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Agroscope

LCA FOOD 2020

Modelling foreground and background land use impacts in agricultural systems: the dilemma of highly detailed or universally applicable

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1 Introduction

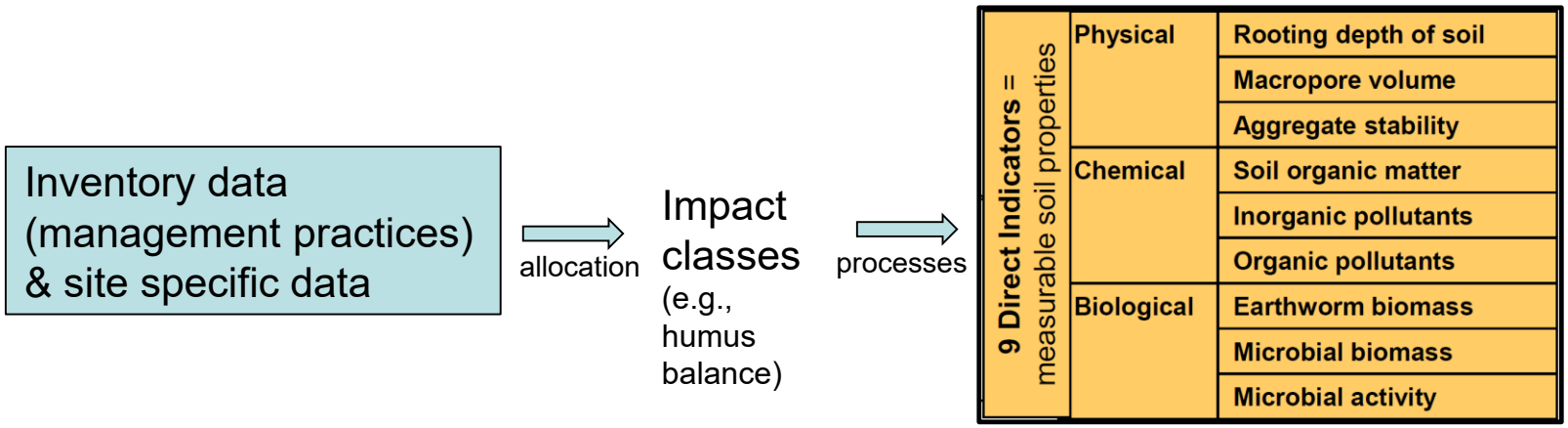
- ✓Life cycle assessment (LCA) can assess all relevant environmental impacts for the whole food supply chain
- ✓Substantial proportions of the environmental impacts caused by modern agriculture occur abroad
- ✓Generally detailed knowledge on management practices is available for the foreground system
- ✓Data on background system (e.g., purchased inputs) is much less specific and detailed
- ✓ Models for soil quality and biodiversity generally consider the foreground system only (spatial system boundary = farm)
- ✓ The landscape quality indicator (Schüpbach et al., 2020) only considers the aesthetic quality of the farm's agricultural landscape elements

2 Material/Methods

Soil quality

SALCA-SQ (Oberholzer et al., 2012)

- Assesses changes in soil quality due to agricultural management practices (e.g. ploughing or slurry applications)
- Spatial system boundary = farm
- Temporal system boundary = crop rotation period (6-8 years)
- Management data of all plots of a farm in a single year are considered as representative for a whole crop rotation



2 Material/Methods

Soil quality

LANCA® (Bos et al., 2016)

- estimates impacts due to land occupation and land transformation
- agricultural soil management is condensed into a few agricultural land use classes
- calculates the following five soil functions at the midpoint level: (i) erosion resistance, (ii) physicochemical filtration, (iii) mechanical filtration, (iv) groundwater recharge and (v) biotic production
- Key input variables for LANCA are parameters related to soil composition and climate

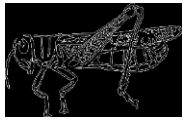
2 Material/Methods

Biodiversity

SALCA-BD (Jeanneret et al., 2014)

Management options	Effect on 11 indicator species groups	Score per indicator species group	Aggregation: overall score

effect



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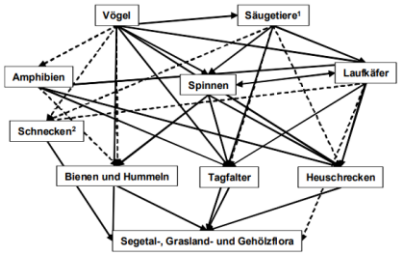
7.2

15.2



6.8

✓ allows to compute the biodiversity deficit (via maximum possible range)

2 Material/Methods

Biodiversity

Method Chaudary & Brooks (2018) [CHBR]

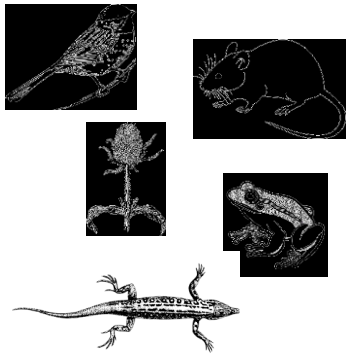
Objective: Quantifies regional species loss due to land occupation and transformation

Land occupation & transformation: type and intensity

Effect on 5 indicator species groups: species loss per m^2 land use and country

Aggregation: Species loss per m^2 land use and country

effect



$6.18*10^{-14}$

$6.52*10^{-14}$

$7.86*10^{-14}$

$6.92*10^{-14}$

$5.98*10^{-14}$

characterisation factors (species lost/m^2)

2 Material/Methods

Landscape quality indicator LQI

Schüepbach et al. (2020)



