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*CIRAIG, École Polytechnique de Montreal*
*WULCA Chair and project manager*

Samuel Vionnet
*Quantis, Water Expert*
PLAN

- Presentations
- Water Cycle and related problems
- LCA: the basis of water footprinting
- Water Footprint: ISO 14046, definition and metrics
- Water footprint step by step
- Examples of application
- Tools available and input from practitioner
- WULCA: current developments
A Water Problem?
Water Natural Cycle

Adapted from Source:
URL: http://ga.water.usgs.gov/edu/watercycle.html
Water: How much is there?

Precipitation on land:
119’000 km³ / year (100%)

Evaporation and transpiration (62%)

Runoff (38%)

Human water use (3%)

2.1% 0.3% 0.6%
Water: what is the problem?

“There is a water crisis today. But the crisis is not about having too little water to satisfy our needs. It is a crisis of managing water so badly that billions of people - and the environment - suffer badly.”

- 3900 children die every day from water borne diseases
- 1 out of 6 people lack access to safe drinking water
- 8 Mighty rivers are running dry from overuse, greatly affecting humans and ecosystems (Colorado, Indus, Amu Darya, Syr Darya, Rio Grande, Yellow, Teesta and Murray)

→ WATER IS NOT EQUALLY DISTRIBUTED IN TIME AND SPACE, AND ITS QUALITY IS DEGRADING AROUND THE GLOBE
Water quantity issues

Source: Boulay et al, 2013
The water footprint: making a link between consumption in one place and impacts on water systems elsewhere

Endangered Indus River Dolphin

[Photo: WWF]
Signs of global water pollution

Devecser, Hungary, Oct. 5, 2010

Source WFN, 2012
Signs of global water pollution

Source WFN, 2012
The water footprint stream: Initiatives and timeline

- 2007: Better accounting of water within the Global Reporting Initiative
- 2007: Launch of the CEO Water Mandate
- 2008: August Life Cycle Initiative
- 2008: Launch of the Alliance for Water Stewardship
- 2009: Start of ISO 14’046 work
- 2009: CDP Water Questionnaire
- 2010: Although existing since a long time, becomes more and more important
- 2009: WULCA, WF Framework
- 2007: WULCA, WF Framework
- WBCSD guide
- BIER first guidelines on water footprint
- GEMI
- Global Water Tool
- GRI
The water footprint stream: Initiatives and timeline

- **2011**
  - Draft 2
  - Release of one of the most extensive WF database on crops

- **2012**
  - Local water tool
  - WULCA, Review of methods

- **2013**
  - Ecoivent v3 Integrates water comprehensively
  - Water valuation Guidelines

- **2014**
  - ISO 14'46 published
  - AWS Water Stewardship Standard Certification system to be ready by end 2014

(c) Quantis
As Kelvin said...

“If you can not measure it, you can not improve it.”
Life Cycle approach: a global view
Mid-point – damage conventional framework

Emissions and Waste
- Pesticide
- SO$_2$
- Cu
- CO$_2$
- Phosphate
- ...

Energy and Resources
- Irrigation
- Water
- Crude Oil
- Iron Ore
- ...

Other:
- Mid-point
- – damage
- conventional
- framework
Electric car: Better or Worst?

Zero emissions?

Emissions elsewhere!
Mid-point – damage conventional framework

- Methodological tool, decision making
- Quantifies potential environmental impacts
- Entire life cycle of a product
- ISO standards 14 040/44

Energy and Resources

Irrigation
Water
Crude Oil
Iron Ore

Global warming
Water availability
Acidification
Eutrophication
Land use
Biotic resource use
Abiotic resource use

Ecosystem Quality
Resources

Jolliet 2004, Life cycle initiative
Comparison of alternatives

![Graph showing the comparison of different alternatives in terms of climate change, resources, human health, and ecosystem quality. The graph indicates the percent of XLERATOR impact across different categories such as materials production, manufacturing, transportation, use, and end of life.](Source: © CIRAIG 2013, used with permission)
Food packaging: Angel or Demon?

