IMPACTS OF WATER CONSUMPTION:
UNCERTAINTIES AND THE QUESTION OF SCALE

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Question of scale

• **No water scarcity** on global average

• Different impacts:
  – Ecosystems
  – Humans
  – Stock/fund resources

• Especially relevant in *agricultural LCA*
  – Highly variable inventories
Uncertainties

• Uncertainty
  – Inventory
  – Impact assessment
  – Spatial

Any LCA

RegionalisedLCA

• Variability
  – Technology
  – Climate
    • Regional
    • Temporal

If LCA-value = f(location)

Spatial uncertainty reflects variability

Improve by increasing precision
Resolution issues

• Connect to inventory
Resolution issues

• Connect to inventory

• Maximize resolution

• Use weighted results for features
Water Impact Assessment (WIA)

– Midpoint and endpoint factors
  • compatible with Eco-indicator 99 (EI99)
– More than 11‘000 watersheds characterized (global coverage)

– Publicly available:

  • Google Earth layer:  
  • Reference:  
Aggregated damage factors

(based on EI99 average weighting)
How to use the regionalized “add-on”

- Impact factors in Google Earth

Application
Cotton example

- Analysis based on country level
  (inventory and impact factors)
Variability of regional impacts

- Water impacts and inventors highly climate-dependant
  - Big countries -> high variations

- Example **United States:**
  - Impact: 0.001 – 0.987 EI99pt/m3 (~ factor of 1000; average: **0.069**)
  - Inventory: infinite factor

Resolution is not enough: Use highest possible resolution
Simulated irrigation water consumption

- Neglected:

\[ \text{Yield} = f(\text{irrigation, temperature, fertilization, machinery, etc.}) \]
Impact assessment

Damage per m$^3$ water consumed

Damage per kg cotton
Production

- Statistical data
  - Uncertainty
  - Variability (annual)

Calculate production-weighted country average

Mainly non-irrigated production
### Difference in results

- **Cotton lint production:**
  - global & national average based on country data
  - national average based on local analysis

<table>
<thead>
<tr>
<th></th>
<th>Water consumption [m³]</th>
<th>Ecosystem Quality [PDF•m²•yr]</th>
<th>Human Health [E-06 DALY]</th>
<th>Resources [MJ]</th>
<th>Share of total Eco-indicator damage</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Global Average</strong></td>
<td>7.89</td>
<td>3.67</td>
<td>5.40</td>
<td>12.1</td>
<td>37%</td>
</tr>
<tr>
<td><strong>US average data</strong></td>
<td>1.34</td>
<td>0.42</td>
<td>0.003</td>
<td>2.51</td>
<td>7%</td>
</tr>
<tr>
<td><strong>US local assessment</strong></td>
<td>2.92</td>
<td>3.28</td>
<td>0.022</td>
<td>12.1</td>
<td>31%</td>
</tr>
</tbody>
</table>
Aggregate as late as possible!

• High spatial resolution:
  – Increased precision
  – Decreased accuracy

• Combine on country level:
  – Increased precision
  – Increased accuracy
Conclusions

• Calculate impact factors on highest resolution

• Define inventory flows as locally as possible
  – Provide link to inventories (e.g. country/global average)

• Aggregate factors as late as possible
  – Generic, process-specific data (supply chain modeling)

• Need for consistent uncertainty assessment
  – Impact factors and inventories
  – Trade off accuracy / precision
  – Overall decreased uncertainties
THANKS FOR YOUR ATTENTION!

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APPENDIX

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Example: US cotton production

Inventory (water consumption)

Impact factors

Reference:
Example: US cotton production

Production per watershed

Total water impact per watershed

Reference:
How to use our “add-on”

Click on Information Points “i” in relevant watershed

Water Stress Index = 0.1236

LCA impact factors (E199):
DALY (E-06 year) = 0
M2YR = 0.0843
MJ = 0

Human Health E199_PTS = 0
Ecosystem Quality E199_PTS = 0.0066
Resources E199_PTS = 0
Aggregated E199_HA_PTS = 0.0066