WULCA

WULCA Expert Workshop

"Development of a stress-based indicator for LCA-based water use impact assessment"

When: September 10th, 8:30 – 18:00

Where: Zurich, ETH Main Building (HG), Room F 33.1

Participants:

Name	Organisation
Anne-Marie Boulay	CIRAIG, Ecole Polytechnique of Montreal
Stephan Pfister	ETH Zurich
Laura Scherer	ETH Zurich
J-J Beley	DANONE
Yann Lemoine	EDF
Petra Döll	University of Frankfurt (WaterGAP)
Julie Clavreuil	Unilever
Masaharu Motoshita	AIST in Japan
Sara Marks	EAWAG
Namy Espinosa	Nestlé
Sebastien Worbe	Veolia
Amandine Pastor	Wageningen University
Sebastien Humbert	Quantis
Dieter Gerten	PIK in Potsdam (LPJmL)
Ines Francke	NATURA / Brazil
Sandi Ruiz	Quantis
Camillo De Camillis	FAO
Jan (Pariyapat Nilsalab)	JGSEE in Thailand

Online:

Name	Organisation
Bo Weidema	Consultant, Life Cycle Academy
Naji Tannous	Consultant Engineer, Lebanon
Montse Nunez	ELSA-PACT, Montpellier (France)
Maite Aldaya	UNEP consultant
Laura Roibas	Santiago de Compostela University, Spain
Helena Wessman	VTT Technical Research Center of Finland

Elina Saarivori	VTT Technical Research Center of Finland
Ed Barnes	Cottons Incorporated
Briana Niblick	Stuttgart University, Germany
Annette Koehler	Consultant, PE International (Switzerland)
Angeline de Beaufort	Consultant, Netherlands
Manuele Margni	CIRAIG, Ecole Polytechnique of Montreal

A. Opening and introduction to WULCA

In the first part of the morning, Anne-Marie Boulay made an opening statement and all participants introduced themselves. Anne-Marie provided an introduction to WULCA, and the interconnected projects: Life Cycle Initiative global guidance flagship project on indicators (group led by Olivier Jolliet and Rolf Frischknecht) and on the ISO 14046 Water Footprint standard. The objectives of the meeting are stated:

- Present the current status of the indicator development

  →Receive comments on usefulness, acceptability and relevance
- Describe modeling challenges and answer specific questions associated with them

Clarifications are brought with respect to some LCA concepts (midpoint, endpoint, types of models, expected users of the method and intended use, inventory, marginal impact, etc.)

B. Classification of the concept of the current indicator-the right indicator for the right question

In this second part of the morning, three different types of questions are presented, with the associated indicator:

1- **Questions:** “To which extent are humans using the available water in this region?”, “What is the potential of affecting water availability for human uses?”
Indicator: WTA or CTA based
2- **Questions:** “What is the potential of depriving another user from water, with no specification of who the user is (i.e. humans or ecosystems)?”
Indicator: DTA based (all demand (including ecosystems)-to-availability ratio)
3- **Questions:** “How much water is available in this region?”, “What is the risk of running out of water?”, “how dry is the region?”, “how critical is the water availability in this area and how much will an additional use affect it?”
Indicator: 1/availability per area, 1/(availability-demand) per area

The group agrees that the indicator to be developed should answer question 2 above.
Discussions arise on which indicator is the best to answer it. Most agree that DTA is a good option, with two main concerns:

1- Would resulting values in arid areas be lower than some other regions which have more water but more activity, i.e. Belgium ? This problem arises from the fact that, in deserts the hypothesis that LCA assesses a marginal water use breaks down: any supply chain situated in dry area might use high percentage of availability, have a high influence, and any small change can have a big influence, hence dry area should come out as problematic. Three approaches are discussed that can allow this:
   a. Both information should be combined into one indicator (referring to Berger et al work, but more sophisticated approach required)
   b. Consider the type 3 indicators from above, with 1/(availability – consumption – EWR).
   c. Have one parameter that assesses the contribution of the process to the water "unavailability" (i.e. 1/availability), and one parameter that assesses the situation in the region (i.e. demand/availability), and have them multiplied.

➔ The question whether "deserts need to be red" is discussed and still a source of disagreement. While some believe that the indicator should be maximal in a desert area, others feel that it depends what the question to be answered is, and whether the additional use of water is marginal or not. The conclusion seems to be that **deserts correspond to special cases that should be integrated with special attention in the model.**

➔ Proposal from D.Gerten: deserts (i.e. regions with a runoff <e.g. 1km3/yr) could just be left out from the analysis, as any modelled effect would be too uncertain anyway (and probably not meaningful given low population).

2- Whether it is feasible to include environmental water demand in a sufficiently robust way with available methods. This will be discussed in the afternoon with the model experts.

C. Modelling Challenges

i. *Environmental Flow requirements*

Presentations from experts:

- Presentation by Amandine Pastor

Values developed at monthly time scale, closer than Smakthin to values assessed in local case studies, varies monthly, but annual average around 37% for many regions, compared to Richter 2011 which sets the value at 80%, which is based only on 4 case studies in temperate climate. The hypothesis (used e.g. by Smakhtin, 2004) is that "fair conditions" with respect to natural flow corresponds to the state that most watersheds are in today. This is probably the weakest point, but a range of uncertainty can be used using the different assessment methods.