- LQI evaluates the aesthetic value of various land scape elements

LQI = Arithmetic mean of two independent subindicators

(1) Diversity indicator (land use and seasonal diversity, based on Shannon index)
(2) Area-weighted preference value (AWPV)

3 Results & Discussion

Idea: Apply different models for the foreground system (FS) and background system (BS)

Inventory data
FS: detailed information on agricultural farming activities
BS: only generic knowledge, no details on agricultural farming activities

Soil quality
FS => SALCA-SQ
BS => LANCA

Biodiversity
FS => SALCA-BD
BS => CHBR

Aesthetic landscape quality
FS/BS => Landscape quality indicator by Schüpbach et al. (2020)

3 Results & Discussion

Reference situation

Three options

I. Potential natural vegetation (PNV)

II. Current land use mix (CLM).

III. Most positive management (MPM)

Soil Quality

SALCA-SQ: good agricultural practice ≈ CLM

LANCA: can be selected

Biodiversity

SALCA-BD: most positive management (biodiversity deficit) ≈ MPM

CHBR: natural undisturbed habitat ≈ PNV

Landscape Quality Indicator

Indicator is normalized by a reference group with similar climate, topography ≈ CLM

3 Results & Discussion

Methodological similarities

Some indicators in the local and global model describe similar processes, e.g.

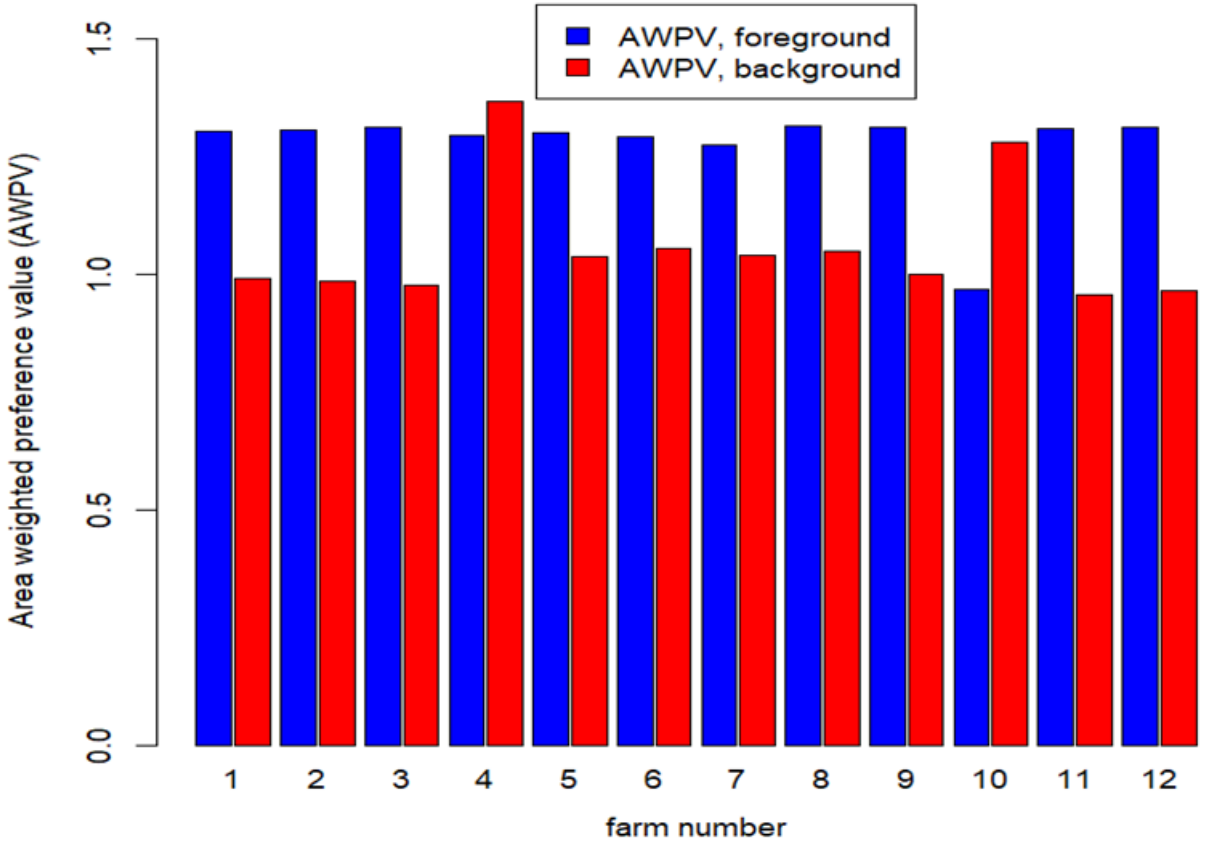
- ✓ Erosion risk => rooting depth (SALCA-SQ) and erosion resistance (LANCA)

- ✓ Taxa: mammals, birds, amphibians are considered in both SALCA-BD and CHBR
- ✓ Land use types: annual crops, permanent crops and pasture are treated in both SALCA-BD and CHBR

➢ Partial overlap between local and global model possibly allows linkage of impact assessment

3 Results & Discussion

Area weighted preference value (AWP)



Background system: Mainly purchased concentrate and roughage feed, Machinery: omitted

Data: Hohenrain II project (Zumwald et al. 2018)

4 Conclusion

- Application of different models for FS and BS makes it possible to account for differing levels of knowledge regarding management practices, production conditions, soil conditions and production location

- Conceptual differences complicates application
- Reference situation differs between local and global model
- Some methodological similarities between local and global model

- Landscape quality: same model can be applied for FS and BS












Thank you for your attention.

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