Source: © CIRAIG 2013, used with permission
Individual packaging: Angel or Demon?
Innovations stemming from life cycle thinking

Cold water detergents

Inverted bottle to stop wasting the last 5% of the product

Source: © CIRAIG 2013, used with permission
Environmental labeling

Type II (ISO 14021)
Self-declared claims

- Established by the manufacturer
- Usually based on a single environmental criteria
- No verification
- No threshold criteria
- Example: “recycled content, biodegradable”

Type I (ISO 14024)
Ecolabels

- Life Cycle thinking based
- Points to best alternative in a product category
- Threshold criteria
- Third party verified

Type III (ISO 14025)
Environmental product declaration

- Life Cycle Assessment based
- Analogy: Nutritional facts
- Third party verified
- Registered trademark

Source: © CIRAIG 2013, used with permission
Environmental labeling

Source: © CIRAIG 2013, used with permission
Apple

The story behind Apple’s environmental footprint.

Apple reports environmental impact comprehensively. We do this by focusing on our products: what happens when we design them, what happens when we make them, and what happens when you take them home and use them.

2011 Total Footprint

- Manufacturing: 61%
- Transportation: 5%
- Product Use: 30%
- Recycling: 2%
- Facilities: 2%

Toxic Materials Removal

Our entire product line — Mac, iPad, iPhone, iPad, and accessories — is free from many toxic materials used by others.

- Lead-free
- BFR-free
- PVC-free
- Mercury-free
- Arsenic-free glass

CO₂ Emissions per Hour of Product Use*

- 60-Watt Incandescent Light bulb: 48.4g
- 13-Watt CFL Light bulb: 10.5g
- 2011 Mac mini: 10.5g
- 2011 11” MacBook Air: 7.4g
- 2011 iPad 2: 2.5g
- 2011 Apple TV: 1.7g
- 2011 iPhone 4: 1.2g

Source: © CIRAIG 2013, used with permission

http://www.apple.com/environment/
A water footprint, is an LCA which includes only the water-related impacts

- Same use, interpretation and opportunities with a specific water-related scope
- Since it does not include all impacts, it cannot serve to claim product superiority
- Different types of water footprint exists, based on which “water-related impacts” are considered. They have different labels.
From inventory, to risk, to impacts...

Inventory of water use and emissions

Water-related problems (midpoint)

Water-related damages (or endpoint)

WATER FOOTPRINT

Water Inputs
- Surface water
- Groundwater
- Turbid water

Water Outputs
- Thermally polluted water
- Water consumed

Water-Related Problems
- Pollution
- Toxicity
- Acidification
- Eutrophication

Impact Categories
- Human health
- Ecosystem quality
- Resources

Impact Units
- [DALY / y]
- [PDF m^3 yr / y]
- [MJ / y]
Types of water footprint metrics and assessments
Water Footprint Network (WFN)

A Volumetric Approach:

Blue water

Green water

Grey water
Water Footprint components (WFN)

**Green water footprint**
- volume of rainwater evaporated or incorporated into product

**Blue water footprint**
- volume of surface or groundwater evaporated or incorporated into product

**Grey water footprint**
- volume of water needed to assimilate pollution

Source: Water Footprint Network
ISO 14046: Water footprint: Principles, requirements and guidelines

Developed in an international consensus-based process 2009 – 2014

Approved in May 2014

Published in August 2014
ISO 14046 WATER FOOTPRINT

IMPORTANT CONCEPTS

– Should be life-cycle based

– Could be “stand-alone” or part of a full Life Cycle Assessment

– Results should include impact assessment (volumes not sufficient) and address regional issues

– Both quantity and quality should be considered

– Comprehensive impact assessment related to water (not only water use but all impacts related to water)

– Can result in one or several indicators
## Water Footprint types as per ISO 14046

