: Part I - inventory modelling and characterisation factors for the main impact pathways. *The International Journal of Life Cycle Assessment*, 14, 28-42
- Motoshita, M., Itsubo, N., Inaba, A. (2008). Development of impact assessment method on health damages of undernourishment related to agricultural water scarcity. *Proceedings of the 8<sup>th</sup> International Conference on EcoBalance*, Tokyo, 10 -12 December
- Motoshita, M., Itsubo, N., Inaba, A. (2009). Development of damage assessment model for infectious diseases arising from domestic water consumption. *Proceedings of the SETAC Europe 19th Annual Meeting*, Gothenburg, 31 May - 4 June
- Pfister, S., Köhler, A., Hellweg, S. (2009). Assessing the Environmental Impacts of Freshwater Consumption in LCA. *Environmental Science & Technology*, 43, 4098-4104
- Van Zelm, R., Schipper, A.M., Rombouts, M., Snejpangers, J., Huijbregts, M.A.J. (2011). Implementing groundwater extraction in life cycle impact assessment: characterization factors based on plant species richness. *Environmental Science and Technology*, 45, 629-635
- Veolia Water (2010). The Water Impact Index and the First Carbon-Water Analysis of a Major Metropolitan Water Cycle. Veolia Water
- Verones, F., Hanafiah, M.M., Pfister, S., Huijbregts, M.A.J., Pelletier, G.J., Koehler, A. (2010). Characterization Factors for Thermal Pollution in Freshwater Aquatic Environments. *Environmental Science & Technology*, 44, 9364-9369