Life Cycle Assessment and biodiversity impacts

Francesca Verones
Life Cycle Assessment
Areas of Protection

Environmental Interventions (LCI)

Midpoint level

Impact categories

Damage level

Damage level (aggregated into areas of protection)

Weighted single score

Elementary flows (chemical or other emissions; extraction of resources)

- Climate change
- Stratospheric ozone depletion
- Particulate matter formation
- Photochemical ozone formation
- Ionizing radiation
- Human toxicity
- Ecotoxicity
- Acidification
- Eutrophication
- Land use
- Water use
- Resources use
- Seabed use
- Noise

Impact categories

- Climate change
- Stratospheric ozone depletion
- Particulate matter formation
- Photochemical ozone formation
- Ionizing radiation
- Human toxicity

Damage level (aggregated into areas of protection)

- Human health
- Ecosystem quality

Natural resources

- Not yet operationalized
  - Ecosystem services
  - Socio-economic assets
  - Cultural heritage
  - Natural heritage

Single score

Verones et al. 2017
What is biodiversity?

• Genetic diversity
• Species diversity
• Ecosystem diversity
Where is the biodiversity?

Verones et al. (2017), Kuipers et al. (2019)
What affects biodiversity?
What affects biodiversity?

Lenzen et al. (2012)
How bad are these impacts?

Land use
Climate change
Overexploitation
Pollution
Invasives

IPBES (2019), slide from K.Kuipers
How can we assess biodiversity impacts?

https://www.oneclicklca.com/life-cycle-assessment-explained/
Current coverage of impact categories

Modified from Winter et al. 2017
Current coverage of impact categories

- Terrestrial ecosystems
- Aquatic ecosystems
- Marine ecosystems
Where are the impacts of my cappuccino?
How to calculate biodiversity impacts from land use?

3,462 of the 5,620 endangered terrestrial vertebrate species are threatened with land use

IUCN (2019)
How to calculate biodiversity impacts from land use?

> 26 000 species

> 700 ecoregions

> 26 000 species

8 impact types
How to calculate biodiversity impacts from land use?

- Species-area relationship:
  \[ \text{Species} = c \times \text{Area}^z \]
- Commonly used model to assess species extinction due to habitat loss

\[ S_{\text{lost}} = S_{\text{org}} - S_{\text{org}} \left( \frac{A_{\text{new}}}{A_{\text{org}}} \right)^z \]
How to calculate biodiversity impacts from land use?
How to calculate biodiversity impacts from land use?

Sri Lanka dry evergreen forests
How are impacts of land stress distributed?

Kuipers et al. 2021
How are impacts of land stress distributed?

Verones et al. (2020)
How do existing LCIA methods cover biodiversity?

EDIP

LC-IMPACT

LIME 3

ReCiPe

IMPACT World+™

TRACI

Tool for the Reduction and Assessment of Chemical and Other Environmental Impacts
How do existing LCIA methods cover biodiversity?

- Endpoint focus here

<table>
<thead>
<tr>
<th>Name of AoP</th>
<th>Metric</th>
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<tbody>
<tr>
<td>Biodiversity</td>
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Based on Annex to Chapter 10 in Hauschild (2018)
PDF ≠ PDF

• local?

• global!

• include global extinction probability

Global extinction potential (GEP)

\[
GEP_j = \sum_p \frac{\sum_{s} o_{s,p,j} \cdot TL_s}{\sum_{s} TL_s}
\]

- **TL**
  - 6 (7) classes (LC, NT, VU, EN, CR, EX, DD)
  - information about already occurring threats

- **Endemism (o)**
  - potential range area
  - indication about vulnerability towards habitat loss

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Kuipers et al. (2019)
How do existing LCIA methods cover biodiversity?

<table>
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<tr>
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<th>Eco-Indicator99</th>
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So… What have you learnt?

And now?

https://en.m.wikipedia.org/wiki/File:World_ocean_map_5_oceans.gif