<table>
<thead>
<tr>
<th>Profile of midpoint indicators</th>
<th>Water availability</th>
<th>Water degradation</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIDPOINT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Profile of midpoint indicators</td>
<td>- Water scarcity footprint OR - Water availability footprint</td>
<td>- Human toxicity - Ecotoxicity - Eutrophication - Acidification</td>
</tr>
<tr>
<td>ENDPOINT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Human health</td>
<td>- Malnutrition and/or water related diseases</td>
<td>Human toxicity</td>
</tr>
<tr>
<td>Ecosystems</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ecosystems</td>
<td>- Terrestrial ecosystems - Aquatic ecosystems</td>
<td>- Ecotoxicity - Eutrophication - Acidification</td>
</tr>
</tbody>
</table>

“qualified” water footprint (ex: “degradation” WF, “scarcity” WF, etc)
Types of Water Footprints

LCA

Other Footprints

Carbon Footprint

Water Footprint

Water Degradation Footprint

Water Availability Footprint

Water Scarcity Footprint

Reduced water availability from consumption and degradation + direct pollution impacts

Reduced water availability from consumption and degradation

Reduced water availability from consumption
ISO 14’046 and WFN

WFN framework

- **Phase 1**: Setting goals and scope
- **Phase 2**: Water footprint accounting
- **Phase 3**: Water footprint sustainability assessment
- **Phase 4**: Water footprint response formulation

LCA framework

- **Goal and scope definition**
- **Inventory analysis**
- **Impact assessment**
- **Interpretation**

Generic framework steps

- Setting the goal and scope
- Accounting phase
- Impact assessment phase
- Interpretation and solutions

Complementarities of Water-Focused Life Cycle Assessment and Water Footprint Assessment

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‡CITI, Wageningen University, Wageningen, The Netherlands
§EPFL, Lausanne 1015, Switzerland
Impact pathway Framework for Freshwater use

Water Inventory

Change of water availability (Scarcity/Stress)

LCA of backup technology

Socio-economic assessment

Malnutrition

Water-related diseases

Human Health

Ecosystems

Resources (Future generations)

Areas of protection

Bayart et al, 2010
Detailed impact pathways

Inventory

Water Inventory
(Surface water, renewable groundwater, fossil groundwater)

Midpoint impacts

Volume of water unavailable to other users
Distribution of water deprivation

Scarcity

Water deprived for domestic users
Water deprived for agriculture
Water deprived for fisheries

Socio-economic parameter

Volume of water to be obtained through compensation

Endpoint impacts

Volume of water deprived causing health damages

Impact on human health

Water-related diseases effect per m³ deprived (dom)
Malnutrition effect per m³ deprived (agri)
Malnutrition effect per m³ deprived (fish)

Impact on ecosystems

Terrestrial species loss per m³ deprived
Aquatic species loss per m³ deprived

Impact on resources

Overuse of renewable water bodies
Fossil groundwater depletion

Source: Boulay et al, 2013
Distinction in water impact modeling

- Impacts on the water resource
  - Impacts from water use
    - Consumption
    - Degradation
    - Pollution emission affecting water

- Impact on human health from lower water availability
- Impacts on ecosystems from lower water availability
- Direct impacts from pollution*

* From traditional LCA models including eutrophication, ecotoxicity, thermal, etc.
From inventory, to risk, to impacts...

Water Availability

Impacts from water pollution

Water Footprint Assessment Profile

- Ionizing radiation
- Eutrophication
- Toxicity
- Land Use
- Acidification
From inventory, to risk, to impacts...

Water Footprint Profile

- Water Availability
- Impacts from water pollution

- Human Health
- Ionizing radiation
- Toxicity
- Ecosystems
- Land Use
- Resources
From inventory, to risk, to impacts…

Water Availability
Footprint

Impacts from water pollution

Water Footprint impacts

Water Footprint Assessment Profile

All other LCA impacts not related to water

Human Health

Ecosystems

Resources
1. How can doing a water footprint help your organization?
2. What are the main issues associated with the water resource?
3. What is the difference between a midpoint and an endpoint in LCA?
4. What decisions can an LCA help you with?
5. What are the 3 areas of protection identified in LCA?
6. What is the difference between impacts from water use and impacts on the water resource?
7. What types of impacts are caused by water pollution?
8. What is the main difference between the Water Footprint Network methodology and a life cycle-based water footprint?
STEPS OF A WATER FOOTPRINT

