LIFE CYCLE ASSESSMENT OF ANTHROPIC WATER

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Introduction

In its Regional Policy Statement for 2009-2014, the **Walloon Government (Belgium)** undertakes to make Wallonia a model of good governance. Applying this principle in the field of the environment needs to be based on a continuous, objective and strict evaluation of the evolution of the state of environmental components (air, water, soil, biodiversity, etc.), the pressures to which they are subjected, the resultant impacts and the measures taken to improve living conditions within our Region. Within this framework, the General Operational Direction of Agriculture, Natural Resources and Environment (DGARNE) realizes reports on the state of the environment in Wallonia, in close collaboration with universities and research centers. A chapter is dedicated to the **efficient use of water resources,** including a **life cycle assessment of anthropic water**.

Materials and Methods

Goal definition

The aim of this study is to assess environmental impacts of anthropic water consumed by Walloon citizens, from its collection to its discharge and treatment. The study also includes the collection and consumption of 6.4% of rain-water in addition of the tap water.

Methods

The environmental impacts of anthropic water are assessed using the Life Cycle Assessment methodology, ILDC 2011 [2] and **ReCiPe** 2008 methods (European hierarchist version, update 2014, v1.1) [3]. This study is done in accordance with the ISO standards 14040 [4] and 14044 [5].

Figure 1 presents common steps of the water cycle.

The functional unit (FU) is 1 m³ of water for the Walloon citizen's consumption (including both tap water and rainwater). Time reference is year **2010**.

A model for the whole water cycle is elaborated in order to assess the impact of the different phases of the process, and to emphasize the importance of the different elements in each step. The model includes seven essential steps: 1/ Collection and treatment of surface and ground water, 2/ Water mains, distribution and connections, 3/ Rainwater harvest, 4/ Sewers, 5/ Municipal Wastewater Treatment Plants (MWTP), 6/ Compact Domestic Wastewater Treatment Plants (CDWTP), and 7/ Water elimination without any treatment.

Inventory data includes construction materials, chemicals consumption, energy consumption, output water streams (liquid discharge and sludges). Construction, earthwork, transport of materials and chemicals, and direct land use, are not included in LCI.

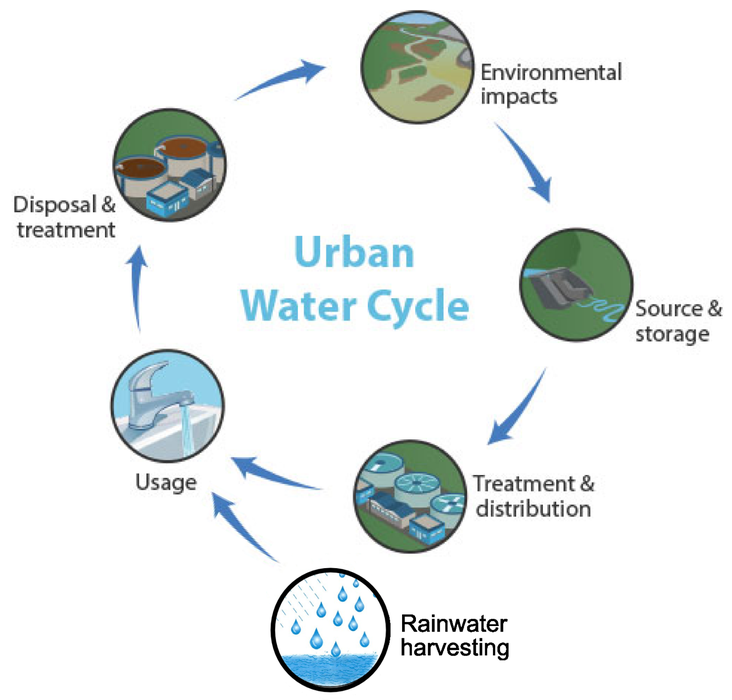

Figure 1. Water Cycle Stages [1]

Water balance in the Walloon Region (2010): 172 Mm³ consumed, including: 161 Mm³ of tap water (composed of 80% of groundwater and 20% of surface water)
11 Mm³ of rainwater

Wastewater treatment equipment (2010): 76.2% including 75.2% of MWTP and 1 % of CDWTP

Results and Discussion

Main results of this study are presented in Figure 2 and 3 for 1 FU. The commercial Ecoinvent database [6] is used for generic data needed of the model, in SimaPro 8.0.2 (PRé-Consultant). Electricity corresponds to the Walloon regional mix in 2010 (Nuclear: 67%, Natural gas: 23.6%, Renewable: 8.5%).
Summary available here (in French): *http://etat.environnement.wallonie.be/index.php?page=etudes-detaillees*

Summary:

- **Most impacting steps of the cycle** (Figure 2)
  - Municipal Wastewater Treatment Plants
  - Collection and treatment
  - → ***chemicals and electricity***
  - Distribution: → ***pig iron, steel***
  - Discharge without treatment
- **Most impacted categories** (Figure 3)
  - Eutrophication (Freshwater > Marine)
  - Freshwater ecotoxicity
  - Human toxicity
  - (Metal depletion)

