Annual meeting
SETAC Europe, Barcelona, Spain
May 7th, 2015
Outline

- Introduction to WULCA
- Framework and Consensual indicator Project

Updates:
- activities, publications, upcoming

Work progress:
- Stress subgroup (40 min)
- Human Health subgroup (10 min)
- Ecosystem subgroup (15 min)

Final discussion and closing (15 min)
<table>
<thead>
<tr>
<th>Name</th>
<th>Organisation</th>
<th>Type of member</th>
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</table>
1- Introduction to WULCA
WULCA Working group

Water Use in LCA - International initiative for LCA (2007)

Goal

- Guide the scientific development of a consensual and operational method which shall be in line with both the ISO Water Footprint Standard and the LCA principles
- Provide guidance to practitioners and researchers in their understanding of comprehensive water footprinting.
- Represent the scientific voice on water footprinting
  - Provide scientific support and guidance to the ISO 14046 TR
  - Influence international initiatives, present in conferences and trainings
WULCA Working group

Water Use in LCA

Specific Task for the Flagship Project on LCIA Guidance on indicators:

Develop a consensual method for a subset of impact pathways assessing *water use in LCA* with priority to midpoint indicators and an area of protection showing sufficient scientific maturity.
Timeline and progress of work

Framework on how to assess water use in LCA (Bayart et al, 2010)

2008

Development of several new methods

2012

Quantitative comparison of existing methods (Boulay et al, 2015,a,b)

2013

Development of a consensual method (2015)

Qualitative comparison of existing methods (Kounina et al, 2013)
WULCA Phase 3

- Transition into Phase 3 and official acceptance from Life Cycle Initiative in Spring 2013
- Identified in Glasgow as a Flagship category from the Global Guidance Flagship categories from UNEP SETAC Life Initiative

Anne-Marie Boulay
Project Manager, Chair

Stephan Pfister
Deputy Manager, Co-Chair

www.wulca-waterlca.org
Membership

Active (~20 members) approx. 1 day/month
• Involved in water-related methodology development or plan to be
• Contribute to the outcome and deliverables of the working group
• Included in all communications with respect to on-going work and progress

Experts (~100 members) approx. ½ day/month
• Knowledgeable on the topic of water and LCA
• Contribute their expert judgment to the outcome of the working group
• Included on communications that are relevant for their expertise

Sponsors (8-9 sponsoring companies)
• Provide 10’000 USD/yr for 2 years
• Individual from sponsoring companies can act as an active, expert or observer member
Link with ISO water footprint process

There is no official link between ISO DIS 14046 on Water footprint and WULCA, however:

- The convener and several delegates of the ISO working group are members of WULCA
- The work of WULCA has served as a basis in the development of the DIS
- The current DIS does not propose one specific method, but rather Principles, Requirements and Guidelines
- **WULCA can propose this method as the result of a consensus** which could be integrated in the next review of the standard
Link with LCIA global guidance flagship project
Goal of the flagship project

• Establish a consensual set of environmental impact category indicators

• For use in
  – Environmental product information schemes
  – Corporate reporting of multinational companies
  – International and/or national environmental policies
  – Common LCA work commissioned by governments and companies
General outline

- **Task 1: Scoping phase** (2012-2013)
  Establish short list of impact category indicators and themes for first and second stage
  → Yokohama 2012 & Glasgow 2013 scoping workshops
  → Stakeholder feedback at events worldwide

- **Task 2: Consensus finding, stage 1** (2013-2015)
  → Pellston workshop 1 (with output being an agreement)

- **Task 3: Consensus finding, stage 2** (2015-2017)
  → Pellston workshop 2

- **Task 4: Dissemination** (2018)
Global Guidance on LCIA indicators
Chairs: Olivier Jolliet and Rolf Frischknecht

- Consensus on global warming indicator
- Consensus on water use indicator

WULCA
Chair: Anne-Marie Boulay
Co-chair: Stephan Pfister

- Education and training
- Scientific support to other initiatives and events (e.g. ISO TR 14073)

