Towards comprehensive inventory data for water footprinting (ID:401)

Samuel Vionnet[1], Alicia Offutt[1], Lindsay Lessard[1], Anna Kounina[1,2], Manuele Margni[1], Yves Loerincik[1], Caroline Coquerel[1], Damien Friot[1], and Sebastien Humbert[1,*]

[1]Quantis, Lausanne, Switzerland

[2]Swiss Federal Institute of Technology, Lausanne, Switzerland

*sebastien.humbert@quantis-intl.com

Abstract Water is a growing concern in life cycle assessment. Several impact assessment methods have been developed or are being developed to assess the impacts on water. However, current inventory databases do provide only limited data on water, mainly on withdrawal, and are all mis-matching the inventory of the methods developed recently to address the issue of water impact assessment. Lack of sufficient and relevant data is in many cases the most important limiting factor to perform corporate water accounting and impact assessment. In light of this issue, a project was launched by a consortium of companies, lead by Quantis, to create an exhaustive “water” life cycle database. The database will include a full balanced account of water flows, different regionalization possibilities, and a spectrum of impact methods applied to the inventory flows. The availability of inventory data will make it possible to widen the scope of actual “water footprint” studies at an inventory and impact level. Final results will be presented at LCM 2011 in Berlin.

1 Introduction

Water is an essential resource, imperative to both anthropologic and natural activities. Future stresses on water resources, such as population growth, economic activity, and climate change pose a wide series of challenges on the management of water. Life cycle water management and water impact assessment, or water footprinting, are key to meeting these challenges. Water footprinting is increasingly becoming the focus of conferences, reporting initiatives and business risk management as companies seek reliable assessment technology. The Water Footprint Network (WFN), the UNEP-SETAC life cycle initiative, the WBCSD Global Water Tool, and the Water Disclosure Project, are but a few of the dedicated initiatives and tools already in existence. Involved in numerous international water initiatives such as UNEP-SETAC, WFN, and CEO Water Mandate, Quantis is at the forefront of development. Analysing life cycles of products and companies demands quality data, which is currently lacking given the nature of water use. Thus, to fill the gap, a project was launched by a consortium of companies – including Ecoinvent, Danone, Kraft, L'Oreal, Molson Coors Brewing Company, Natura, Steelcase, Unilever, Veolia Environnement and lead by Quantis – to create an exhaustive "water" life cycle database [1]. Modifying and extending the current Ecoinvent database, Quantis quantified inventories and impacts associated with water in ways that are congruent with those used for other impact categories such as carbon footprint. The key features of the database include:

• A full balanced water accounting taking into account water flows that are addressed in the recently developed accounting and impacts methods,

• Different regionalization possibilities at the level of the country, the level of the watershed or using an archetype approach, and

• A preset choice of impact assessment methods applied to the inventory flows.

2 Inventory methods

The framework is based on a cause-effect chain from inventory up to endpoints (Figure 1). The different water use impact assessment methods that have been developend recently are positioned along this cause-effect chain.

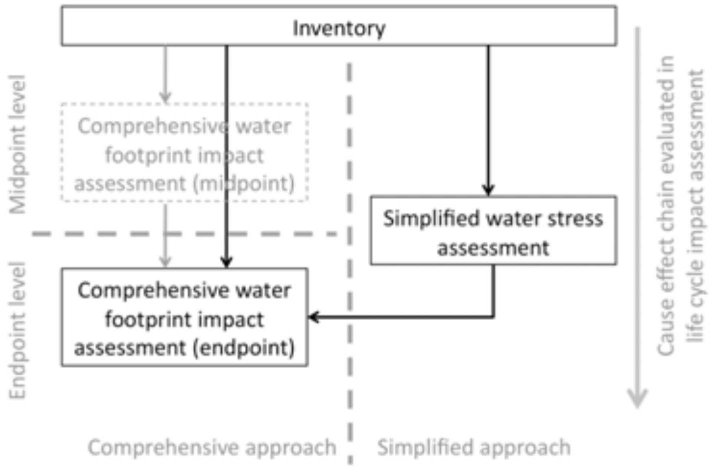

Fig.1: Framework used for the impact assessment of water use

Based on the latest publication in this field an exhaustive inventory framework was built to achieve a balance between water withdrawn and released for each process considered in the database. This inventory framework is built to take into account, as broad as possible, requirements of existing and future methods in water use impact assessment (Figure 2).