- Goal and scope
- Inventory
- Impact assessment
- Interpretation
Goal and Scope

Decision tool: which decision?
Internal, public?
Time and money available
→ Type of water footprint
A WATER FOOTPRINT INVENTORY IS THE COMPILATION AND QUANTIFICATION OF INPUTS AND OUTPUTS RELATED TO UNIT PROCESSES MAKING UP THE PRODUCT SYSTEM

THE INVENTORY IS MUCH MORE THAN JUST WATER VOLUMES, IT ENCOMPASSES ALL INPUTS AND OUTPUTS OF A PRODUCT SYSTEM THAT MAY RESULT IN ENVIRONMENTAL IMPACTS ASSOCIATED WITH WATER
Water Footprint Inventory
Useful definitions

**Drainage basin:**
Area from which direct surface runoff from precipitation drains by gravity into a stream or other water body (ISO DIS 14046)

**Water Withdrawal:**
Anthropogenic removal of water from any water body or from any drainage basin, either permanently or temporarily (ISO DIS 14046)

**Water Consumption**
Water removed from but not returned to the same drainage basin (ISO DIS 14046)

**Elementary water flow**
Water entering the system being studied and that has been drawn from the environment, or water leaving the system being studied that is released into the environment (ISO DIS 14046)

**Technosphere water flow**
Water embedded in the system being studied and that has been drawn from the environment at some previous stage in the product system
Area from which direct surface runoff from precipitation drains by gravity into a stream or other water body (ISO DIS 14046)
Water balance for consumptive water use

water IN = water OUT

ecoinvent version 3

(c) Ecoinvent, use with permission
(Levova et al, LCAXIII, Orlando, 2013)
Pork water inventory in low water stressed region - Results

- **Slaughter**
- **Slaughter – infrastructure and energy**
- **Breeding**
- **Breeding – infrastructure and energy**
- **Avoided impact – fertilizer (from manure)**

### Freshwater withdrawal

- **Surface water**
  - Litre / kg of meat: 92
- **Ground water**
  - Litre / kg of meat: 71
- **Cooling water withdrawal**
  - Litre / kg of meat: 168

### Water released

- **Water released**
  - Litre / kg of meat: 53
- **Thermally polluted water released**
  - Litre / kg of meat: 44
- **Consumed water**
  - Litre / kg of meat: 22

(c) Quantis
A t-shirt – Example of Switcher

- Environmental labelling of Switcher products
  - Carbon footprint – climate change
  - Water footprint – water consumption and associated impacts

(c) Quantis
A VOLUMETRIC INVENTORY IS INSUFFICIENT FOR ASSESSING A WATERFOOTPRINT BECAUSE RESULTS OF SUCH INVENTORY AND THE IMPACTS RELATED TO WATER ARE OFTEN NOT CORRELATED.
Data sources and database

- econvent Centre
- Quantis Water Database
- GaBi Database Content
- Water Footprint Network
- Other publications
1. What is a water footprint inventory?
2. Why is regionalization important in performing an inventory?
3. What decision can a water inventory help you make?
4. What is the difference between an elementary flow and a technosphere flow?
5. Does a water footprint inventory only contain water flows? Explain.
6. What information is essential in a water footprint inventory?
7. What is the difference between water withdrawal and water consumption?
BREAK
STEPS OF A WATER FOOTPRINT

- Goal and scope
- Inventory
- Impact assessment
- Interpretation
At this point, water scarcity or water availability indicators are being used as generic midpoints for water consumption in LCA, until ecosystem-specific midpoint become available. WULCA’s development on the topic is presented at the end of this training.
Availability assessment

