Hour 4: Life Cycle Inventory

LCA training for CIAT and WUR employees

July 4th, 2019, Roel Helmes

1. Life Cycle Inventory Intro
2. SimaPro Demo

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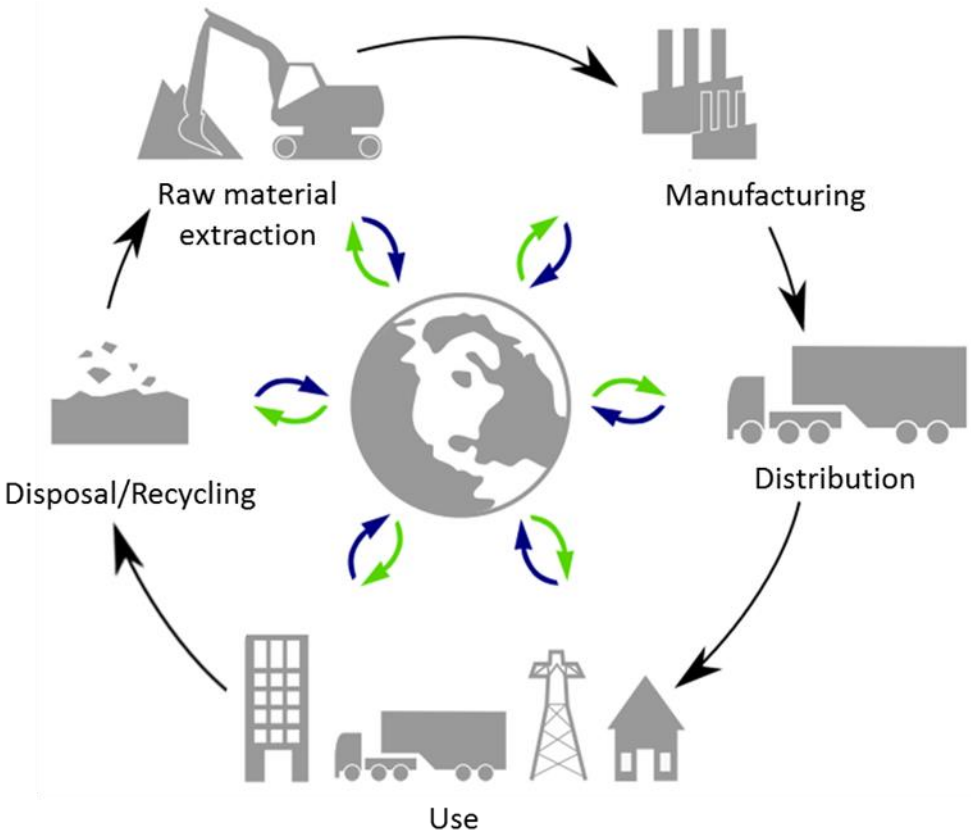
100years 1918 — 2018

