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Agroscope

Considering regionalized information by creating agricultural LCI

Jens Lansche

With contributions from Maria Bystricky and Andreas Roesch

LCA Discussion Forum 69, 13.09.2018

Background – Regionalization in agricultural and food LCA

- **Different definitions of a region** depending on context:
  - political (e.g. world, EU, country, canton)
  - economic (e.g. farm, enterprise/industry branch, cooperatives)
  - topograhic (e.g. slope of the field, shape of slope)
  - environmental conditions (e.g. soil type, climate)
  - …

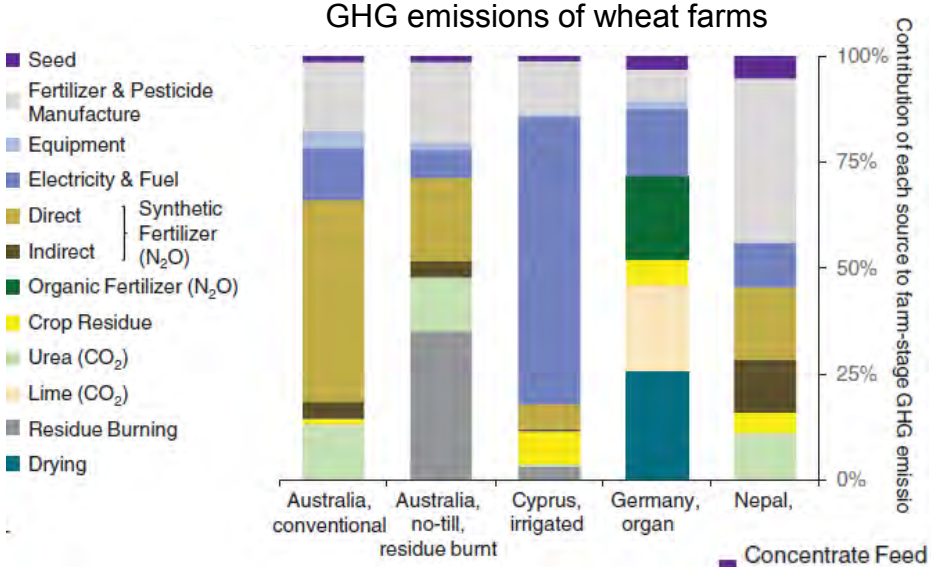
Adapted from Patouillard et al 2018

- **Different perspectives** for regionalization
  - Impact assessment
  - Inventory (background and foreground)

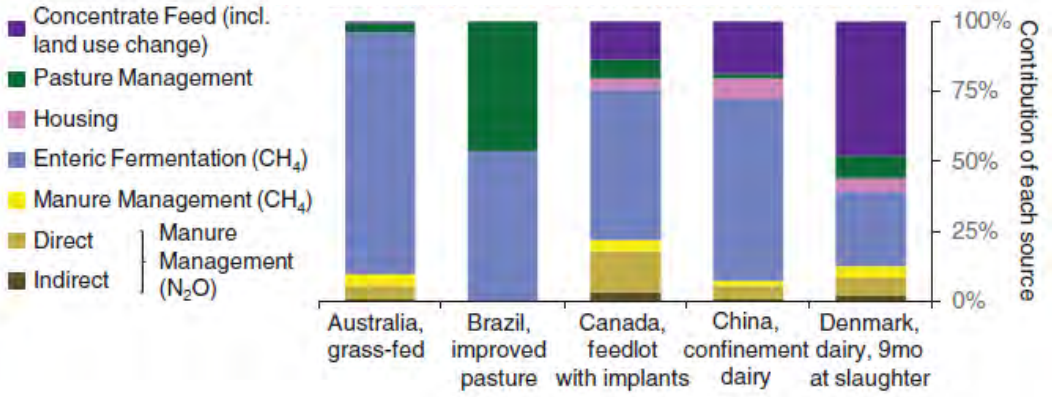
particular **importance of direct emissions** in agriculture (primary production) due to high contribution to a product's overall environmental impact and high variability

Direct emissions in agriculture: contributions to environmental impacts and high variability