- Presentation by Petra Döll

Involved in the work of Smakhtin and received a lot of criticism, the effect of change of flow on ecosystem is very uncertain. Assessment was criticized by ecologists as being too low (20-50% of natural flow), and fair conditions were not sufficient. Definition of fair, good or excellent is also subjective. Hence Richter et al proposed a 80-90% value everywhere, independently of the type of ecosystem (i.e. not regionalized). Work on assessing the impact of river flow regime changes on fish catch based on literature data (work in progress by Jing Zhang) seems to show that (almost) any decrease of flows (seasonal low or high flows, annual flows) leads to a decrease of fish catch. This fits to the work of Carlisle et al. (2010), also cited by Richter et al. (2011). They found no threshold for biological disturbance of fish or macroinvertebrates in the USA, just an increasing deterioration with decreasing flow magnitudes. However this is only for fish and probably not representative of other species.

An indicator was developed for Yale university as (Qm_anthropo – QM_natural)/Qm_nat, which was described as a way of avoiding value-driven choices (but somehow similar to CU/Availability).

ii. Green water and terrestrial ecosystems

The group agrees that green water and terrestrial ecosystems should not be included in the indicator mainly because the indicator is meant to assess blue water use, which does not compete with green water users. If blue water requirements for terrestrial ecosystems were known, this could be considered, but this is not known, nor the pathway that links blue water consumption to change in terrestrial ecosystems quality.

iii. Temporal resolution

Only a brief discussion on temporal resolution occurred, intertwined with other topics. Although a monthly resolution seem to be the most relevant, later on aggregated at the yearly scale, Petra Döll mentions that models are not good enough for monthly indicators, availability and irrigation values can easily off by a month. However, mean annual water availability would lead to an overestimation of water availability in semi-arid/arid areas and monsoonal areas as compared to others. An alternative to consider temporal variation is to use Q90, the quantity exceeded in 9 out of 10 months (e.g. evaluated on 3 years periods to account for interannual variability). This is not further discussed.

iv. Data Source (hydrological models)

WaterGap – Presentation from P.Döll

Müller Schmied et al. 2014[1] presents WaterGAP 2.2, update at the end of 2014 for 2.2b

Data will be made available: www.pangaea.de, PANGAEA data publisher for earth & environmental science

LPJmL – Presentation from Dieter Gerten

[1] Müller Schmied, H., Eisner, S., Franz, D., Wattenbach, M., Portmann, F. T., Flörke, M., and Döll, P. (2014): Sensitivity of simulated global-scale freshwater fluxes and storages to input data, hydrological model structure, human water use and calibration. Hydrol. Earth Syst. Sci. 18, 3511-3538, doi:10.5194/hess-18-3511-2014

LPJmL compared to WaterGAP: evapotranspiration compted differently and in a more sophisticated way; domestic and industrial use taken e.g. from WaterGAP, so less strong on non-agricultural demand side; integrates ecological and hydrological modelling.

Data available upon request

- ➔ P.Döll states that WaterGAP is not better, but because of correction factors for flows water availability is more trustworthy, the arid areas overestimation (common for hydrological models) is corrected.
- ➔ Differences in models come from different hypothesis on evaporation, calibration, different climatic data, etc.
- ➔ An alternative would be to use the mean of models for water use

*Question on inclusion of desalinated water in water availability

v. Geographical resolution

This topic was not thoroughly discussed but it was briefly mentioned that at the subbasins scale, anthropogenic flow should be considered, otherwise downstream subbasins without consumption show no stress, although the natural system is already disturbed, (referring to Loubet, cascading of water use).

It is thought that maybe a scale large enough so that downstream / upstream effects are not so relevant anymore should be chosen, but this is not further discussed.

D. Discussion on human and ecosystems water demand

Recommendation to stay away from "essential" versus "useful" categorization of water type for human and ecosystems as too much value judgement and uncertainty would be present. Assessment of actual water use is preferred. For Ecosystems, Amandine Pastor recommends to use EWR median and maximum of different methods or range of 35% to 80% of pristine (natural) conditions to provide a range, with uncertainty, of actual (current) water requirements. P. Döll argues that ecosystems can use anything that is left after human use, hence, even though it would be nice to have it there, the alternative approach would be to use CU/Q90 to answer question 2, but this disregards the geographical and temporal variability of ecosystem demand.

E. Wrap-up of the meeting

Discussion on indicator/equation for assessing the potential of depriving another user from water → Expanded choice of indicators

- HWC+EWR/WA

- HWC+EWR / WA^2
- 1 / (WA-HWC-EWR) (Petra Döll)

Water consumption and EWR (possible as range) should both be included (general agreement with some reserve)

Green water should not be included (common agreement)

Marginal assumption might not be valid in arid regions and model should be adapted for this

Spatial and temporal resolution as food for thoughts