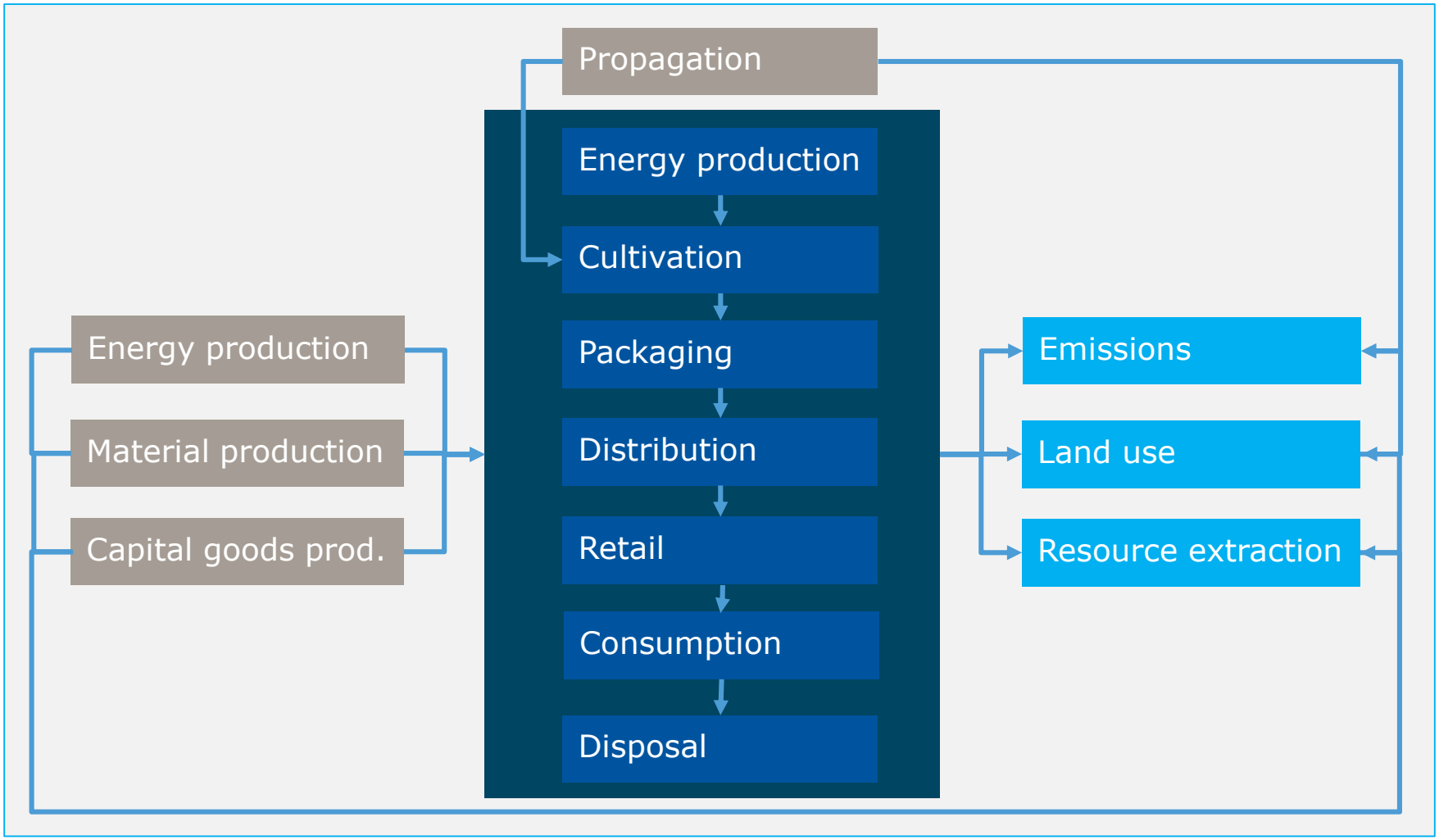
Phase 2: Life Cycle Inventory

- One long list of emissions and resource extractions

1. Box model
2. Inputs & outputs
3. Connect background data
4. Aggregate emissions & extractions



Example of a box model



Questionnaires for primary data

- Grapes example

Background data

- EcoInvent
- Agrifootprint
- World Food Database
- ...Others inside SimaPro
- Secondary data outside SimaPro
    - Martin Heller's database: Meta analysis on impacts
    - Stoessel et al. 2012: Meta analysis on inputs
    - More meta-analysis

SimaPro Demo 1/2

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SimaPro

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SimaPro Demo

- Structure of SimaPro: Libraries, Projects, Processes & "Workflow"
- *Introduce EcoInvent Background data*
    - *System / Unit*
    - *CURC / APOS / Consequential (?)*
    - *Market / Transformation*
- Process (Grapes project)
- LCIA
- *Show water scarcity characterisation*
- *Show Comparison*