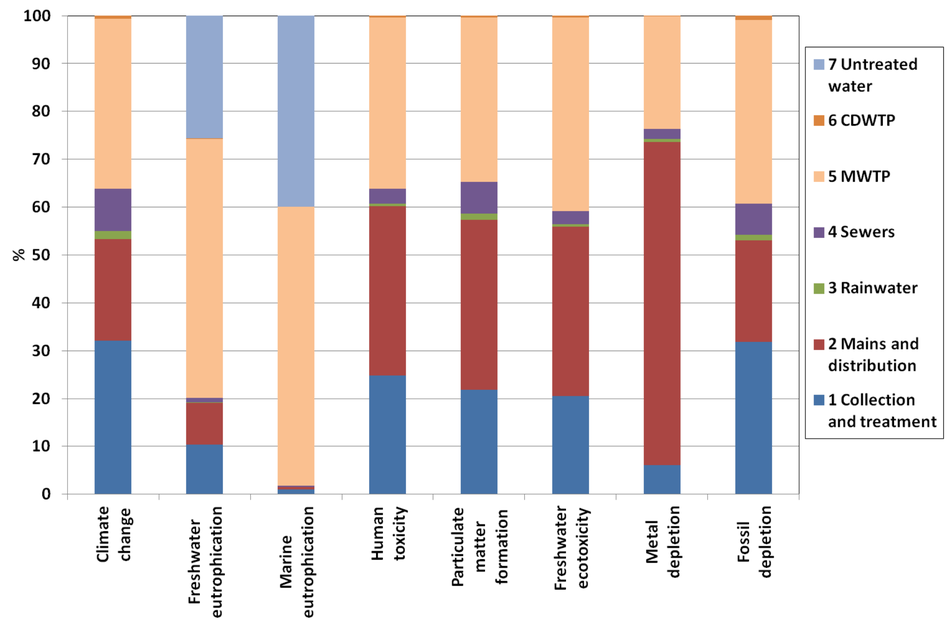

Figure 2: Relative contribution of each step of anthropic water

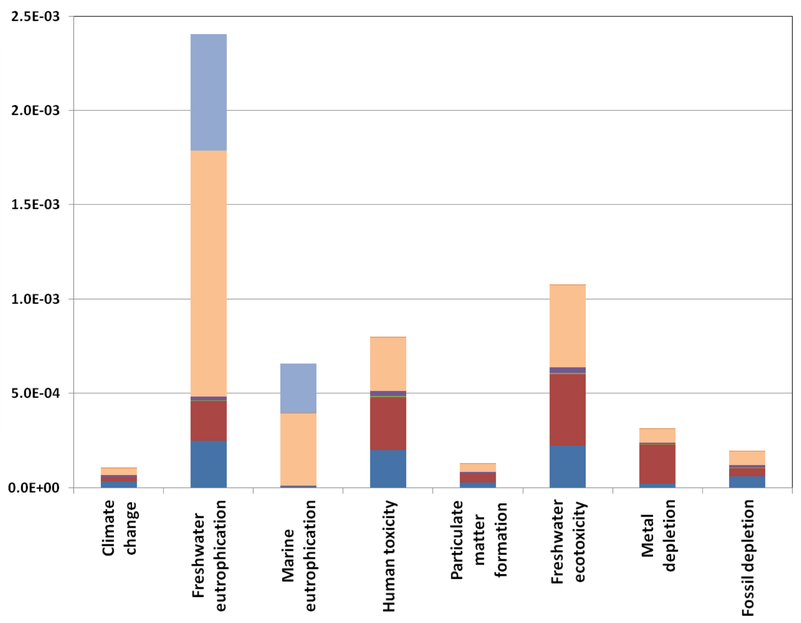

Figure 3: Normalisation of impact of anthropic water

Conclusions

The life cycle assessment of anthropic water points up the way that water consumption by Walloon citizens affects globally the environment. The most impacting steps of the process are highlighted as well as the most affected impact categories. The survey of the way each step influences negatively ecosystems provides some approaches to improve the global environmental impact of human water consumption in the future (e.g. intensive treatment systems /wetlands to complete the equipment in MWTP).

Remark: Sanitary and health improvements for humans and environment are not taken in account because no measurement of toxic pollutants or pathogenic micro-organisms is made in routine and included in the inventory data. These essential benefits that we owe to (waste)water treatment are then underestimated in this LCA.

References

[1] http://www.usaus-h2o.org/modules/source-and-storage/

[2] European Commission - Joint Research Centre - Institute for Environment and Sustainability (2010). International Reference Life Cycle Data System (ILCD) Handbook - General guide for Life Cycle Assessment - Detailed guidance. First edition March 2010. EUR 24708 EN. Luxembourg., Publications Office of the European Union

[3] Goedkoop, M., et al., ReCiPe 2008 - A life cycle impact assessment method which comprises harmonised category indicators at the midpoint and the endpoint level, Ruimte en Milieu, Editor 2009

[4] ISO 14040:2006 Environmental management - Life cycle assessment - Principles and framework

[5] ISO 14044:2006 Environmental management - Life cycle assessment - Requirements and guidelines

[6] Ecoinvent Centre, The life cycle inventory data version 3.01, 2014. Swiss Center for Life Cycle Inventories. http://ecoinvent.ch/