WULCA stress meeting
April 14th, 2014
Objective/discussion points

1. Reminder on current status
2. Jane’s request: discussion on inclusion of human and ecosystem’s needs in stress indicator
3. Blue and green water integration in stress indicator
4. Sources of data for ecosystem’s water requirements: terrestrial and aquatic
5. Points to discuss
6. General approach for the stress midpoint and causality chains (HH and EQ)
7. Next meeting/Presentation
Include Vulnerability Factors for HH \((VF_{HH})\) and EQ \((VF_{EQ})\) based on endpoint modelling.

The general structure could be:

\[
WIF_{\text{midpoint}} = f\left(\frac{\text{Consumption}}{\text{Availability}}\right) \times VF_{HH} \times VF_{EQ}
\]

The factors need to account for regional specific circumstances.

**PROS:** Represents elements of both ecosystems and human health impacts

**CONS:** care should be used to avoid implicit weighting
Sub-group summary: Stress (Approach B2)

Water needs from all users

Renewable water availability

Water needs- humans: water consumption

Water needs - ecosystems: needs to be investigated how this can be done with reliable science

Renewable water availability: considering only renewable water allows to reflect aquifer overuse

PROS: Generic – no weighting – simple

CONS: Challenge of representing ecosystems water needs in a reliable way, consult with ecologists?
Sub-group summary: Stress (Approach B2)

Scarcity/stress indicators existing so far

Human point of view:
- Human water use
- Water available

Ecosystem point of view:
- Human water use
- Water available – ecosystem requirements

Human water use + ecosystem requirements

Scarcity/stress = Water available

As per last meeting: Proposal from Jane to consider only human water use to be discussed
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3. **Blue and green water integration in stress indicator**
4. Sources of data for ecosystem’s water requirements: terrestrial and aquatic
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7. Next meeting/Presentation
2. Approach (b2) stress based on the ratio of all water users needs and water sources to available water

\[
\text{STRESS} = F \left( \frac{\text{Human Water consumption “needs” (NET green + blue) + ecosystems water needs}}{\text{Renewable water availability + green water availability}} \right)
\]

**NET green** = ETc – ETpnv = evapotranspiration studied syst. – evapot. potential natural vegetation

**Green water availability** = f(soil texture) or f(Precipitation – evapotranspiration)...

Stress defined following a human point of view:
(see minutes stress March 11 meeting)

For a global approach (HWU+EcWU), EWR aquatic ecosystems have to be added in the numerator
2. Approach (b2) stress based on the ratio of all water users needs and water sources to available water

\[ \text{STRESS} = F \left( \text{Human Water consumption (NET green + blue) + ecosystems water needs, Renewable water availability (+ green water availability)} \right) \]

Green water availability not included (only for practical reasons). There are maps such as Easily available water (FAO) that can be of usefulness.

Water consumption = WC industry + WC houses + WC agriculture + WC actual vegetation – WC potential vegetation

WC agriculture + WC actual vegetation = ETc actual

Actual vegetation is regarded as human made

Water availability = actual runoff? It could also be pristine runoff.
2. Approach (b2) stress based on the ratio of all water users needs and water sources to available water

\[
\text{STRESS} = F (\text{Human Water consumption “needs” (NET green + blue) + ecosystem water needs})
\]

\[
\text{Renewable water availability (+ green water availability)}
\]

Data sources* :

**Water consumption (mm/yr):**

**Water availability (mm/yr):**

* First rough calculation. Without considering possible inconsistencies of input maps used (e.g., base Precip., ET0...)}
Additional comments (AMB)

1. Need to add freshwater aquatic ecosystems requirements to numerator (not water consumption but water needs) → need to harmonize for both human and ecosystems: needs (minimal? Actual?)

2. For the denominator, if all renewable water is considered (blue and green), why not consider precipitation minus evaporation (not transpiration)?
   
   i.e. Since precipitation = runoff + evaporation + transpiration, then: available water = precipitation - evaporation

3. Do we want an index that represents the pressure on blue water resource, or on all water, blue and green?
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3. EWR: applied methods in watershed management plans (WMP) in Spain

- WMP have locally-calculated EWR, though data quality varies depending on the WTS
- Usually, data processing is required before using calculated local EWR (e.g., grouping of river sections into WTS, standardisation of units, application of methods to calculate EWR)

Applied methods:
- 1) Fixed annual or monthly average rate (~ Smakhtin)
- 2) Hydrological methods:
  - based on long-term statistics reported in WMP (e.g., Q5, Q21, Qavg month...).
  - The easiest to apply and the most applied
  - Output: monthly water body specific EWR
- 3) Ecological methods

Not discussed – postponed to next meeting
3. EWR in Spain: examples

Guadiana watershed

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Not discussed – postponed to next meeting
3. EWR in Spain: examples

Duero watershed (m³/s)

Not discussed – postponed to next meeting
Inga’s reference on EFR

1. Pastor et al. 2013
2. Compared several EFR methods and propose one global and applicable method for EWR, variable monthly flow (VMF) (fitted with case studies and within range of all other models)
3. Assessed monthly and regionalised % of flow required for *freshwater aquatic ecosystem* to remain in “fair“ ecological conditions
4. Authors contacted to obtain full data
Aspects to discuss

1. Temporal resolution
   AMB: Proposal to consider building monthly indicators and aggregate them to also provide an annual indicator

2. Terrestrial and wetlands water requirements
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7. Next meeting/Presentation
1. General approach for stress midpoint and causality chains based on fate/effect factors

- Stress midpoint

**FF:** does WC affect the water balance?

Option 1:
Watershed evaporation recycling (Berger et al. 2014)
→ Yes: 
LCI* (0.01 - 100%)
→ No: LCI* (0%)

Option 2:
Change in water cycle (e.g. Verones et al. 2013)
→ LCI*Δ change, Δ WC

**Noise:** Is this change important given the local water stress?

→ Yes: (new stress midpoint)
→ No: Not discussed – postponed to next meeting
1. General approach for stress midpoint and causality chains based on fate/effect factors

- Complete cause-effect chains

**FF**: does WC affect the water balance?

Option 1:
Watershed evaporation recycling (Berger et al 2014)
→ Yes: LCI*(0.01-100%)
→ No: LCI*

Option 2:
Change in water cycle (e.g. Verones et al 2013)
→ LCI*Δ change/Δ WC

**ExF**: is there any organism (human or ecosystem) exposed to the change in the water balance?

**EF**: which is the damage caused in exposed organisms?

Not discussed – postponed to next meeting

**LCI**: Incorporated in the **EF**
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7. Next meeting/Presentation + LCA Food paper