- Guidance to practitioners and researchers
- Consensus on other indicators
Activities May 2014 – May 2015
Updates: Activities 2015

- **Trainings**
  - San Francisco, October

- **Workshops**
  - Zurich, September
  - San Francisco, October
  - Tzukuba, October
Updates: Publications

Publications

Quantitative comparison papers (A and B): published


LCA Food 2014: Progress paper on scarcity indicator

Expert workshop outcome paper
Past Presentations

- Hydro-Vision (July, Nashville)
- World Water Week (September, Stockholm) (2)
- LCA Food (October, San Francisco)
- LCA XIV (October, San Francisco)
- Ecobalance (October, Tzukuba)
- Carbon Disclosure Project (November, London)
- FAO (April, Rome)
- SETAC (May, Barcelona)
May 2014 – May 2015

- 10 presentations, 3 workshops on 3 continents, 1 training, 4 publications
- Including organisations such as: Food and Agricultural Organisation (FAO), Biological and agricultural engineers (ASABE), Hydropower (HydroVision), World Water Week, Water Footprint Network, etc.
- Collaboration with European Commission (JRC)
- Reaching out to more 500-700 people
Consensual indicator project and work progress
Water Inventory (Surface water, renewable groundwater, fossil groundwater)

Volume of water to be obtained through compensation

Compensation processes

Human health specific midpoint

Impact on human health

Ecosystem specific midpoint

Impact on Ecosystems

Resource specific midpoint

Impact on Resources

Stress-based generic midpoint

Inventory from compensation processes
Generic stress-based midpoint

- No true common midpoint for human health and ecosystems

- Consistent (proportional) results cannot be obtained between a midpoint indicator and the endpoint indicators
  - Regionalization affects both midpoint and endpoint models

- Desire to develop a stress-based midpoint indicator
  - not necessarily correlated to HH and EQ,
  - Provides a simple single indicator to support decision
  - In compliance with ISO 14046
Evolution of scarcity indicators in LCA

The question the indicator aims to answer

“What is the potential of depriving another user of water (human or ecosystems) when consuming water in this area”
Three indicator options

1. DTA = \( \frac{\text{Demand}}{\text{Availability}} \)

   *Indicator is maximal for arid regions*

   *Modelled between 0.001 and 1*

*Demand = human consumption + environmental water requirement (EWR) *
DTA

DTA = \frac{\text{Demand}}{\text{Availability}}
DTAx(0.34)

\[ DTAx = \frac{\text{Demand}}{\text{Availability}} \times \frac{\text{Area}}{\text{Availability}} \]
AMD – range 0.1 - 100

AMD: Availability minus demand
AMD – range 0.1 - 1000
DTA indicator is eliminated first

\[ DTA = \frac{\text{Demand}}{\text{Availability}} \]

→ Strong influence of arbitrary value choice for arid regions
→ 1 order of magnitude → low discriminatory power

Alternative modeling: indicator is divided by world average
Where range is set to 0.1 to 100 by cutoff, no function
Alternative modeling: cutoff at 0.1 and 1000

\[ \text{UW}_w \text{ is world average value for (area/availability - demand)} \]

→ Strong influence of arbitrary value choice for arid regions
→ 1 order of magnitude → low discriminatory power
# Evaluation Criteria

<table>
<thead>
<tr>
<th>Criteria</th>
<th>2 - DTAx</th>
<th>3 - AMD</th>
</tr>
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<tbody>
<tr>
<td>Stakeholders acceptance (initial survey, 23 participants, 16 answers)</td>
<td>Low (4/23)</td>
<td>Good (12/23)</td>
</tr>
<tr>
<td>Robustness with known cases</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Orange, Limpopo</td>
<td></td>
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<tr>
<td></td>
<td>Show higher scarcity ranking</td>
<td>Ganges, Yellow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Murray-Darling, Colorado, Nile, Jordan, Indus</td>
</tr>
<tr>
<td>Main Normative choice</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Absolute and relative availability have equal contribution to impacts (x=0.34)</td>
<td>Regions where demand &gt; availability are set as maximal (equation is discontinuous)</td>
</tr>
<tr>
<td>Physical meaning</td>
<td>Two relatively physical quantities, combined empirically: result is an index with no physical meaning</td>
<td>Physical meaning (available water remaining), up to the point where demand = availability</td>
</tr>
</tbody>
</table>
Relative User Deprivation Potential