GHG emissions of wheat farms



GHG emissions of beef farms



Poore et al., Science 360, 987–992 (2018)

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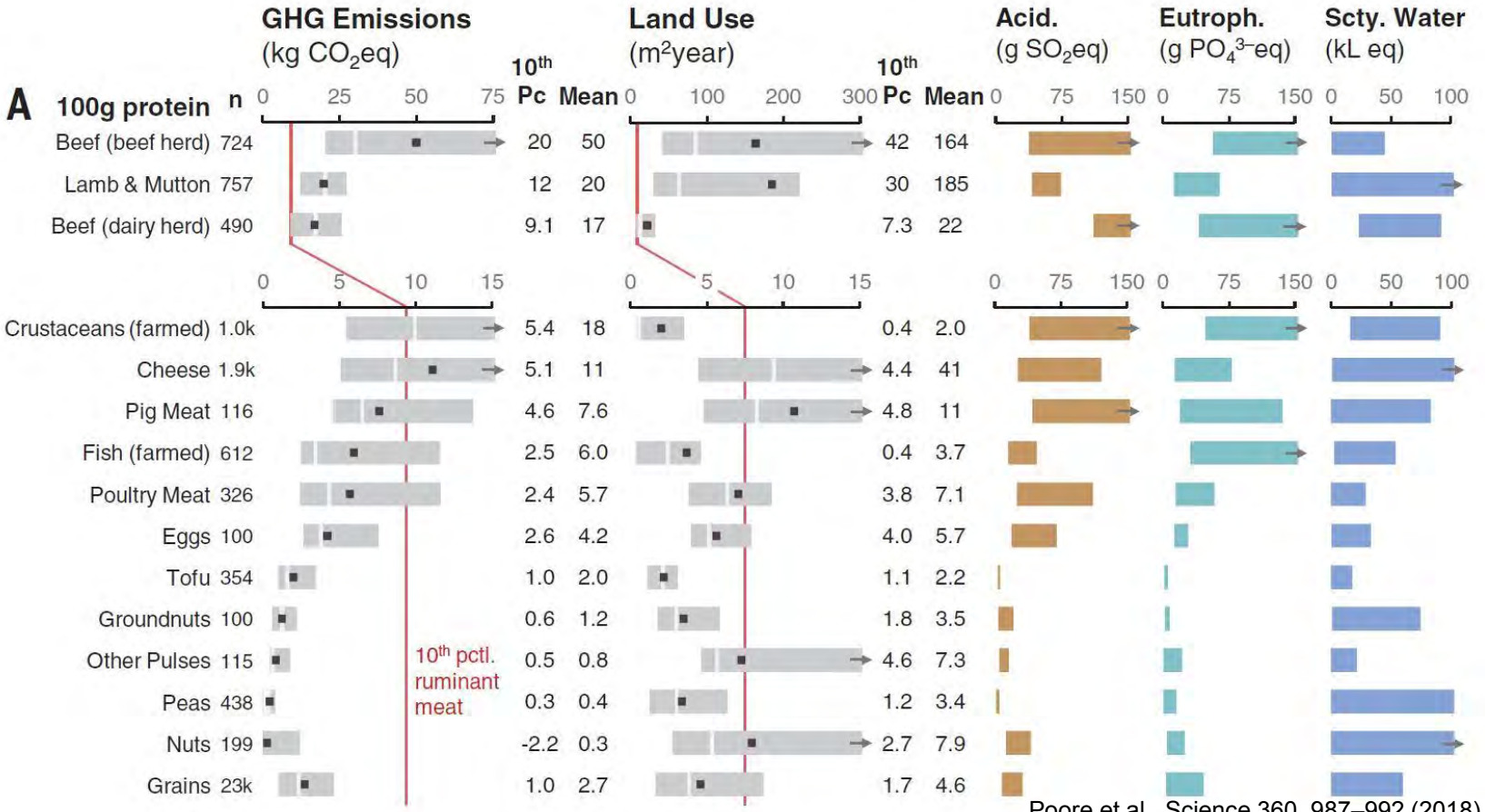
Direct emissions in agriculture: contributions to environmental impacts and high variability



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How to consider regionalized information for creating agricultural LCI? (1)