Hour 5: LCI for Crops & Exercises

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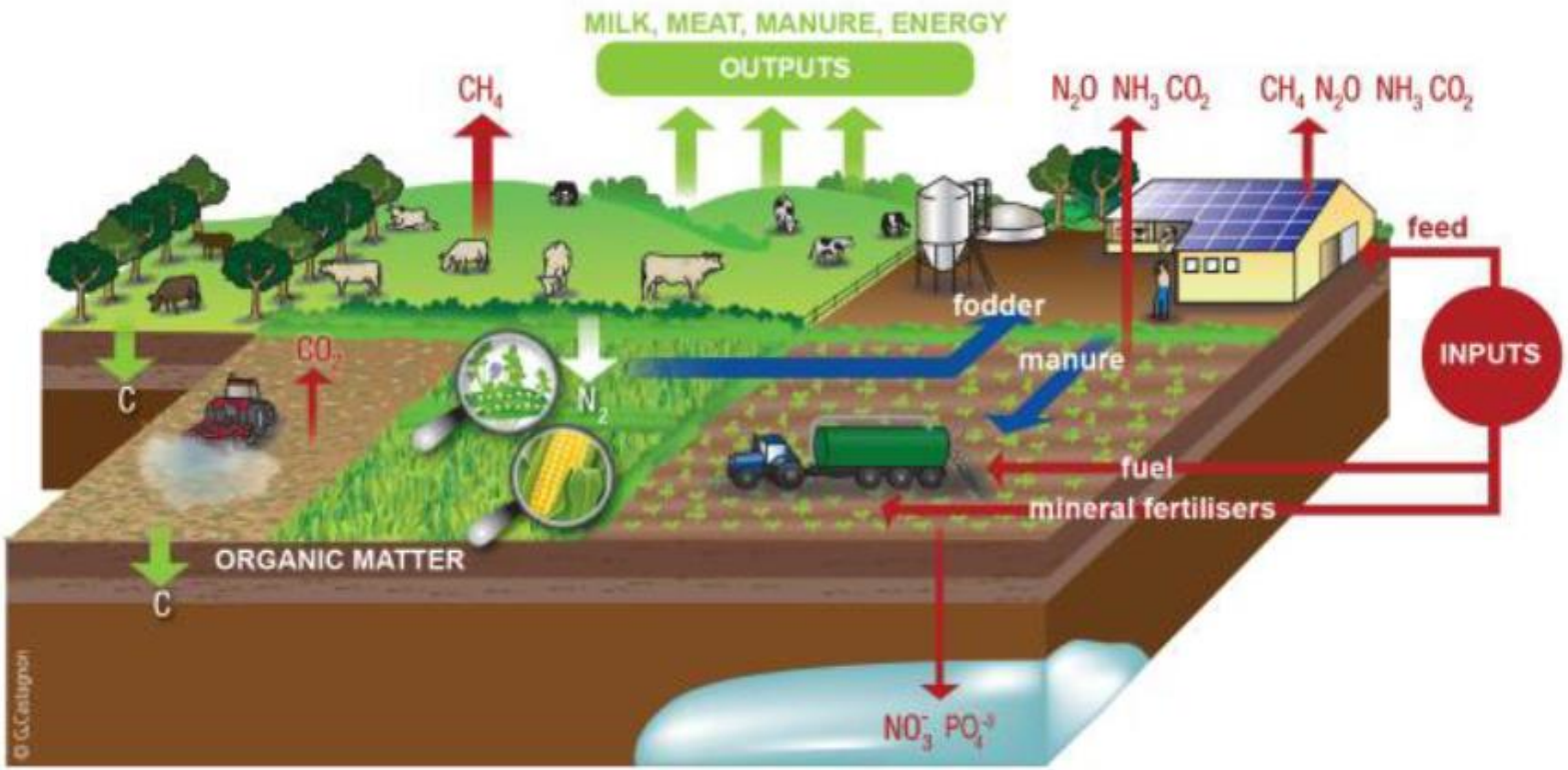
Many flows on a farm



What to think of

- Land use
- Fertilizer application
- Water use
- Pesticide application
- Machinery & Equipment
- Greenhouses, etc.

