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LCIA methods for biodiversity and soil degradation: Challenges towards broad application in LCA

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HOW TO ASSESS IMPACTS OF LAND USE ON BIODIVERSITY AND SOIL QUALITY IN LCA?

Introduction

- Application of two LCIA methods developed by Matthias Meier and Franziska Stössel
 - Soil compaction; biodiversity loss
- ... in case studies comparing organic and conventional food products
- Evaluation of results
- Discussion in view of LCA practice and ISO standards

CASE STUDY RESULTS

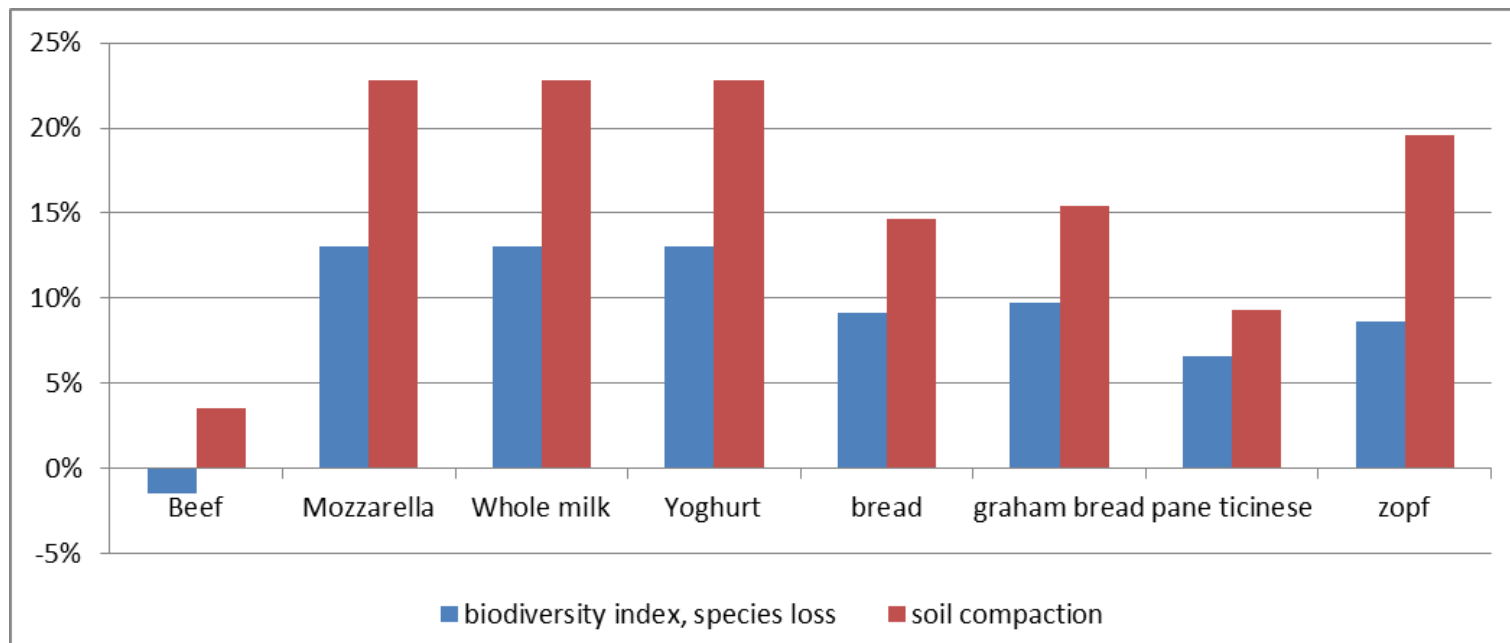
Main questions

- Is it possible to apply the new LCIA methods for biodiversity and soil compaction?
- What are the LCIA results for the comparison of organic and conventional products?
- What are the insights from these new methods?

Working steps

- Calculation of two new flows for several agricultural products by the LCIA experts
- Import of LCI into a copy of the ecoinvent library v2.2+# in SimaPro
- Analysis of 3 case studies on beef, dairy and bread with own foreground data
- Evaluation per kg of product in supermarket

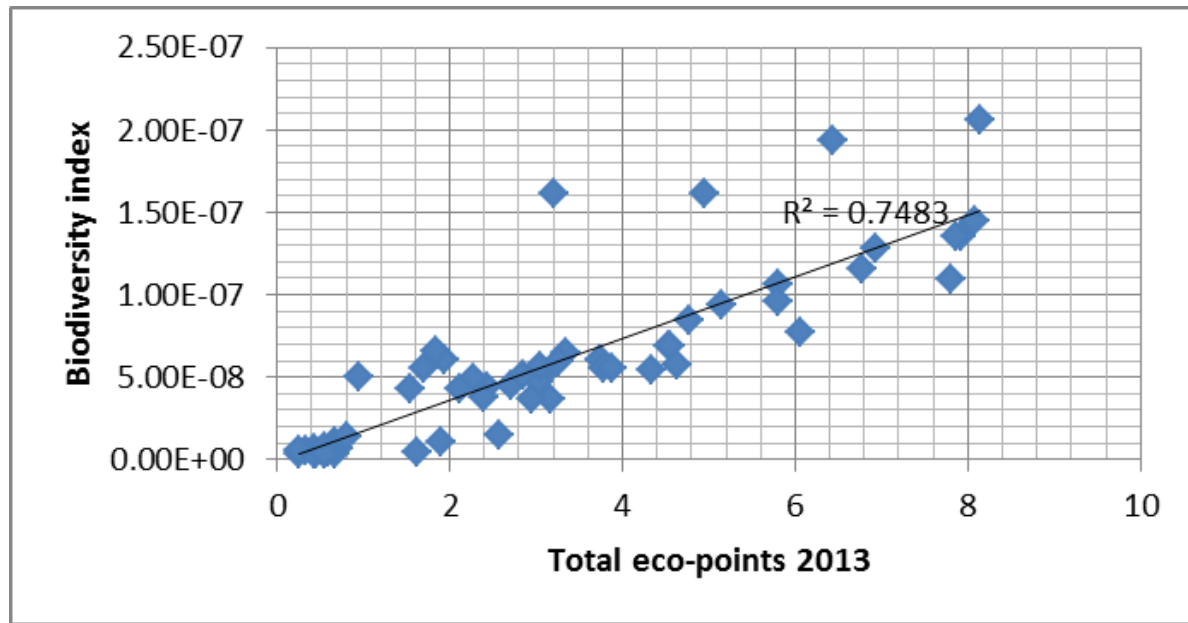
Relative difference of organic products compared to integrated production