\[
\text{Unused water remaining} = \text{Availability} - \text{Demand} \quad (\text{for } 1 \text{ m}^2)
\]

- Demand includes human and aquatic ecosystems
- The value is normalized with the reference flow of the world weighted value
- Maximal value when Demand \(\geq\) Availability
  \(\Rightarrow\) A value of 10 (denominator) means that there is 10 times more unused water available in this region than where the average water “consumption mix” in the world.

\( CF \) is the inverse of unused water remaining
  \(\Rightarrow\) The more unused water available in an area, the lower the potential to deprive other users!
New indicator for water scarcity footprint
Relative User deprivation potential from 0.1 to 1000
Limits of both indicators

- Environmental water requirements implies a normative choice on the status of ecosystems to be maintained (“fair condition with respect to pristine conditions”, which is taken as a proxy for current state)
- Normative choices in the modeling of the indicator: cut-off values for min and max
- Aquatic ecosystems only (not terrestrial ecosystems)
Regional / temporal resolution

- Indicators calculated at the **sub-basins scale**, available also at the **country scale**
- Indicators calculated at the **monthly scale**, available also at the **annual scale**

→ Aggregation made to represent agricultural use or industrial/domestic uses (one value for each, as well as a default value, aggregating both)

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<th>Default</th>
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<tr>
<td>Spain, June</td>
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What we expect to provide

- indicators calculated at the sub-basins scale, available also at the country scale
- indicators calculated at the monthly scale, available also at the annual scale
- aggregation made to represent agricultural use or industrial/domestic uses
  → One value for each, as well as a default value, aggregating both

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Next steps for this indicator

- Google layer → need support!
- Publication
- Testing
- Approval / modifications at Pellston workshop (January 2016)
Questions and discussion (15 min)
Human Health
Human Health

Inventory from compensation processes

Volume of water unavailable to other users

Distribution of water deprivation:
- Water deprived for domestic users
- Water deprived for agriculture
- Water deprived for fisheries

Socio-economic parameter:
- Volume of water deprived causing health damages
- Volume of water to be obtained through compensation

Impact on human health:
- Water-related diseases effect per m³ deprived (dom)
- Malnutrition effect per m³ deprived (agri)
- Malnutrition effect per m³ deprived (fish)

FATE

Exposure

Effect
Human Health

Expert Workshop held in Barcelona May 3rd
10 participants (FAO, WRI, Unilever, Quantis, etc.)
7 questions are discussed:
- Surface / ground water
- Water quality
- Inclusion of domestic users
- Trade effect
- Adaptation capacity
- Effect factor from domestic deprivation
- Effect factor from malnutrition
Preliminary outcome of discussion

- Trade effect: to be included, Motoshita et al. (2014) or other?
- Inclusion of domestic users, further discussion on how
- No differentiation of surface / ground
- Water quality: nice to have but perhaps not feasible in the short time available
- Adaptation capacity: GDP-based plus possibly other indicators *if relevant*, and secondary adaptation as part of the effect factor
- Malnutrition effect: in DALYs per kcal deprived
Next steps

- The group will further work on these questions
- Additional group members welcome
- Preliminary proposal(s) to be provided on time for the Pellston workshop (January 2016)
Ecosystems quality
Current members