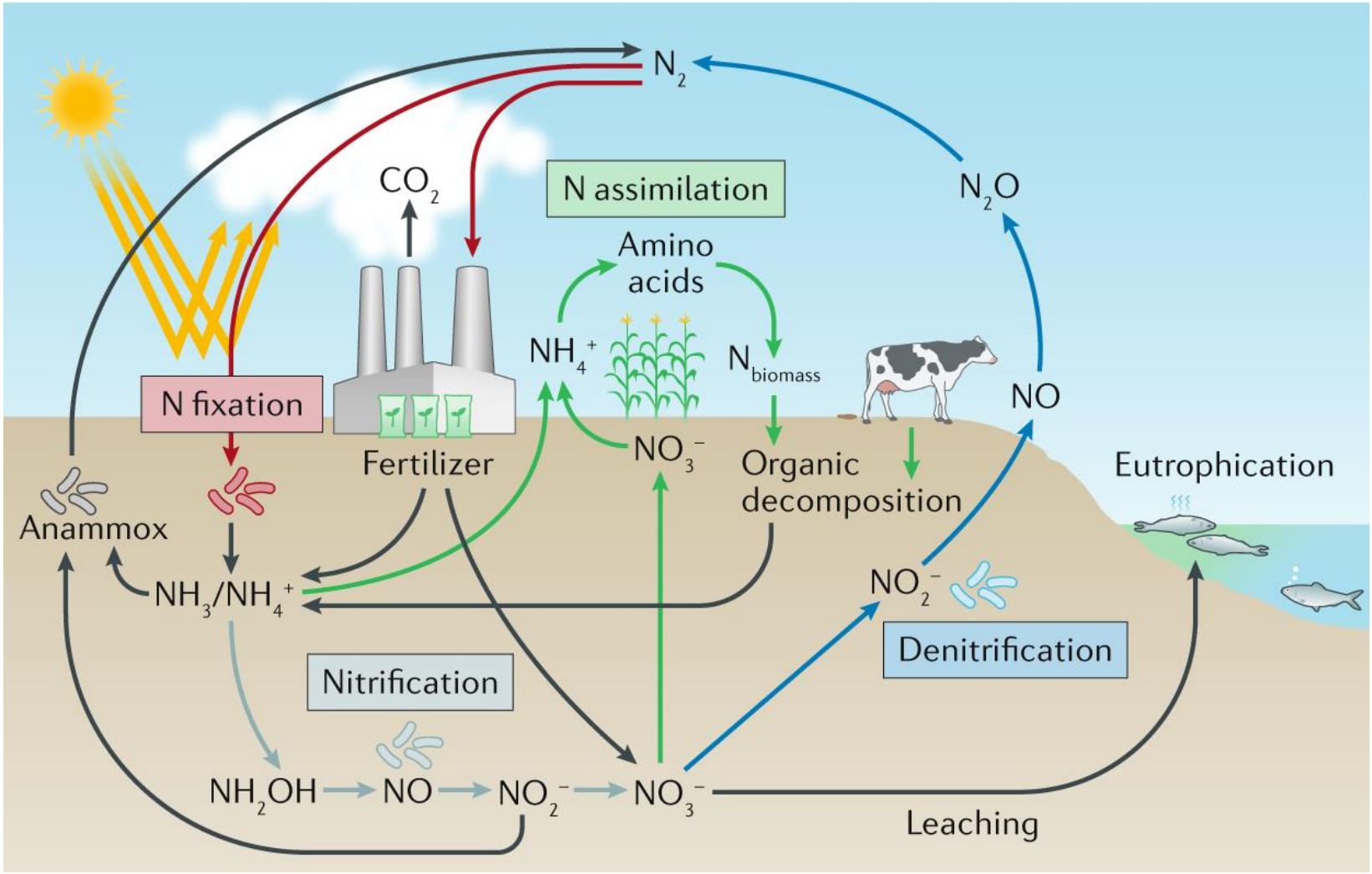
What to think of (off-farm)