Research question leads to "regional" levels:

- Intranational level (farm level or regions within a country defined according to topographic or environmental conditions)
- National level
  - Agricultural primary production
  - Processing
- Global level

level and degree of necessary adaptations depend on the "regional" level and production step

How to consider regionalized information for creating agricultural LCI? (2)

Levels of adaptations in the life cycle inventories:

- Foreground:
  - Farm management data (e.g. type and amount of fertilizers, pesticides, feedstuff, machinery and infrastructure used; yields; field work processes;…)
  - Calculations of direct emissions (parametrization, selection or adaptation of emission models)
- Background (energy carriers, production of fertilizers, pesticides, machinery …)

Intranational level – example farm level

Initial situation:

Different farms should be compared in terms of environmental impacts. Emission models are available that are suitable for the regional context.

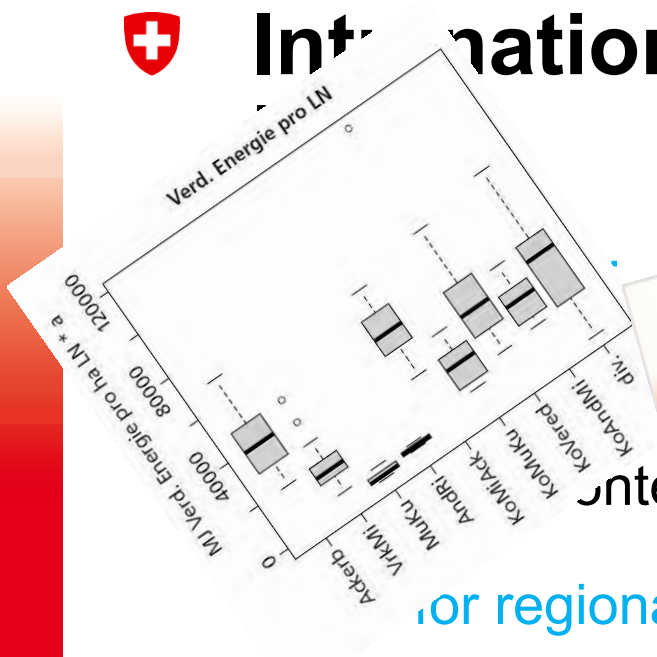
Goals for regionalization:

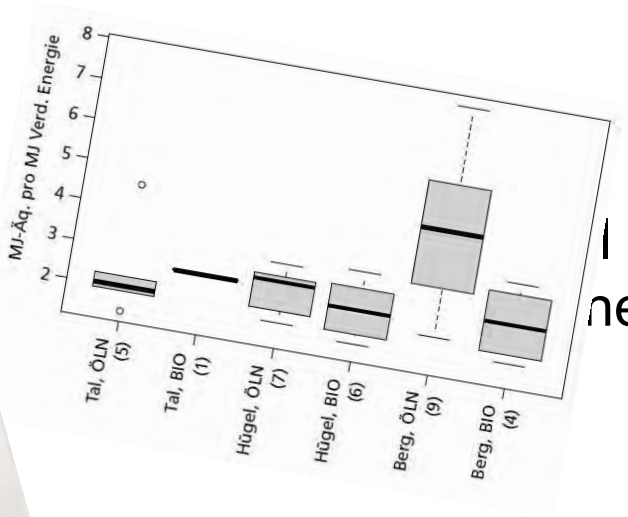
Specific differences on farm-level relevant for environmental impacts should be covered

Adaptation:

Comprehensive collection of primary data due to the huge variability of inputs, outputs and resulting environmental impacts on farm-level and calculation with existing emission models