- Christian Bouchard (Université Laval, Canada)
- Manuele Margni (CIRAIG, Canada)
- Cecile Bulle (CIRAIG, Canada)
- Anne-Marie Boulay (CIRAIG, Canada)
- Michael Lathuilliere (University of British Columbia, Canada)
- Jane Bare (EPA, U.S.)
- Francesca Verones (NTNU, Norway)
- Stephan Pfister (ETH, Switzerland)
- Lorenzo Benini (JRC, European Union)
- Montse Núñez (Irstea, ELSA, France)

The group is open and warmly welcomes new participants
Organisational aspects

- 8 teleconference meetings from last SETAC in May 2014
- Consensus-building on the Ecosystem Quality indicator(s) is an activity of the 2\textsuperscript{nd} part of the flagship project (2016 – 2018), therefore recommendations are for after the Pellston workshop of January 2016
Objective

- **General Objective:**
  Development of a framework linking water use to ecosystem quality Area of Protection

- **Specific objectives:**
  1. Analyze consistency, complementarity and comparability of the existing impact pathways
  2. Propose a framework based on a mechanistic approach (FF, XF and EF ?) and filling in existing methods
  3. New research works to fill in existing gaps
1. Analyse existing methods: Harmonisation is required

Source: Bouchard et al in prep
2. Propose a framework based on a mechanistic approach

- Identify key issues
- Define principles for framework development
- Identify a comprehensive set of impact pathways
- Define and update terminology and definitions
Identification of key issues for the framework

EQ framework

- Mechanistic model (not scarcity-based)
- Impact pathway coverage
- Avoid overlaps LCI-LCIA
- Structure of the CFs
- Key terminology and definitions
- Applicability
- Uncertainties

Aspects we would like to include in the framework, identified mapping ideas in a graphical way (mindmap)
### Emissions of radioactive waste

- Groundwater consumption
- Surface water consumption
- Soil water consumption
- Other water consumption
- Removal of sediments and pollutants
- Introduction of invasive species
- Noise and vibrations
- Thermic pollution of water
- Emissions of nutrients and other non-toxic substances
- Emissions of metals and other toxic substances
- Emissions of acidifying substances
- Emissions of pathogens
- Emissions of radioactive waste

### Groundwater consumption

- Change in soil-atmosphere water balance
- Change in soil-water balance
- Groundwater table change

### Scarcity

- Modification of average flow rate, volume, area or depth of a water compartment
- Alteration of flow variability, and drought or flood intensity or occurrence
- Artificial barrier to migration

### Habitat modifications

- Watershed or downstream surface water flow regime alteration
- Upstream surface water flow regime alteration
- Water chemical quality alteration*
- Turbidity, water colour alteration, sedimentation

### Quality

- Saline intrusion
- Surface water temperature alteration
- Biological water quality alteration
- Effects of sound and vibrations
- Radioactivity

### Impacts on aquatic ecosystems (plants, fishes, etc.)

- Scarcity:
- Habitat modifications:
- Quality:

### Impacts on terrestrial ecosystems (plants, worms, mammals, etc.)

- Change in soil-atmosphere water balance
- Change in soil-water balance
- Groundwater table change

### Water chemical quality alteration*

* Any type of chemical change: salinization, eutrophication, acidification, eco-toxicity, etc.
Emissions of radioactive waste
Groundwater consumption
Soil water consumption
Other water compartments
Removal of sediments and pollutants
Introduction of invasive species
Noise and vibrations
Thermic pollution of water
Emissions of nutrients and other non-toxic substances
Emissions of metals and other toxic substances
Emissions of acidifying substances
Emissions of pathogens
Emissions of radioactive waste

Change in soil-atmosphere water balance
Groundwater table change
Watershed or downstream surface water flow regime alteration
Saline intrusion
Upstream surface water flow regime alteration
Water fragmentation

Scarcity:
Modification of average flow rate, volume, area or depth of a water compartment
Alteration of flow variability, and drought or flood intensity or occurrence
Artificial barrier to migration

Habitat modifications

Quality:
Water chemical quality alteration*
Turbidity, water colour alteration, sedimentation
Surface water temperature alteration
Biological water quality alteration
Effects of sound and vibrations
Radioactivity

Impacts on terrestrial ecosystems (plants, worms, mammals, etc.)