- Waste & Loss
- Transport
- Energy & Water use for processing
- ...discuss

Use Guidelines for LCI modelling

- IPCC for greenhouse gases
- PEFCR Guidance!
- Database documentation: EcoInvent, AgriFootprint, World Food Database
- Data collection & Expert dialogue: WLR, WPR
- Run cropping models (matching data availability)

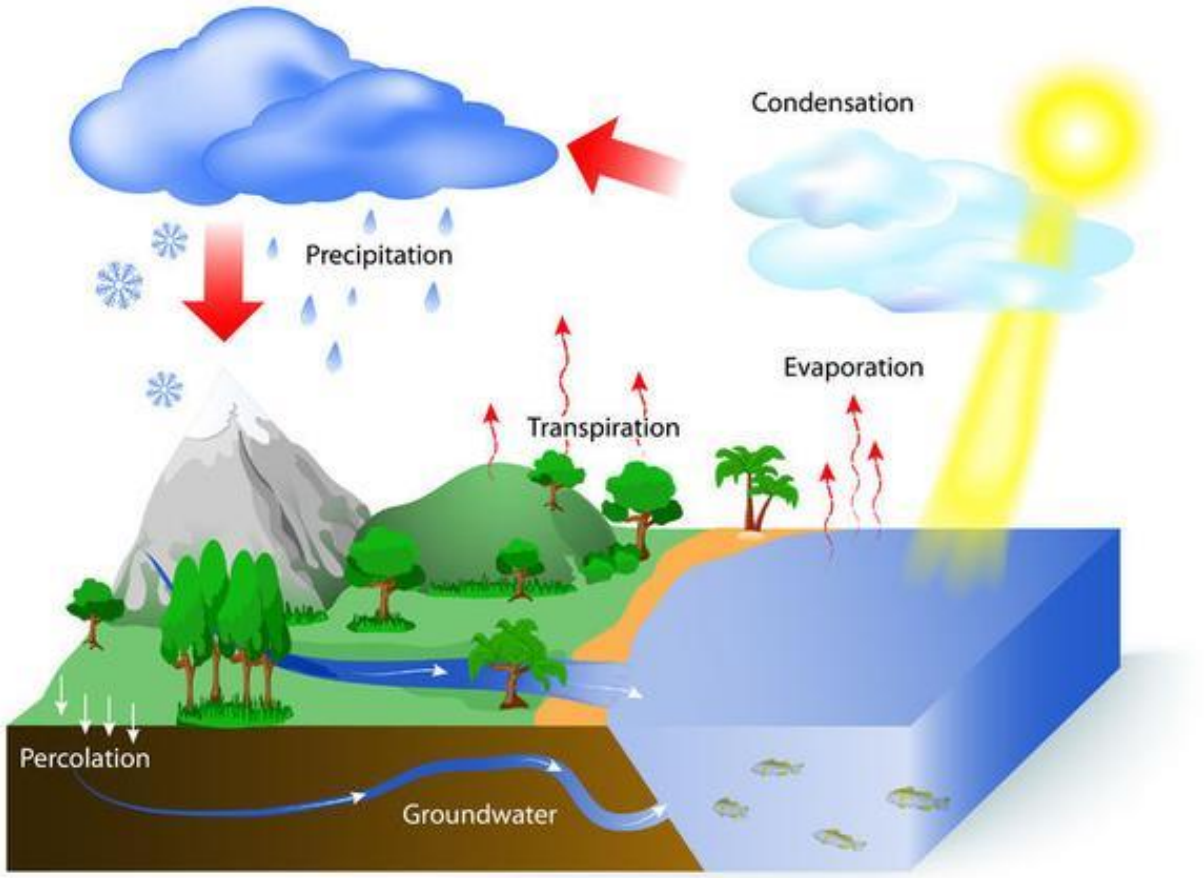
Nitrogen


N_2
CO_2
N assimilation
N_2O
Amino acids
NH_4^+
$N_{biomass}$
N fixation
NO
Fertilizer
NO_3^-
Organic decomposition
Eutrophication
Anammox
NH_3/NH_4^+
NO_2^-
Denitrification
Nitrification
NH_2OH
NO
NO_2^-