- Can be associated with a midpoint assessment in LCA
- Most methods are related to a water scarcity index
  - **Withdrawal to availability ratios (WTA)**
    (Pfister et al. 2009; Ridoutt and Pfister 2010b; Frischknecht et al. 2006; Veolia 2011; Milà i Canals et al. 2009)
  - **Consumption to availability ratios (CTA)**
    (Boulay et al. 2011; Hoekstra et al. 2011).
- Are used as a Characterization Factor (CF) to assess impacts from:
  - **Water withdrawal**
    (Ridoutt and Pfister 2010b; Frischknecht et al. 2006; Veolia 2011),
  - **Water consumption**
    (Boulay et al. 2011; Pfister et al. 2009 Hoekstra et al. 2011; Milà i Canals et al. 2009)
  - **Water Degradation**
    (Hoekstra et al. 2011; Veolia 2010; Boulay et al. 2011).
Consumption-to-availability ratio
Problem (midpoint) impacts: quality

Do you know what these mean?

• Human toxicity
• Ecotoxicity
• Eutrophication
• Acidification
Example of application: Water Footprint at the problem level (midpoint)
Example: Water Footprint from a load of laundry

Various European countries and India
Spain

France

Evaporation

Energy

Water

Source: Boulay et al (2013b)
**Methodology overview - Midpoint**

**Water Footprint profile at midpoint:**

**Water availability and water degradation**

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Water Availability</strong></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Scarcity</td>
</tr>
<tr>
<td>Pfister et al.</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Boulay et al.</td>
</tr>
<tr>
<td>1</td>
<td>Swiss Eco-Scarcity</td>
</tr>
<tr>
<td>1</td>
<td>WFN, Hoekstra et al.</td>
</tr>
<tr>
<td>1a</td>
<td>Availability</td>
</tr>
<tr>
<td>Boulay et al.</td>
<td></td>
</tr>
<tr>
<td>1a</td>
<td>Veolia Impact Index, Bayart el al.</td>
</tr>
<tr>
<td><strong>Water Degradation</strong></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Eutrophication</td>
</tr>
<tr>
<td>ReCiPe</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Acidification</td>
</tr>
<tr>
<td>Impact 2002+</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Ecotoxicity</td>
</tr>
<tr>
<td>USEtox</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Human Toxicity</td>
</tr>
<tr>
<td>USEtox</td>
<td></td>
</tr>
</tbody>
</table>

→Only one method needed

Midpoint Water Footprint profile

Water Scarcity indicators

Water degradation indicators

End-of-life: packaging
End-of-life: product
Use: heating energy and moving the drum
Use: tap water
Manufacturing
Suppliers

Ecotox: 4.18E+00 CTUe
Eutrophication: 1.21E-04 kg P-eq
Acidification: 1.25E-03 kg SO2-eq
Human Tox: 8.14E-08 CTUh

Manufacturing
Suppliers
Scarcity vs availability

Results in m3 equiv.

End-of-life: packaging
End-of-life: product
Use: heating energy and moving the drum
Use: tap water
Manufacturing

Source: Boulay et al (2013b)
1. What information is used to calculate water scarcity?

3. What are the specific water pollution impact categories? Describe each of them.

4. What is the difference between scarcity and availability?

5. Which indicators do you need at a minimum to perform a water footprint at the midpoint?

6. What type of assessment can you perform if you do not have any water quality information?
Damage (endpoint) impacts: availability

Inventory
- Water Inventory (Surface water, renewable groundwater, fossil groundwater)
- Source: Boulay et al (2013a)

Midpoint impacts
- Scarcity/stress
  - Water functional? (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
  - Assessment of disruption of water balance
  - Overuse assessment
  - 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

Endpoint Impacts
- Socio-economic parameter
  - Volume of water to be obtained through compensation
  - Volume of water deprived causing health damages
  - Water-related diseases effect per m³ deprived (dom)
  - Malnutrition effect per m³ deprived (agri)
  - Malnutrition effect per m³ deprived (fish)
  - Terrestrial species loss per m³ deprived
  - Aquatic species loss per m³ deprived
  - Impact on human health
  - Impact on Ecosystems
  - Impact on Resources

Compensation processes
Impacts are assessed in DALY: Disabled adjusted life years
Human Health
Dependent on the level of human development and economic welfare

