

Regionalised assessment of fresh water abstraction within the ecological scarcity method 2006



Rolf Frischknecht

LCA discussion forum 35: Assessment of water use within LCA
ETH Zürich, June 5, 2008

Contents

- Basic layout of ecological scarcity 2008
- Regionalised assessment of water use
- Case studies
- Conclusions

ecological scarcity method (ES 2006)

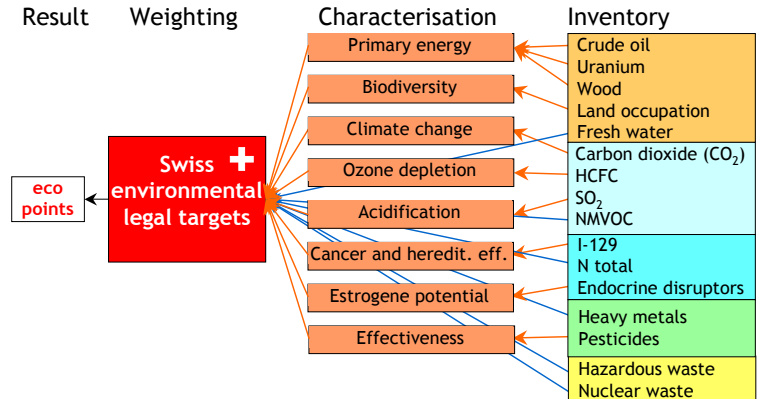
Purpose:

- Aggregation of pollutants according to **politically defined** scarcity

Characteristics:

- fully aggregating
- considers manifold environmental impacts (and wastes)
- bases on Swiss and international environmental legislation

Basic layout



ecological scarcity formula

$$w_i = \underbrace{1UBP}_{\text{Charakterisierung (optional)}} \cdot \underbrace{\frac{K_j}{F_{n,i}}}_{\text{Normierung}} \cdot \underbrace{\left(\frac{F_i}{F_{k,i}}\right)^2}_{\text{Gewichtung}} \cdot \underbrace{\xi}_{\text{Konstante (10e12)}}$$

w_i : ecofactor of elementary flow (emission, resource) 'i'

UBP : ecopoint (the unit)

$K_{r,i}$: characterisation factor regarding environmental impact 'r' of elementary flow 'i'

$F_{n,i}$: normalisation flow of elementary flow 'i'

F_i : actual flow of elementary flow 'i'

$F_{k,i}$: critical flow of elementary flow 'i'

normalisation, actual and critical flow

- overall emissions in Switzerland per year
- normalisation:
 - Emission individual elementary flow or
 - characterised impact indicator value
- actual and critical flow:
 - identical unit

basis for weighting

Political targets:

- compliance with Swiss environmental goals and legislation
- Basis: environmental protection law
no damage to humans, flora and fauna
- Political targets include technical and economic feasibility, social acceptance

fresh water use

- Freshwater is getting increasingly scarce in more and more world regions
- Large regional and local differences in scarcity
- Need for regionalised eco-factors
- Scarcity to be defined in relative terms
- Water stress index:
 - water consumption / renewable water resources
- References
 - Concept: UN 1997 / OECD 2004: Key environmental indicators
 - Data: FAO 2005: Aquastat database

Normalisation / Characterisation

- Method applied on Swiss situation
- Freshwater use in Switzerland:
2.57 km³ per year
(= normalisation flow)
- No characterisation applied

Weighting

$$\text{Weight (Region A)} = \left(\frac{\text{current flow in Region A}}{\text{critical flow for Region A}} \right)^2$$

$$= \left(\frac{\text{water consumption (Region A)}}{\text{renew. water resource (Reg. A) \cdot 20\%}} \right)^2$$

- critical flow = „medium water stress“
- „medium water stress“:
abstraction = 20% of renewable water resources

regional „water stress“

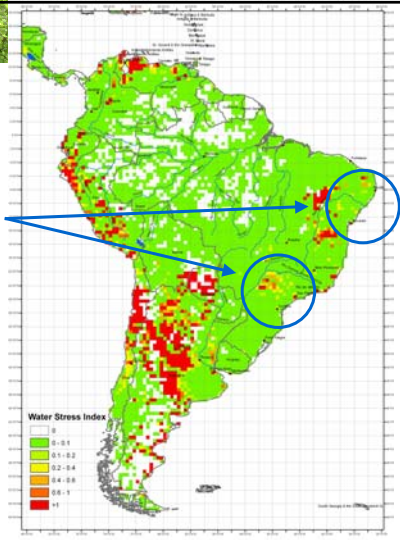
Category	water stress range	actual water stress	weighting factor
<i>low</i>	<0.1	0.05	0.0625
<i>moderate</i>	0.1 to <0.2	0.15	0.563
<i>medium</i>	0.2 to <0.4	0.3	2.25
<i>high</i>	0.4 to <0.6	0.5	6.25
<i>very high</i>	0.6 to <1.0	0.8	16.0
<i>extreme</i>	≥1	1.5	56.3