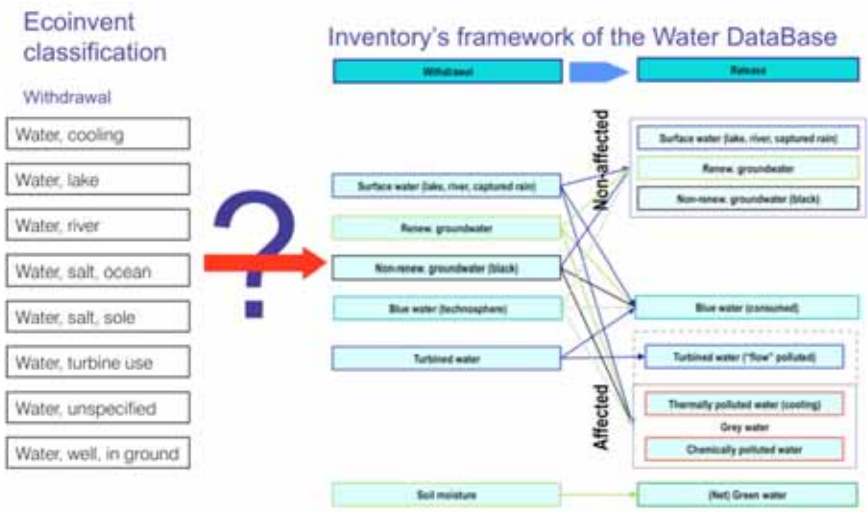

Fig.2: Framework used for the impact assessment of water use

Withdrawal flows for each process are separated into the following categories: river, lake, shallow and other renewable groundwater, groundwater non-renewable, salt water, atmospheric water, and incorporated water (from the technosphere).

Other water inputs from the technosphere (e.g. tap, dilution, softened and decarbonized water) are also attributed to water withdrawal inventory. These water categories while not considered direct water use, are recognized as water transiting the system boundaries of the process and thus must be accounted.

Release flows for each process use the same water categories as water withdrawal (including quality and location) however additional characteristics are also included. Flows are separated into those that are non-affected (non-polluted), affected (polluted) along with associated pollutant loads (emitted by the process). In the case of water use for processes such as cooling or power generation, additional flows are incorporated including: surface water from cooling, evaporated water from cooling, turbined water, evaporated water from turbined water and green water.

Water resource quality assessment is based on GEMSTAT database of surface and ground water quality collected from the GEMS/Water Global Network with more than 3'000 stations.

As water is a local issue, the database also offers regionalization of the inventory possible per country, watershed, or region. Regionalized data includes surface to groundwater withdrawal, evaporation rates, quality of resource, cooling water surface to groundwater extraction, turbined water evaporation and the ratio of electricity generated from dams and reservoirs to rivers.

3 Impacts methods

Beyond water inventory, the Water DataBase also has a list of inventory and impact results pre-calculated to help interpreting impact on environment. Impact methods, that follow the cause-effect chain illustrated in Figure 1, are separated into three categories that include impacts at the inventory, impact and damage level.

Inventory methods such as the one suggested by the Water Footprint Network [2] is included. It comprises the blue, grey and green water inventory categories.

Midpoint methods include water stress index weighted inventory. Some more specific methods are included developed by some companies that are partner of the project.

Damage methods are used to assess the environmental impacts of water use in relation to damages to three areas of protection: human health, ecosystem quality, and resources. Regionalized damage can be quantified using characterization factors (CF) that can imply the relative impact of water consumption in a region. At the damage level, resource scarcity would affect areas of protection; human health for example, could be affected resulting in malnutrition or poor hygiene. Damage level methods include Pfister et al. 2009 [3], Vionnet et al. 2011 [4], Maendly and Humbert 2011 [5], Verones et al. 2010 [6], Van Zelm et al. 2011 [7], Motoshita et al. 2010 [8] and Boulay et al. 2011 [9].

The final version of Quantis' Water DataBase is presented schematically in Figure 3. Background (or indirect) and foreground (direct) water use inventory and impacts will be reported separately. Regionalization is dynamically included in the results, so that by changing a country of a process, the inventory is automatically modified according to the specificities of the selected country.

