

Workshop

Towards consensus about the delimitation between life cycle inventory and impact assessment in LCAs with pesticide and fertilizer use (agricultural field emissions)

Saturday 11 May 2013

8:00 – 19:00

Hotel Thistle Glasgow, Cambridge Street, room California Suite

Sponsors

Syngenta generously supports this workshop, facilitating the rental of the required meeting space and enabling us to offer free lunch and coffee breaks to all participants. The support from the TOX-TRAIN project (EU Grant Agreement no. 285286) is also gratefully acknowledged.

Organisers

Technical University of Denmark (Ralph K. Rosenbaum), Quantis (Xavier Bengoa) with the support of the EU project TOX-TRAIN (<http://toxtrain.eu>) and the USEtox team (<http://www.usetox.org>)

Objective

Create consensus about clear guidelines for LCA practitioners, data (base) and characterisation method developers, and decision makers where the boundary between the product system model (emission inventory) and the environmental model (impact assessment) should be set in all three spatial dimensions when considering intentional application of substances to an open agricultural field and consequent emissions to the natural environment and their potential impacts. The workshop will **NOT** be about *how* to quantify emissions or related impacts of pesticides and fertilizers, but focusing on clearly defining *what* should be quantified in the emission inventory of the product system and *what* should be quantified by the characterisation factors from the impact characterisation models, avoiding any overlap or double counting of processes. The solution should not be dependent on or endorsing a specific model.

Expected results and outcomes

The consensus should be published in a relevant scientific journal, so that it can be referred to and referenced by all stakeholders (similar to Diamond et al., 2010, IJLCA or Jolliet et al., 2006, IJLCA, as two examples that focused on impact assessment aspects).

Problem description

In the context of pesticide, fertilizer, plant growth regulator (etc.) use in a life cycle assessment (LCA) a clear definition of the delimitation between the product system model as represented in the life cycle inventory (technosphere) and the natural environment as represented by impact characterisation models (ecosphere) is currently missing. The typical difficulty for pesticides and fertilizers is to quantify the amount emitted to the ecosphere, while usually only the amount applied to the agricultural field is known, which some consider as part of the technosphere and some as part of the ecosphere. As a consequence, several approaches and hypotheses have been proposed and used up to now, which are inconsistent and may not always represent realistic conditions. Here are a few examples of current practice (the list not being exhaustive):

- 1) The widely used life cycle inventory database ecoinvent adopted the assumption that the amount of pesticide applied is emitted 100% to agricultural soil (Nemecek and Kägi 2007).
- 2) In USLCI pesticide emissions are inventoried as emissions to air and water.
- 3) Models such as PestLCI (Birkved and Hauschild 2006 and Dijkman et al. 2012) employ a local fate model that estimates the amounts emitted (i.e. leaving the agricultural field) to air, surface water, and ground water respectively based on application techniques, meteorological conditions, crop types, and other influencing factors.

Current characterisation models consider the fate of a pesticide (e.g. USEtox, USES-LCA, IMPACT 2002, etc.) or fertilizer in the environment, once emitted to air, water, or soil in the natural environment. In order to remain consistent with the characterisation of other chemical emissions, there is only limited flexibility to change the characterisation modelling, hence the most practical way seems to be to focus on clearly defining the inventory requirements for pesticide/fertilizer emissions. There is no evident scientific or objective way to identify the best delimitation approach. Therefore, a consensus-based definition of a convention is required.

Some open questions to be discussed in order to establish consensus:

- Is the ecosystem on the agricultural field part of the area of protection (natural environment) and should thus be covered by the impact assessment or is it a highly controlled ecosystem anyway and essentially part of the technosphere?
- Does it lead to double counting if both the inventory model and the impact model involve a fate modelling step or can these be distinguished clearly?

- Spatial dimensions: Can we define the agricultural field as a 3-dimensional box by height of air above the field, width and length of the field including buffer zones, and soil depth? Then only the fraction(s) of an applied pesticide/fertilizer leaving this box to various environmental compartments would be accounted for in the emission inventory.
- Which emission compartments are relevant to cover: air, surface water, ground water, deeper soil layer(s), others? Pesticide residues in food products may be the dominating human exposure pathway in some cases, but requires the inventory to also report the quantity applied directly to the crop and not just the emission to the environmental compartments. Therefore, a clear definition of what needs to be reported and how in the life cycle inventory is needed.
- Temporal dimensions: Pesticides and fertilizers are typically applied in pulses. Does the assumption of similarity between pulse and continuous emissions in the steady-state model of LCA also hold for such emissions? How can it be determined, when steady-state assumptions are satisfactory and when not? Which periods of time from application to ecosphere emissions need to be taken into account in the emission inventory and in the impact assessment?
- Can we define the same recommendations for all emissions to agricultural fields, including fertilizers and plant growth regulators?
- Are different recommendations required for specific cases such as greenhouses, irrigated vs. non-irrigated fields, etc.?

Workshop agenda and schedule

- 08:00 - 08:30 Arrival of participants and tea/coffee
- 08:30 - 09:00 Welcome and introduction to the workshop (Ralph Rosenbaum, DTU)
- 09:00 - 10:30 Input presentations for the discussion (~20 min each incl. Q&A):
- A LCA practitioner perspective: Current issues when conducting LCA including pesticide application (Sebastien Humbert, Quantis)
 - A LCI (emission inventory) modelling perspective: Pesticide emission modelling in PestLCI 2.0 (Teunis Dijkman, DTU)
 - A LCIA (impact assessment) modelling perspective: Impact pathways of pesticides and their current modelling in LCIA (Peter Fantke, DTU; Ronnie Juraske, ETHZ)
 - A case-study covering LCI and LCIA for pesticides (Rosalie van Zelm, Radboud University; Philippe Roux, IRSTEA/ELSA)
- 10:30 - 11:00 *Tea/coffee break*
- 11:00 - 12:00 Plenary discussion (moderator Ralph Rosenbaum)
- 12:00 - 12:30 Definition of 2-3 break-out groups and subjects
- 12:30 - 13:30 *Lunch (all participants are invited to a buffet)*
- 13:30 - 16:00 Discussion in break-out groups
- 16:00 - 16:30 *Tea/coffee break*
- 16:30 - 18:00 Presentations from the break-out groups and discussion
- 18:00 - 19:00 Wrap up and next steps (moderator Ralph Rosenbaum):
- Is a 2nd workshop needed or have we reached a publishable consensus?
 - What's next? Who does what?
- 19:00 Closure of the workshop