Sustainability assessment of common reed-based production

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Contents

1 Sustainability of using common reed
2 Methods assessing sustainability=
   2.1 Life-cycle assessment (LCA) +
   2.2 Multi-criteria (decision) analysis (MCA)
3 Description of an empirical setup
4 Discussion on methodological and empirical challenges
Sustainability of using common reed

- Common reed can be used for various purposes (energy, construction, fertilizer etc.)

- Utilization of common reed has several beneficial sustainability impacts:
  - Improved nutrient balance, positive biodiversity impacts
  - Recreational values improved, jobs for contractors
  - Economic profitability?
  - etc.

What is the most sustainable way to utilize common reed?
Methods assessing sustainability: Life-cycle assessment (LCA)

- Environmental impacts of a product from a gradle to a grave

<table>
<thead>
<tr>
<th>Characterized Impact assessment scores</th>
<th>Alternative A</th>
<th>Alternative B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Climate change</td>
<td>55 kg CO2-Eq</td>
<td>89 kg CO2-Eq</td>
</tr>
<tr>
<td>Acidification</td>
<td>17 kg SO2-Eq</td>
<td>10 kg SO2-Eq</td>
</tr>
<tr>
<td>Metal depletion</td>
<td>25kg Fe-Eq</td>
<td>8 kg Fe-Eq</td>
</tr>
</tbody>
</table>

• No unambiguous comparisons of alternatives!
Methods assessing sustainability: Multi-criteria (decision) analysis (MCA)

- MCA determines the decision alternative with the highest utility with respect to decision-makers preferences
- no advanced tools for assessing environmental (or other) impacts
Methods assessing sustainability
Life-cycle assessment (LCA) + Multi-criteria (decision) analysis (MCA)

<table>
<thead>
<tr>
<th>Characterized Impact assessment scores</th>
<th>Weight</th>
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</thead>
<tbody>
<tr>
<td>Alternative A</td>
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<tr>
<td>Climate change</td>
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<tr>
<td>Metal depletion</td>
<td>25 kg Fe-Eq</td>
</tr>
</tbody>
</table>

Single scores:
Alternative A = 32.01
Alternative B: = 35.31
Sustainability assessment of common reed-based production (a case-study in Eastern Finland)

Dimensions of sustainability

- Economic
- Ecological
- Social

Phases of life-cycle

- Cutting
- Transportation
- Processing
- End use and disposal

Compared alternatives

- Producing pellets from reed
- Producing construction materials from reed
- Nutriren removal with other way
- No actions
Economic sustainability of using common reed

Phases of life-cycle

1. Cutting
   - Costs are highly sensitive to the cutting technique

2. Transportation
   - Possibly the most relevant phase

3. Processing
   - Highly dependent on the products

4. End use and disposal
   - ++++

Compared alternatives

- Producing pellets from reed
- Producing construction materials from reed
- Nutrient removal with other way
- No actions
Ecolgical sustainability (=Life cycle ansessment) of using common reed

End use and disposal

Processing

Transportation

Cutting

Cutting biodiversity?

Impact categories used in LCA:
- agricultural land occupation
- climate change
- fossil depletion
- freshwater ecotoxicity
- freshwater eutrophication
- human toxicity
- ionising radiation
- marine ecotoxicity
- marine eutrophication
- metal depletion
- natural land transformation
- ozone depletion
- particulate matter formation
- photochemical oxidant formation
- terrestrial acidification
- terrestrial ecotoxicity
- urban land occupation
- water depletion

Also saved emissions considered!

Phases of life-cycle

Compared alternatives
- Producing pellets from reed
- Producing construction materials from reed
- Nutrient removal in other way
- No actions
Social sustainability of using common reed

- **Cutting**: Jobs for contractors, Recreational values
- **Transportation**: No actions
- **Processing**: Attitudes of end-users, Acceptability?
- **End use and disposal**: Compared alternatives: Producing pellets from reed, Producing construction materials from reed, Nutrient removal in other way
Results of sustainability assessments (empirical results missing)

<table>
<thead>
<tr>
<th>Sustainability Indexes</th>
<th>Economic</th>
<th>Ecological</th>
<th>Social</th>
</tr>
</thead>
<tbody>
<tr>
<td>Producing pellets from reed (0.25)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Producing construction materials from reed (0.25)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nutrient removal in other way (0.25)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No actions (0.25)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Discussion on methodological and empirical challenges

- Who should complete weighting
- Which MCA-method should be used
- Data availability
- How to compare environmental impacts to social and economic aspects
- Acceptability of the results