Changes in genes, species, communities and ecosystems

* Any type of chemical change: salinization, eutrophication, acidification, eco-toxicity, etc.
Definition of principles: mechanistic model

Causal relationship from environmental interventions to impacts

LCI

Resource consumption

Fate factor (FF)

Physical changes to local conditions

Exposure factor (XF)

Contact to target organisms

Effect factor (EF)

Adverse effects on users

\[ FF \times XF \times EF = \text{Characterisation factor (CF)} \]
Definition of principles: regionalized multimedia model

With interconnections between water compartments

**Figure 2:** Example of relevant flows between compartments that need to be defined in terms of fate factors (FF) to enable the characterization of impacts due to groundwater abstraction.
Next steps

- Regular meeting with the goal to develop a framework linking water use to ecosystem quality Area of Protection (objectives 1 & 2)
- Individual contributions to specific impact pathways (objective 3)
Conclusion and Final Discussion
Upcoming

- LCM, Bordeaux, September 2015 *(poster)*
- Expo Milan, October 2015
- LCA XV, Vancouver, October 2015 *(pending acceptance)*

Publication planned on scarcity indicator consensus building process
Publication planned in the next year on ecosystem framework
Recommendations planned for Human Health (white paper) for Pellston workshop

Pellston Workshop, January 2016
Sponsorship serve in financing industrial contribution to Mitacs (for fellowship), organize workshop, dissemination, WULCA participation to conference and events (e.g. SETAC, World Water Week, etc) and other operational costs (website, softwares, etc).
THANK YOU FOR YOUR PARTICIPATION
Current General Framework

Inventory

- Volume of water unavailable to other users
- Water deprived for domestic users
- Water deprived for agriculture
- Water deprived for fisheries

Midpoint impacts

- Volume of water to be obtained through compensation
- Water-related diseases effect per m³ deprived (dom)
- Malnutrition effect per m³ deprived (agri)
- Malnutrition effect per m³ deprived (fish)

Endpoint impacts

- Impact on human health
  - Terrestrial species loss per m³ deprived
  - Aquatic species loss per m³ deprived

Impact on Ecosystems

Impact on Resources

Inventory from compensation processes

Socio-economic parameter

Disruption of water balance

- Change in flow quantity
- Change in groundwater table level
- Change in flow regime
- Loss of water quality
- Overuse of renewable water bodies
- Fossil groundwater depletion

Volume of water deprived causing health damages

Scarcity

- Water Inventory (Surface water, renewable groundwater, fossil groundwater)
New indicator for water scarcity footprint: Units

Relative User Deprivation Potential

\[ m^3_{\text{world eq}} \]

Water consumption (inventory)

\[ m^3_{\text{region i}} \]

Unused water remaining

\[ \frac{m^3_{\text{region i}}}{m^3_{\text{world eq}}} \]

\[ \frac{m^3_{\text{world eq}}}{m^3_{\text{region i}}} \]

CF

Both calculated for the same fixed area
Modeled DTA\(_X\) indicator

2 DTA\(_X\)(0.34)

Cutoff 10 and 90 % area
(choice to validate/justify/finalize)
Weighted average

Orders of magnitude

Min value of 0.001
Max value of 1

Orders of magnitude

DTAx\_10/90 weighted avg

Log10(DTA\(_X\)6)
Modeled DTA indicator

DTA

Cutoff 10 and 90 % area
Weighted average

Min value of 0.001

Max value of 1

1 order of magnitude

Orders of magnitude

Log10(DTA6)

1 order of magnitude
DTAx(0.34) – normalized (world average)

DTAx indicator = \( \frac{DTAx}{DTAx_{world}} \)

Orders of magnitude

2 orders of magnitude
AMD – range 0.1 - 100

3 orders of magnitude

Max value of 100
AMD – range 0.1 - 1000

4 orders of magnitude

Max value of 1000