Grouping of countries

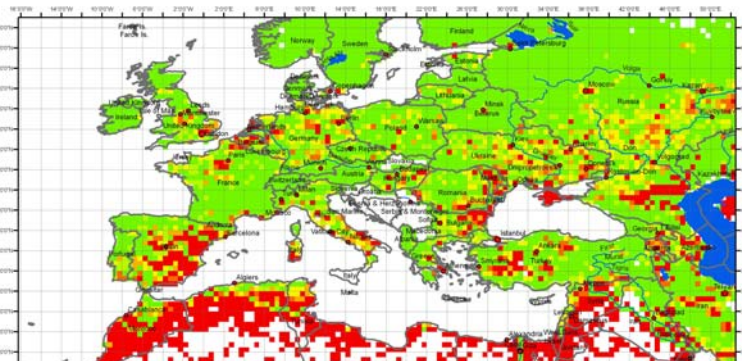
water stress category	weighting factor	countries
<i>low</i>	0.0625	Argentina, Madagascar, Russia, Switzerland
<i>moderate</i>	0.563	France, Greece, Mexico, USA
<i>medium</i>	2.25	Japan, Thailand, China, Germany, Spain
<i>high</i>	6.25	Algeria, Morocco, Sudan, Tunisia
<i>very high</i>	16.0	Pakistan, Syria, Tadschikistan, Turkmenistan
<i>extreme</i>	56.3	Israel, Jemen, Kuwait, Saudi-Arabia

Differentiation within South America

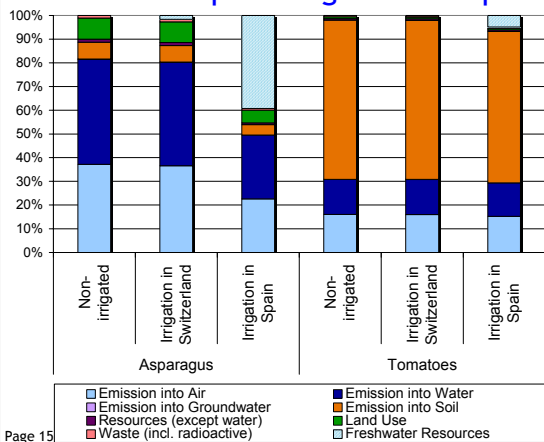
Sugar cane cultivation



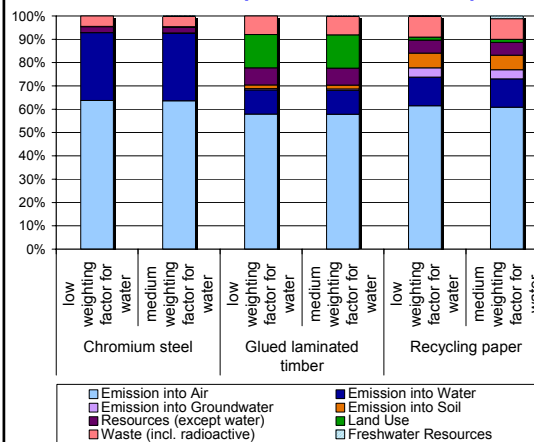
Differentiation within Europe



Example 1: agricultural products



Example 2: material production



Other new features

- land use: impacts on biodiversity
- gravel resource: included for the first time
- precautionary principle: applied on dioxins, benzene and diesel soot emissions
- heavy metals: long term soil fertility target
- micro pollutants: compatible assessment
- emission of phosphorus in surface water: regional scarcities considered
- radionuclide emissions to the Sea
- organic wastes to landfill: Carbon content targets used

Conclusions

- Assessment of water use based on widely used indicator: water stress index (FAO, OECD, UN, WWRDII)
- Allows for global, regional, national and local eco factors of water use
- Regional classification into six water stress levels, from low to extreme, avoids hundreds of individual elementary flows
- water use significant in LCAs of agricultural products from arid regions

Further Information

Report (in German; English version planned)

ecological scarcity method - ecofactors 2006

online at:

http://www.oebu.ch/oebu/downloads/oekofaktoren_sr28.pdf

impact factor files suited for LCA-Software

online at:

<http://www.esu-services.ch/cms/index.php?id=ubp06>

Questions: frischknecht@esu-services.ch