Benchmarking farm sustainability performance

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key messages

Benchmarking is a useful performance measure

Rural food systems are not (yet) sustainable: Economic assessment should be complemented with ecological and social aspects (= sustainability assessment)

All aspects should be assessed carefully with appropriate methods (e.g. Life cycle costing, Life cycle analysis,...)

Value-orientated sustainability performance tools have several advantages (and disadvantages).
Unsustainable socio-technical systems
Unsustainable rural food systems

or

or
Unsustainable rural food systems
Unsustainable rural food systems in Europe

- Land use change and biodiversity
- Leaching of nutrients and eutrophication of waters
- Water availability and increasing demand for water
- Soil degradation and pollution (e.g. erosion, acidification)
- Greenhouse gas emissions to the air
European Common Agricultural Policy (CAP)

CAP beyond 2020: Modernizing and Simplifying the Common Agricultural Policy (CAP)
Global challenges
Sustainability assessment

Nevens et al., 2008
Sustainability assessment: Example 1 (MOTIFS)

Meul et al., 2008
Sustainability assessment

Meul et al., 2008
Sustainability assessment

Van Passel & Meul, 2012
Sustainability assessment: Example 2 (Sustainable Value Approach (SVA))

Numerical integration

SVA shows in monetary terms the value that a company creates or destroys by the use of a set of different resources (Figge & Hahn, 2005)

SVA-choices

- Selection of economic activity or entity to be analyzed
- Selection of resources
- Selection of benchmark
- Selection of production technology


Example of the calculation of the sustainable value
Calculation of the sustainable value of a dairy farm with a value added of €80 000: example

<table>
<thead>
<tr>
<th>Resource</th>
<th>Resource use of farm</th>
<th>Productivity of use (Value added / Resource use)</th>
<th>Value contribution (€)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm</td>
<td></td>
<td>Farm</td>
<td>Benchmark</td>
</tr>
<tr>
<td>Land</td>
<td>30 ha</td>
<td>2667 Euro/ha</td>
<td>2600 Euro/ha</td>
</tr>
<tr>
<td>Labour</td>
<td>1.00 fte</td>
<td>80 000 €</td>
<td>50 000 €</td>
</tr>
<tr>
<td>Farmcapital</td>
<td>€ 300 000</td>
<td>0.27</td>
<td>0.27</td>
</tr>
<tr>
<td>Energy use</td>
<td>1 000 000 MJ</td>
<td>0.08</td>
<td>0.07</td>
</tr>
<tr>
<td>N-surplus</td>
<td>6000 kg N</td>
<td>13.33</td>
<td>17.78</td>
</tr>
<tr>
<td>Sustainable value</td>
<td></td>
<td>3062</td>
<td></td>
</tr>
</tbody>
</table>
Sustainability assessment: multi-level & multi-user

Resources (e.g. labour, land, capital, nutrients, biodiversity, energy, water)

Agricultural sector: Specialised crop
- Farm 1
- Farm 2
- ...
- Farm n

Agricultural sector: Specialised dairy
- Farm 1
- Farm 2
- ...
- Farm n

Agricultural sector: Mixed farming
- Farm 1
- Farm 2
- ...
- Farm n

...

Agricultural output and services (e.g. milk, meat, cereals, vegetables, care)

Sustainable value approach
- Numerical integration
- Sustainability assessment between agricultural sectors
- Evolution within sectors
- Support policy makers

MOTIFS
- Visual integration
- Sustainability assessment of agricultural farms
- Support farmers

Van Passel & Meul, 2012
Case-study: intensive versus zero-grazing

• (More) integrated analysis of specialized dairy systems in Flanders (Belgium) using visual integration of MOTIFS-results
• Zero-grazing performed worse from an ecological and economic point of view due to a less efficient use of concentrates and byproducts
• Social sustainability performance did not differ

Meul et al. (2012)
Case study: LCA to support environmental decisions at commercial dairy farms

Life Cycle Assessment (LCA) can support decision taking

Key aspects are:

- the flexibility and accessibility of the model
- the use of readily available farm data,
- farm advisors being intended model users,
- the identification of key farm and management characteristics affecting environmental performance and
- the organization of discussion sessions involving farmers and farm advisors.

Attention should be paid:

- to provide sufficient training and guidance for farm advisors on the use of the applied LCA model and the interpretation of results,
- to evaluate the correctness of the used data and
- to keep the model up-to-date according to new scientific insights and knowledge concerning LCA methodology.

Meul et al., 2014
Case-study: Spec. dairy versus arable farming (BE)

Average resource productivities and eco-efficiencies.