Water use ultimately leads to an aggregated impact on human health, generally expressed in disability-adjusted life years (DALY)

- Lack of freshwater for hygiene and ingestion (spread of communicable diseases) (Motoshita et al. 2010b; Boulay et al. 2011b)

- Water shortages for irrigation resulting in malnutrition (Pfister et al. 2009; Motoshita et al. 2010a; Boulay et al. 2011)

- Water shortage for freshwater fisheries resulting in loss of productivity and food supply (Boulay et al. 2011b).
Ecosystems impact pathways
(adapted from Kounina et al. 2012)

Scopes of methods developed are complementary

Impacts are generally assessed in PDF. Potentially disappeared fraction of species
Example of application: Water Footprint at the damage level (endpoint)
Example: Water Footprint from a load of laundry

Source: Boulay et al (2013b)
## Ecosystem Water Footprint

### IMPACTS FROM WATER CONSUMPTION

<table>
<thead>
<tr>
<th>Ecosystem impacts in PDF*(m^2)yr</th>
<th>Terrestrial species</th>
<th>Groundwater level</th>
<th>Aquatic species</th>
<th>Ecotox</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total:</td>
<td>3.58E-03</td>
<td>2.40E-04</td>
<td>2.22E-05</td>
<td>4.59E-03</td>
</tr>
</tbody>
</table>

### IMPACTS FROM WATER DEGRADATION

<table>
<thead>
<tr>
<th>Ecosystem impacts in PDF*(m^2)yr</th>
<th>Terrestrial species</th>
<th>Groundwater level</th>
<th>Aquatic species</th>
<th>Ecotox</th>
<th>Eutrophication</th>
<th>Aquatic acidification</th>
<th>Thermal pollution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4.76E-03</td>
<td>2.21E-05</td>
<td>4.97E-06</td>
</tr>
</tbody>
</table>

### Source:
Boulay et al (2013b)
Endpoint WF profile  Human health

Human health water footprint indicators

Daly per load of laundry

- End-of-life: packaging
- End-of-life: product
- Use: heating energy and moving the drum
- Use: tap water
- Manufacturing
- Suppliers

Human Tox

E-Motoshita agri
E-Motoshita dom
E-Pfister
E-Boulay distri
E-Boulay Marg

4.5E-07
4.0E-07
3.5E-07
3.0E-07
2.5E-07
2.0E-07
1.5E-07
1.0E-07
5.0E-08
0.0E+00

4.24E-07
1.59E-09
1.54E-11
1.72E-11
7.51E-10
5.35E-10


Source: *Boulay et al (2013b)*
1. How may water consumption affect human health?
2. How are impacts from human health assessed for water consumption in developed countries?
3. What is the advantage of presenting results at the endpoint?
4. What types of impacts on the ecosystems are caused by water consumption?
5. What types of water footprint results can you present if you go to the endpoint?
Examples

(until 3:45 pm)
Case study: Water scarcity and water footprint of Intel

2010 Corporate Responsibility Report
Intel case study: Importance to assess impacts

Water use (m³)

Scarcity weighted water us

(c) Quantis
Intel case study: Water scarcity footprint at the endpoint

<table>
<thead>
<tr>
<th></th>
<th>Water inventory x10^3 m³</th>
<th>Simplified water stress assessment x10^3 m³ equivalent</th>
<th>Human health DALY</th>
<th>Ecosystem quality PDF.m2.y</th>
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<td>Ronler Acres, OR</td>
<td>5,761</td>
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Of total freshwater withdrawal, 43% is consumed.
Human health impacts are dominated by direct and indirect **toxic emissions** to the environment. 

*Little irrigation* in Brazil.

Ecosystem quality impacts are dominated by **freshwater consumption** (crop irrigation). Freshwater **eutrophication** (fertilisers) and **ecotoxicity** are also contributors (herbicides).
Example of water inventory results
1 kg maize cultivated in China

Of total freshwater withdrawal 48% is consumed
Human health impacts are dominated by direct and indirect toxic emissions to environment.

Freshwater consumption impacts are due to irrigation water use.