NO_3^-
Leaching

Nitrogen and Phosphorus (Nutrients)

- Track inputs and outputs
- Choose & Apply soil nutrient model
- Deal with missing data
- Calculate losses (or shortages)
- Show Cocoa example

Water

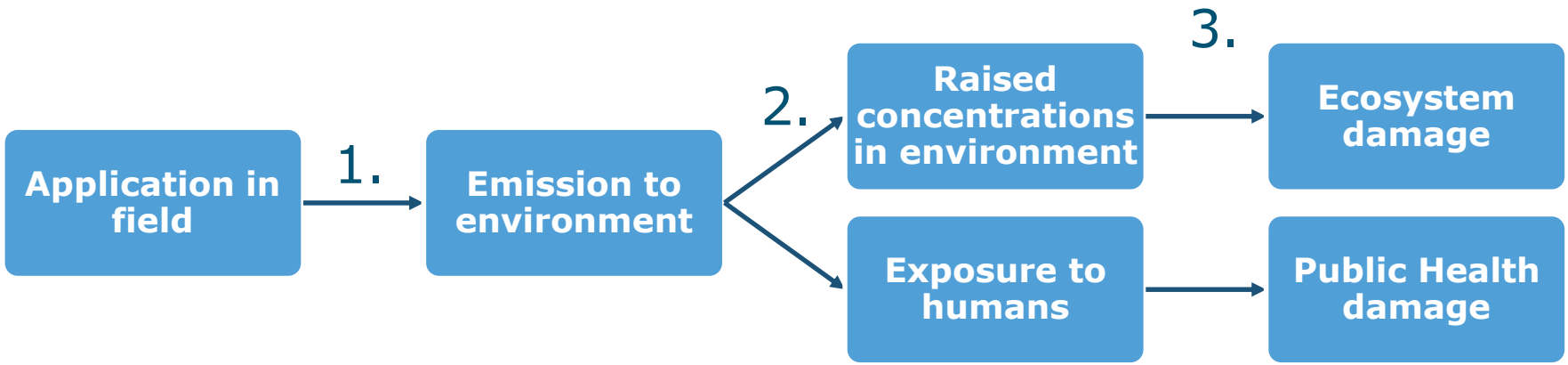

Condensation
Precipitation
Evaporation
Transpiration
Percolation
Groundwater

Water “footprinting”

- It’s all about time and place and quality
- Green water, blue water, grey water
- Water withdrawal vs. water consumption
- Water consumption > Water stress
- Methods:
    - Cropwat & Aquastat
    - Estimate irrigation (actual / modelled)

