

Potential ecotoxicity impact assessment

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Is ecotoxicity part of the air quality? How can that be measured in product chain context?
How do plant protection products affect air quality via product chain?

Ecotoxicity impact assessment in LCA

How ecotoxicity is forming in LCA? - Figure 1

- Chemicals induce ecotoxic effects that could be measured with the ecotoxicity impact assessment in LCA per functional unit of the final product
 - Chemicals are used in different steps of the product chain, e.g. plant protection products (PPP) in the crop production in a field or industrial chemicals in the production of food packing materials
 - Ecotoxic effects include fate of the emitted chemical to different environmental compartments (air, water, soil), and exposure and effect of organisms in that environment
- ≈ ecotoxicity footprint

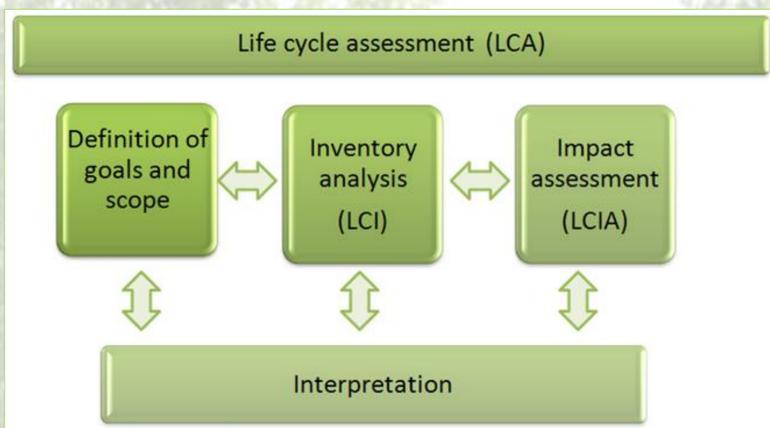


Figure 2. LCA is done in the following steps. LCI = life cycle inventory analysis, LCIA = life cycle impact assessment.

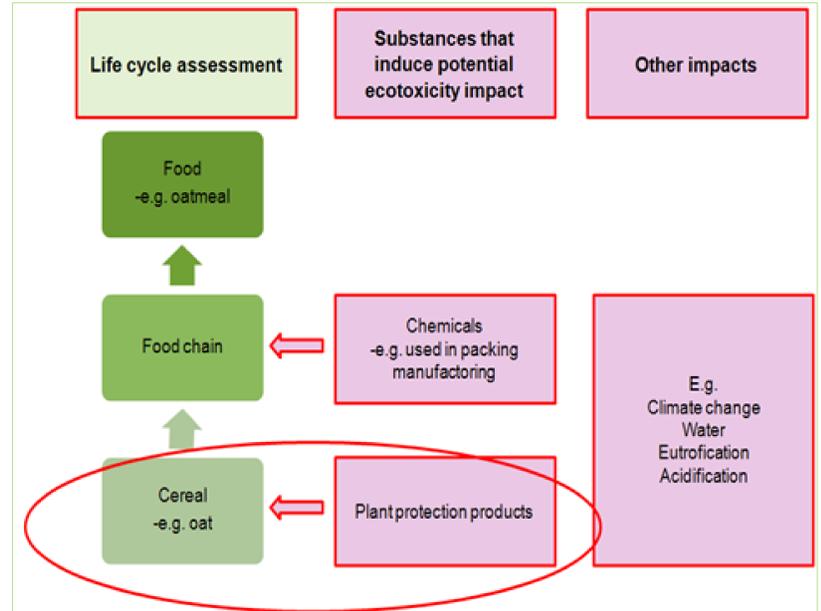


Figure 1. Forming of potential ecotoxicity in LCA. Circle illustrates the substance of our study.

Life cycle analysis (LCA)

LCA method is based on a standard ISO 14040/44 – Figure 2

- a tool for identifying and evaluating the environmental aspects and potential impacts vertically throughout the whole life-cycle of products and services
- the result is expressed against certain quantity or value of final products or service units (=functional units)
- the benefits of LCA are diverse, environmental aspects of products and services at different points of their life cycle can be identified
- impact categories e.g. climate change, water, eutrophication, acidification, ecotoxicity

Ecotoxicity impact assessment and PPP

How ecotoxic effects induced by PPP usage can be measured in LCA? - Figure 3

- PPP are chemicals that induce ecotoxic effects on a field usage
- In our study – Formula a
 - PestLCI 2.0 (Dijkman *et al.* 2012) is used to model emission fate
 - SETAC consensus LCIA model Usetox (Rosenbaum *et al.* 2008, Usetox 2010) is used to calculate impacts for active ingredient (= characterization factors, =LCIA)
 - quantitative result is a potential ecotoxic pressure (= impact score, CTU as an unit) that is describing the potentially affected fraction of species in the environment induced by the active ingredient usage

Formula a. Potential ecotoxicity in life cycle assessment is calculated via the following formula using PestLCI and Usetox:

$$IS = \sum CF * M = EF * XF * FF * M$$

IS = impact score (= potential ecotoxicity, CTU = PAF m³ * d/kg)
CF = ecotoxicological characterisation factor
M = emission
EF = effect factor (= toxicity)
XF = exposure factor (=bioavailability factor)
FF = fate factor (=substance emission into environment parts)

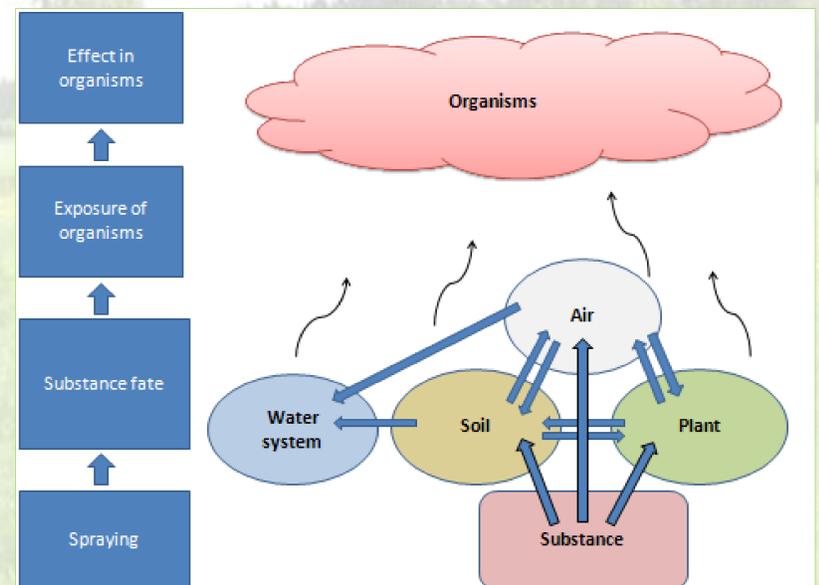


Figure 3. The relative potential impacts of PPP emissions can be evaluated in LCA by modelling the fate of active ingredient in air, water, and soil and their exposure and effects on organisms. PestLCI and Usetox are used in our studies.

PPP effects are part of the air quality:

- directly - emissions can be drifted to the air and affect organisms there
- indirectly - emissions can be drifted via air to the other environments

- In LCA context, PPP effects are part of the total product chain impacts.

- We are able to raise the understanding of food ecotoxic background not depending where production of farm inputs or raw materials or processes take place, in many cases food chains are global.
- It is important to push responsibility for global environmental problems such as climate change and chemicalization.
 - Consequently, the aim is to change the processes towards to sustainable development.

The project PesticideLife - "Reducing environmental risks in use of plant protection products in Northern Europe" (2010–2013)

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