<table>
<thead>
<tr>
<th></th>
<th>Labor productivity (€/hours labor)</th>
<th>Capital productivity (€/€)</th>
<th>Land productivity (€/ha)</th>
<th>Eco-efficiency energy use (€/MJ)</th>
<th>Eco-efficiency N surplus (€/kg N)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arable farms</td>
<td>9.17</td>
<td>0.18</td>
<td>713.48</td>
<td>0.03</td>
<td>9.37</td>
</tr>
<tr>
<td>Dairy farms</td>
<td>11.3</td>
<td>0.10</td>
<td>1568.94</td>
<td>0.04</td>
<td>6.21</td>
</tr>
</tbody>
</table>

A one-way ANOVA test shows that the average capital and land productiveness differ significantly between arable and dairy farms (F-value > 4.23).

Van Passel & Meul, 2012
# Case-study: agro-ecological systems (IT)

**Alta Murgia national park (Italy)**

Moretti et al., 2016

<table>
<thead>
<tr>
<th></th>
<th>Crop farms</th>
<th>Mixed farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital productivity (€/€)</td>
<td>1,10</td>
<td>0,34</td>
</tr>
<tr>
<td>Labour productivity (€/AWU)</td>
<td>113,747</td>
<td>36,235</td>
</tr>
<tr>
<td>Land productivity (€/ha)</td>
<td>507</td>
<td>792</td>
</tr>
<tr>
<td>Eco-efficiency (€/species lost*yr)</td>
<td>3,4E+07</td>
<td>9E+06</td>
</tr>
<tr>
<td>Biodamage</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Case-study: Organic versus conventional farming

Agro-environmental farm modeling to build an environmentally sustainable farm (ESF)
Dairy farming in Mugello area, Northern Tuscany, Italy

<table>
<thead>
<tr>
<th>Indicators</th>
<th>Farming system</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OFS</td>
</tr>
<tr>
<td><strong>Environmental impacts</strong></td>
<td></td>
</tr>
<tr>
<td>Nitrogen leaching (kg ha(^{-1}))</td>
<td>8.80</td>
</tr>
<tr>
<td>Soil erosion (t ha(^{-1}))</td>
<td>3.88</td>
</tr>
<tr>
<td>EPRIP(^1) (score ha(^{-1}))</td>
<td>1.00</td>
</tr>
<tr>
<td>Species Richness (score ha(^{-1}))</td>
<td>18.21</td>
</tr>
<tr>
<td>Sørensen’s S(_c) (score ha(^{-1}))</td>
<td>0.35</td>
</tr>
<tr>
<td><strong>Economic output</strong></td>
<td></td>
</tr>
<tr>
<td>Gross Margin (€ ha(^{-1}))</td>
<td>3479</td>
</tr>
</tbody>
</table>

\(^1\) Environmental Potential Risk Indicator of Pesticide use

The sustainable value (SV) of organic farming (OFS) outperformed the SV of conventional farming (CFS)

Merante et al., 2015
Case-study: Evaluation of AEM (IT)

Combination of farm modeling with the Sustainable Value approach (SVA)
Dairy farming in Mugello (Italy)
Soil erosion and nitrogen leaching should be addressed with specific policy measures to further increase the efficiency of organic farming
Designed organic agriculture support scheme almost closes the GAP with the sustainable benchmark farm.
= more cost-effective and efficient AEM

Pacini et al., 2015
Case-study: Monetary Valuation of Natural Predators for Biological Pest Control in Pear Production

Daniels et al., 2017
Sustainability assessment

Wide range of sustainability tools exist
More value-orientated integrative tools are needed
Valuation of positive externalities (non-market provisioning services) is still problematic and difficult to integrate
(More) evidence-based studies to assess the sustainability performance are needed
Output based cost-effective policy tools to stimulate the use of benchmarking
Impact of value-chain effects on sustainability performance is not well studied
Trade-off between data needs and soundness of assessment
Conclusions

Integrated assessment is needed
✓ It is multi- and interdisciplinary
✓ Scientific and evidence based
✓ Useful information to decision makers

Different decision makers (end-users) require different formats:
✓ visual integration,
✓ tabular integration,
✓ graphical integration,
✓ numerical integration
✓ ..
Conclusions

Integrated assessment can be based on different conceptual frameworks & approaches

- Valuation versus non-valuation
- Quantitative versus Qualitative
- Focus on spatial and temporal concerns
- Stakeholder involvement or less/no involvement
Reading


Reading


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