Ecosystem quality impacts are dominated by freshwater consumption (crop irrigation).
Danone – The water footprint of bottled water

System studied: Evian bottled water

- Four different production sites assessed in this project

(Water Stress Index map per country (Pfister et al. 2009))
Danone – Life cycle of a bottle of water

- Packaging
- Energy used at bottling plant
- Bottling plant
- Distribution and use
- End-of-life (packaging)

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Danone – Inventory analysis

Water Withdrawal

- Energy and industrial processes use a lot of water
- Spring water pumped

Water Returned

- A lot of water used in returned (not consumed)
- Water evaporated from hydroelectricity (turbined water is not shown on this graph)

- 4.3 l consumed water per litre of bottled water (no longer available for other users)

Surface water

- 1.9
- 0.6
- 0.5

Groundwater

- 1.6
- 1.4
- 1.8

Cooling Water

- 14.1
- 4.9
- 4.6
- 2.0
- 1.0
- 0.5

Released Water

- 11.3
- 4.7
- 4.2
- 0.6
- 1.0
- 2.3
- 0.4
- 1.2

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Overview of the results - Ecosystem impacts (biodiversity)

Pollution of water is an important issue (indirect pollutant emission to water from incineration at end of life)

PET production happens in a water stress region

A lot of industrial processes use electricity and thus turbined water

Ecosystems impact per litre of bottled water

Impact categories

Packaging end-of-life
Use stage
Product distribution / storage
Secondary / tertiary packaging
Primary packaging
Energy use at site
Water incorporated into product
Production site
Total

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Engage with stakeholders to reduce water footprint (watershed level)

- Reducing water pollution using waste water treatment plants
  - Reduction of 2’600’000 m$^3$ of grey water at Evian watershed per year
  - Engage with local villages and towns inside the watershed to support the creation of waste water treatment plant

- Reducing water pollution through a change in agricultural practices
  - Prevention of 400’000 m$^3$ of grey water per year at the Evian site through label (organic production) and best practice agriculture

- Improvement of ecosystem quality through wetlands and ecosystem maintenance
  - Benefit for the biodiversity app. 400’000 PDF·m$^2$·y at Evian watershed per year

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Inventory results

Energie
Déchets
Eau (usage direct)
Carton
Electricité
Sucre et arômes
Agriculture
Achats vin et alcohol

Raw materials (supply chain) accounts for more than 99% of water used

Production sites water used is low compared to the total consumed

Consommation d’eau (hm^3/an)

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Priorisation des filiales et sites de production

Water consumption is the highest where water scarcity is high.

Potential physical risk. Prioritisation of Pernod Ricard actions on those sites

Water withdrawal: affiliates benchmark

Water stress assessment: affiliates benchmark

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Tools available and input from practitioner
Tools

- Regionalization not yet operationalized
- Tools don’t integrate water footprint methods yet
Method development: the WULCA working group of the UNEP/SETAC Life Cycle Initiative
UNEP/SETAC Life Cycle Initiative

Water Use in LCA (WULCA)

Founded in 2007, now includes → 100 experts from 21 countries

- **Phase 1**: Proposed a framework to evaluate water in LCA (Bayart et al. 2009)
- **Phase 2**: Review of different methods (Kounina et al. 2012)
- **Phase 3**: Quantitative comparison (Boulay et al A and B, under review)

**Current mandate (2014-2015):**

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

[www.wulca-waterlca.org](http://www.wulca-waterlca.org)

Anne-Marie Boulay, Ph.D. (Canada)
Project Manager

Stephan Pfister, Ph.D. (Switzerland)
Deputy Manager
Water Inventory (Surface water, renewable groundwater, fossil groundwater)

Impact on human health

Volume of water to be obtained through compensation

Impact on Ecosystems

Impact on Resources

Compensation processes

Volume of water to be obtained through compensation

Inventory from compensation processes

Human health specific midpoint

Stress-based generic midpoint

Ecosystem specific midpoint

Resource specific midpoint
References

Please visit:
http://wulca-waterlca.org/publications