Int[illegible]national level – example farm



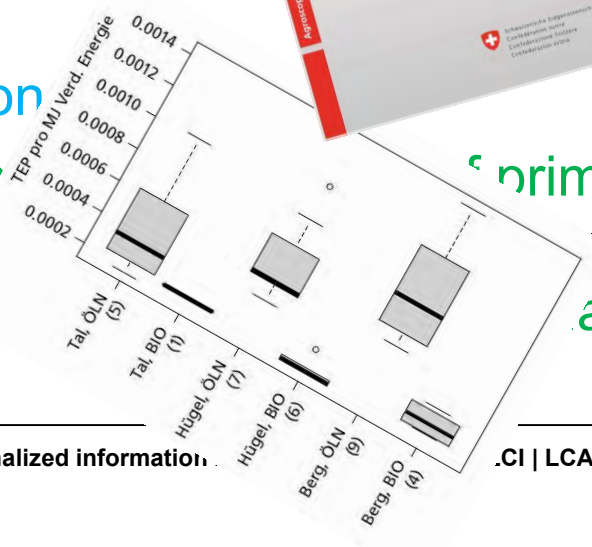


[illegible]or regionali[illegible]

Specific differences [illegible]nmental impacts should be covered

Adaptation

Compreh[illegible] primary data due to the huge variabil[illegible]esulting environmental impact[illegible]ation with existing emission models



Graphs: Hersener et al 2011

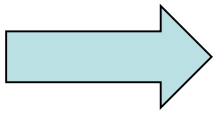
National level – primary production (1)

Initial situation:

Emission models are available that have been developed for specific context in one particular country and should be applied in another country

Goals for regionalization on national level:

- LCA of farms (or products) in two (or more) countries should have the same explanatory power
- Consider region-specific differences between the countries



How can this be done?

Adapted from Bystricky et al 2014

National level - primary production (2)

- Criteria for adaptation of emission models:
  - → Consideration of regions with different environmental conditions
  - → Data available in other/more specific forms
  - → Data not available

- Levels of adaptation:
  - I. Mapping of names and categories
  - II. Adapting parameter values; calculations and formulas remain the same
  - III. Adapting an emission model by changing calculation steps or integrating new parameters
  - IV. Replacing an emission model

Adapted from Bystricky et al 2014

National level – food processing

Initial situation:

Food processing LCI are available that should be applied in another country

Goal for regionalization:

Main drivers for environmental impacts should be covered

Adaptation:

Change origin of inputs (background LCI) from one country to another provided that processing technology is identical or similar in both situations

Global level (1)

Initial situation:

A LCI methodology that is applicable globally with a national resolution should be developed

Goals for regionalization on global level:

- Global applicability (different agricultural production regions)
- Applicability for a wide range of products
- Modelling a representative production system for agricultural products in a given country

Data collection

- Statistical sources can be used

Nemecek et al 2015

Global level (2)

Possibilities for regionalization of emission modelling:

A) Selection of emission models that are applicable on a global scale

or

B) Selection of different models for different regions

Emission	WFLDB	ecoinvent V3.0	AGRIBALYSE
Ammonia (NH_3)	EMEP (EEA 2013) Tier 2	Agrammon (Tier 3 methodology for CH)	EMEP (EEA 2009) Tier 2
Nitrous oxide (N_2O)	IPCC (2006) crops: Tier 1 animals: Tier 2	IPCC (2006) crops: Tier 1 animals: Tier 2	IPCC (2006) crops: Tier 1 animals: Tier 2
Nitrate (NO_3^-)	SALCA-Nitrate (Europe) SQCB (other countries)	SALCA-Nitrate (Europe) SQCB (overseas)	Arvalis method (Tailleur et al. 2012)
Phosphorus (P, PO_4^{3-})	SALCA-P (Prasuhn 2006)	SALCA-P (Prasuhn 2006)	SALCA-P (Prasuhn 2006)
Heavy metals (Cd, Cr, Cu, Hg, Ni, Pb, Zn)	Freiermuth (2006) (SALCA method)	Freiermuth (2006) (SALCA method)	Freiermuth (2006) (SALCA method)
Methane (CH_4)	IPCC (2006) Tier 2	IPCC (2006) Tier 2	IPCC (2006) Tier 2

Nemecek et al 2015

Conclusions

- There is **no "one-size fits it all" solution** for regionalization of agricultural LCA in research
- Regionalized LCA can only provide **meaningful and precise results** if LCI and LCIA are regionalized
- **Level** and **degree of regionalization** depend on the research question(s) and goal(s) of the study
- **Farm-level assessments** should be based on comprehensive collection of primary data to cover huge variability

Thank you for your attention

Agroscope good food, healthy environment