- All organic products in the case studies have higher impacts than the IP ones with the new LCIA methods
- Only exception is biodiversity index for beef where the organic product performs better

Correlation between category indicators of several LCIA methods with new indicators

Impact category	Unit	biodiversity index, species loss
Photochemical ozone formation	kg NMVOC e	87%
Freshwater eutrophication	kg P eq	82%
biodiversity index, species loss	unit	100%
Nitrogen Land deposition	kg N	84%
Ecological Scarcity 2013	kPt	87%
Energy resources	kPt	83%
Land use	kPt	80%
Photochemical oxidant formation	Pt	83%
Freshwater eutrophication	Pt	91%
Agricultural land occupation	Pt	84%



- Good correlation between biodiversity and some LCIA indicators (e.g. eco-points 2013)
- Very good correlation for ozone formation difficult to explain
- Soil compaction very different from all other methods

Evaluation biodiversity index

- LCIA indicator is calculated separately for agricultural LCI and then introduced as an elementary flow to calculate the full life cycle
- Application on other land uses in the LCI necessary for full LCA
- No information yet about practicability for external users

Evaluation soil compaction

- LCIA indicator is calculated separately and then introduced as an elementary flow
- **Quite different results from all other LCIA indicators**
- Application on other land uses necessary for LCA
- No information yet about practicability for external users
- **Might be difficult to apply in databases so far just reporting total amount of diesel used**
- **Soil quality is also a maintenance of production factor like oiling a machine**

DISCUSSION IN A BROADER CONTEXT

Critical review checking ISO 14040

- Product systems are ... linked to ... the environment by elementary flows. (4.4)
- elementary flow: material or energy ... (3.12), including resources (4.4) (= land ?)
- LCI: compilation of inputs and outputs (3.3)
- LCI: Data collection (5.3.2) for inputs, emissions and „other environmental aspects“ (?)
- Input/Output: product, material or energy flow that enters/leaves a unit process (3.21/3.25)
- Nothing found regarding biogenic resources, biodiversity

Critical review checking ISO 14044

- Data representing noise and vibration, **land use**, radiation, odour and waste heat may be collected. (4.2.3.5)
- The collected data, whether **measured**, **calculated** or **estimated**, are utilized to quantify the inputs and outputs of a unit process. (4.3.2.1)
- LCIA is different from other techniques, such as environmental performance evaluation, environmental impact assessment and risk assessment, since it is a relative approach based on a functional unit. LCIA may use information gathered by these other techniques. (4.4)
- The LCIA phase shall include the following mandatory elements (4.4.2.1):
 - selection of impact categories, category indicators and characterization models
 - **assignment of LCI results to the selected impact categories (classification)**
 - calculation of category indicator results (characterization)

Summary of checking ISO standards

- ISO makes clear separation between LCI and LCIA
- Water and land use flows are more and more pre-including impact assessment, e.g. by regionalization of flows
- New flows for biodiversity and soil compaction are separately calculated based on some information in the LCI and further information
- This is introducing a non ISO way how to come from LCI to LCIA in an LCA study

Overlap of indicators

- Existing indicators focus on characterisation of measured or modelled elementary flows, e.g. heavy metals, fuel use, pesticide emissions, land occupation, water use
- New methods calculate the LCIA separately from the life cycle model
- Not clear yet which way provides more reliable results and where are possible overlaps
- Possible double counting of effects has to be regarded in the interpretation

LIFE CYCLE Assessment

- LCA should be able to assess the whole life cycle with all relevant interventions
- In the case studies, impacts during processing, transportation and distribution are not yet accounted for, e.g. buildings and traffic infrastructure destroying soil or impacting biodiversity
- Application in LCA only makes sense if full LC can be considered

Discussion procedure

- Results of indicators directly integrated in LCI cannot be discussed without background knowledge on the LCIA method
- The approach changes the way how LCA is executed since there is no clear distinction between LCI and LCIA (deviate from 4 steps)
- For ISO conformity it is necessary to document the full LCIA calculation with the LCA report

Impact, production factor or output?

- For a greenhouse the boundary would be the building
- System boundaries of field not always clear (fence, depth of roots, height of plants)
- Impacts are outside the system boundaries
- Biodiversity and soil quality inside the boundaries can also be considered as an output

Discussion how to deal with biodiversity

- Biodiversity is a complex issue with several overlaps to existing LCIA indicators
- Full judgement on all aspects of biodiversity not yet possible
- Methods should first be developed in a site specific framework
- Generalization for LCA in a second step when influencing elementary flows are better identified and can be modelled in the LCI and LCIA

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The presentation only reflects the personal point of view of the authors.