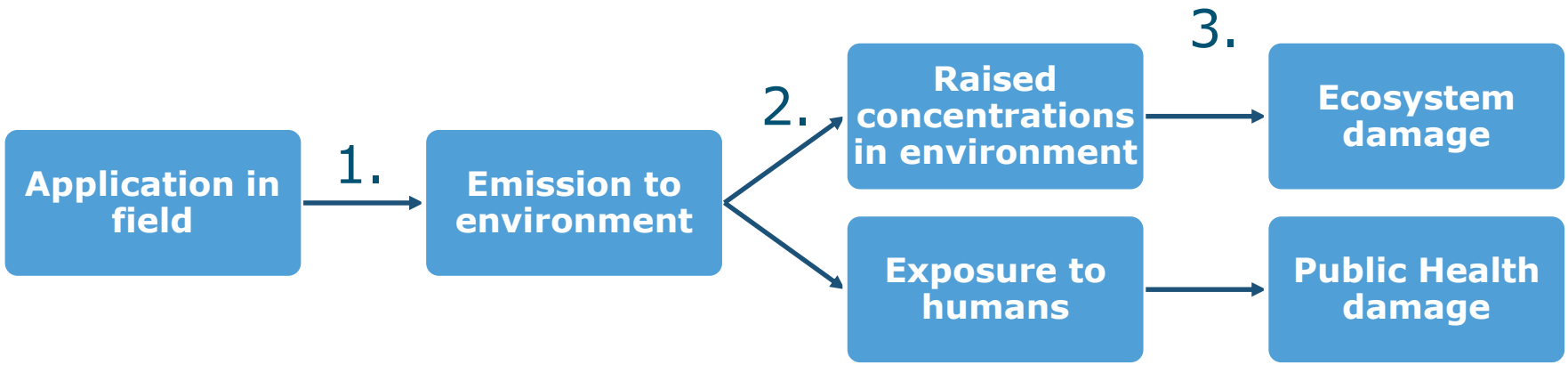
Pesticides & Chemicals: Toxicity

The approach to toxicity impacts



1. A part of the applied amount is directly emitted to different environmental compartments: soil, water, air
2. The emissions are redistributed on a longer term over the environmental compartments and lead to exposures.
3. Environmental concentrations and Exposures lead to damage to ecosystems and humans.

The approach to toxicity impacts



Life Cycle Inventory		Life Cycle Impact Characterization	
Lijst met emissies		Characterization Factors (CF)	
Lijst met toepassingen	Lijst met factoren	Fate Factor (FF)	Effect Factor (EF)

Big challenges

1. Transfer fraction from applied amount to emission is not part of characterisation; currently many coarse methods are available
2. Large uncertainties in Characterisation Factor from emissions to impacts
3. Not all toxic impacts are included in LCIA methods
4. Factoren not available for several pesticide products
5. Pesticide use is highly variable and site-dependent

Exercise 6: Stoessel 2012 et al.

- *Roel: Show in SimaPro*
- *Individual: Go through SI*
  - *Pick a process*
  - *Pick a flow*
  - *Find a source*
  - *What do you think of it?*
- *Discussion: Which choices would you make*

Multifunctionality

- Coproduction of marketable products
- Recyclable materials or waste?
- Depends on the goal of your LCA (discuss palm oil)

- ISO

1) Avoid allocation by splitting processes
2) Avoid allocation by system expansion
3) Physical causality
4) Economic allocation

How to deal with multifunctionality

Milk

Beef

Leather

Tallow

Cow

- System expansion
- Substitution
- Allocation

Multifunctionality (draw on flipover)

- System expansion: FU = Protein & Leather; so when compare ImCow=ImBeef + ImLeather with ImAlt = ImPeas + ImSynthleather

- Substitution: FU = Protein, so ImBeef = ImCow – ImSynthleather

- Allocation: ImBeef = AFBeef * ImCow, with AFBeef = CBeef / CTotal
  - C:
    - Energy invested by animal
    - Mass
    - Revenue (Economic)

How to deal with multifunctionality

Milk

Beef

Leather

Tallow

Labor

Saving

Exercise 7 (or Discussion?)

- *Take your LCA goal & Scope*
- *Describe:*
  - *Which part do you want to model yourself (foreground)? Why?*
  - *Which part do you want to model with background data? Why?*
  - *Which datasources do you use? For foreground & background modelling.*
  - *Do you know fully what to do? How to decide?*

Hour 6: Emissions and herd dynamics modelling in livestock production