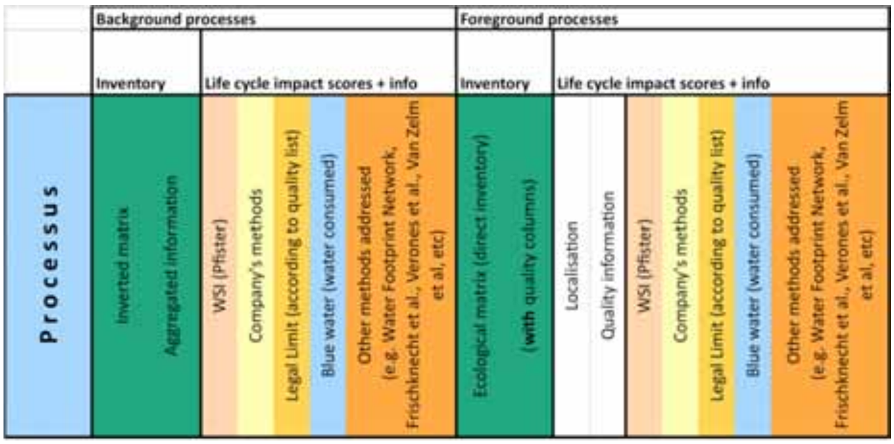

Fig.3: **Final Water DataBase details including both background and foreground processes.**

4 Results and discussion

Figure 4 shows an example of results for a selected set of indicators, the blue and grey inventory indicators and a water stress index weighted inventory (Riddout and Pfister 2009 [10]). The processes shown in Figure 4 are polyethylene terephtalate polymer, paper for newsprint and steel milling. Those processes are taken directly from ecoinvent and have been processed in the project to provide an extended inventory and impacts results.

One can easily compare products and assess a water footprint with the water database. The indirect and direct water use and impact are identified according to the process location. Milling steel process has only indirect water consumption due to energy consumption, but paper and polyethylene terephtalate have direct water consumption linked to cooling and process water use during their fabrication.

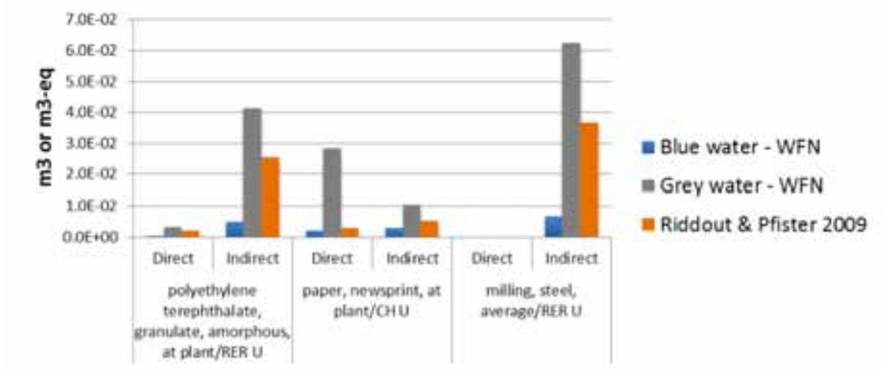

Fig.4: Blue and Grey Water footprint inventory indicator form the Water Footprint Network and weighted inventory following the Riddout & Pfister 2009 [10] publication methodology, using a water stress index.

Comparison of inventory and weighted inventory for paper shows that for direct water footprint, even though the grey water footprint is high, the weighted inventory is low as the process happens in Switzerland and the water stress index and possible impact on the environment is low.

Those results allow a quick overview of the water footprint of products and processes and help companies to take decisions in order to reduce their water consumption, not only in their direct operations but also throughout the entire supply chain of their products.

5 Conclusions

The applications of the Water DataBase in life cycle inventory and impact assessment range from assessing a large number of products, assessing the supply chain and indirect water consumption of materials and energy, as well as full company assessment, for corporate reporting, water management and risk assessment. The use of this database will also make possible for researchers to apply and develop further methods to assess the different types of environmental impacts related to water. The availability of inventory data will make it possible to widen the scope of actual “water footprint” (at inventory and impact levels) studies and include in-stream and off-stream water uses, consumptive, non-consumptive and degradation water uses in a consistent way.

6 References

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