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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

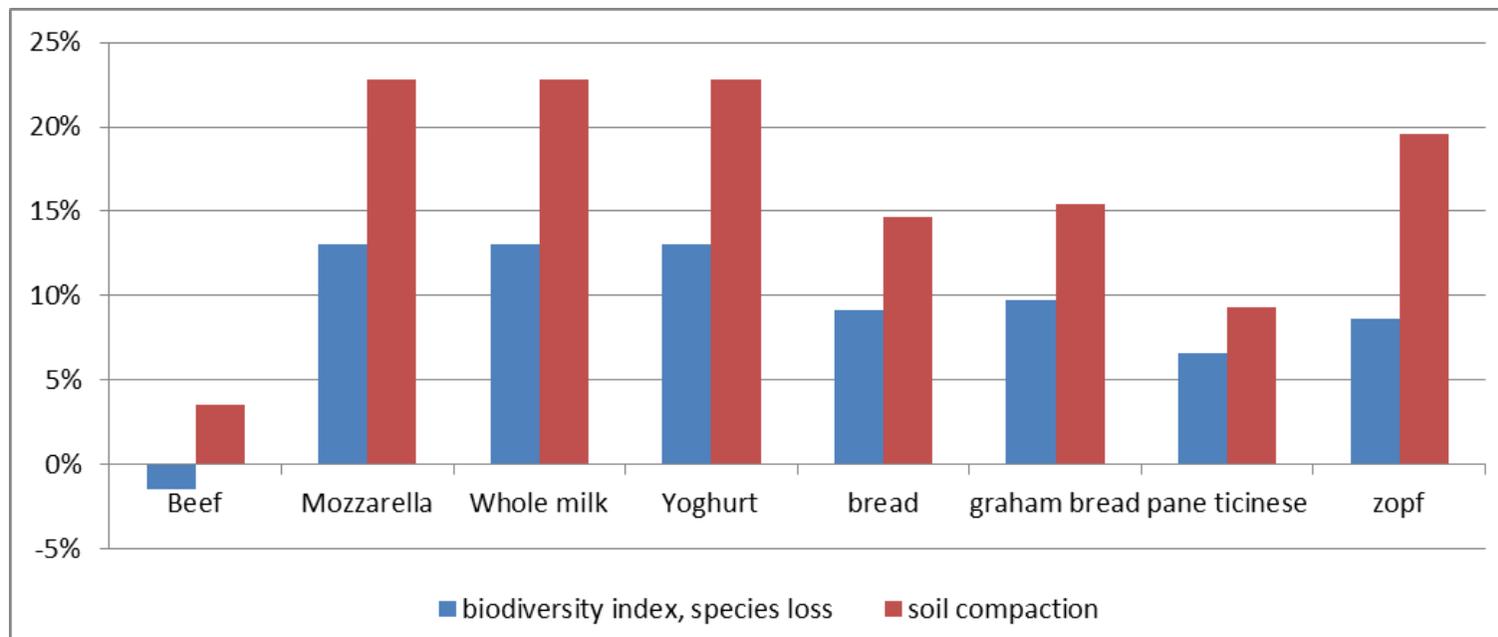
## Main questions

- 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+<sup>#</sup> in SimaPro
- Analysis of 3 case studies on beef, dairy and bread with own foreground data
- Evaluation per kg of product in supermarket

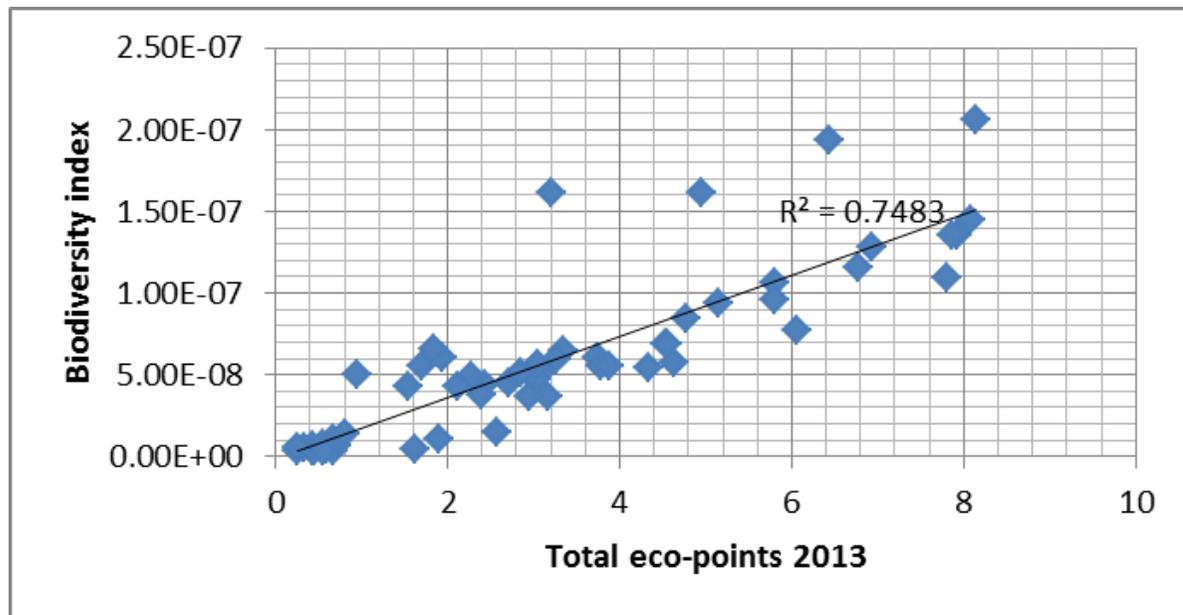
# Relative difference of organic products compared to integrated production



- 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.