Harmonised life cycle inventories of Swiss agricultural production for sectoral and food-system modelling

Vasco Diogo, Maria Bystricky, Utkur Djanibekov, Mélanie Douziech, Cédric Furrer, Jens Lansche, Thomas Nemecek, Albert von Ow, Martin Stüssi

Agroscope, 8046 Zürich, Switzerland; www.agroscope.ch

Why harmonised LCIs for sectoral modelling?

- Food-system and agricultural sectoral models allow to explore alternative developments in agri-food systems under different scenarios and resulting impacts.
- However, agricultural life cycle inventories (LCI) are often developed using different assumptions regarding system boundaries, input data, and background processes, increasing the risk of inconsistencies and requiring extensive *ad-hoc* harmonisation.
- To address this gap, Agroscope developed the Standard Production Variants (STPVs), a harmonised LCI framework of agricultural production in Switzerland that can be consistently linked to multiple sectoral and food-system models.

Standard Production Variants

Each STPV represents a defined agricultural activity (e.g., wheat production) under a set of assumptions structured along three criteria:

- *Standard*: data sources and system boundaries (cradle-to-farm-gate) are internally consistent across all LCIs.
- *Production*: agricultural activities are defined at the level of individual crops and animal categories.
- *Variants*: multiple variants are defined for each crop and animal category to represent differences in biophysical contexts (plain, hill, and mountain regions) and management systems (e.g., conventional, organic, and pesticide-free).

Approach

Harmonised data sources
Detailed datasets on crop and livestock production, including field operation calendars, cultivation methods, machinery and input use, husbandry housing systems and feed composition.

Modular building blocks
Reusable and combinable parameterised foreground process modules, representing specific crop and livestock inventory components.

STPV inventories
Cradle-to-farm-gate crop and livestock LCIs, representing unique combinations of *Activity x Region x Management*, consistent with categories used in national farm structure statistics.

Impact scores
Indicator set of environmental impacts per unit of product for each STPV, including total emissions as well as midpoint and endpoint indicators. Modelled with the Swiss Agricultural LCA (SALCA) methodology and models.

Sectoral modelling
Linked to sectoral models for scenario analysis, by mapping the STPVs to the modelled agricultural products, using the same categories of national farm structure statistics

Illustrative applications of the STPV framework

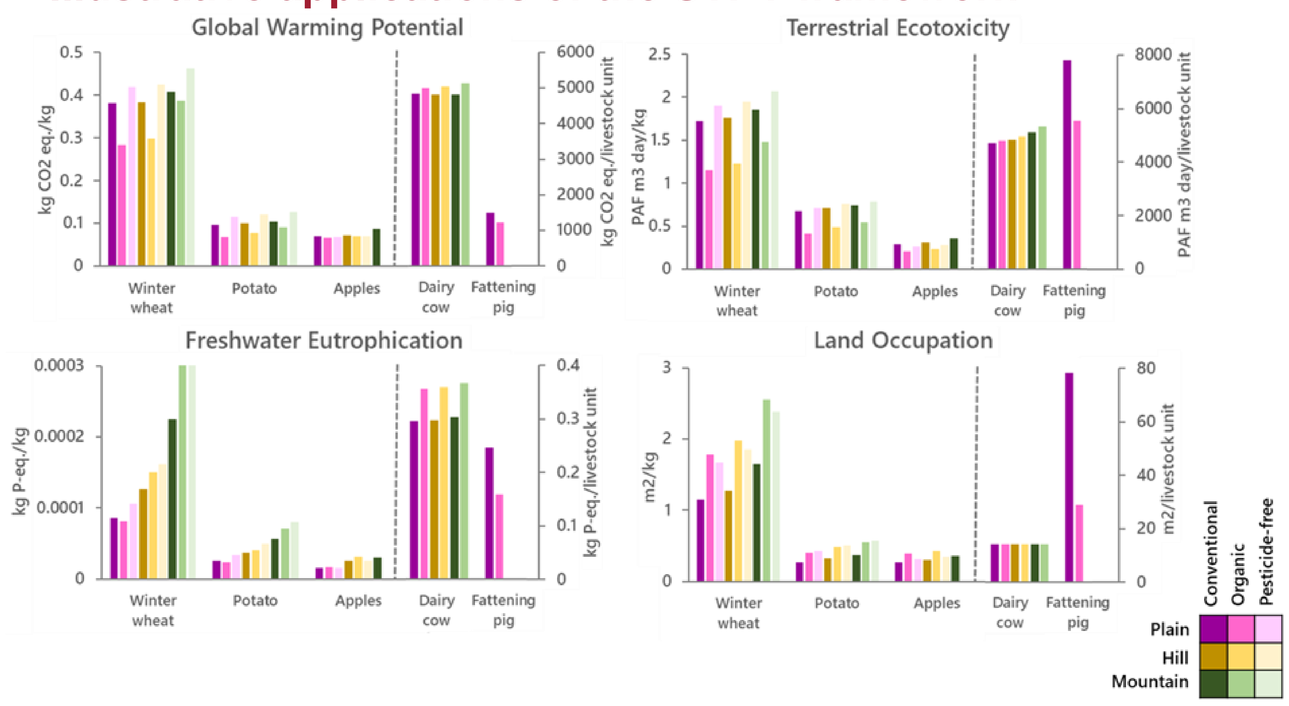


Figure 1: STPV impact scores of winter wheat, potato, apples, dairy cow and fattening pig production across a selection of midpoint indicators.

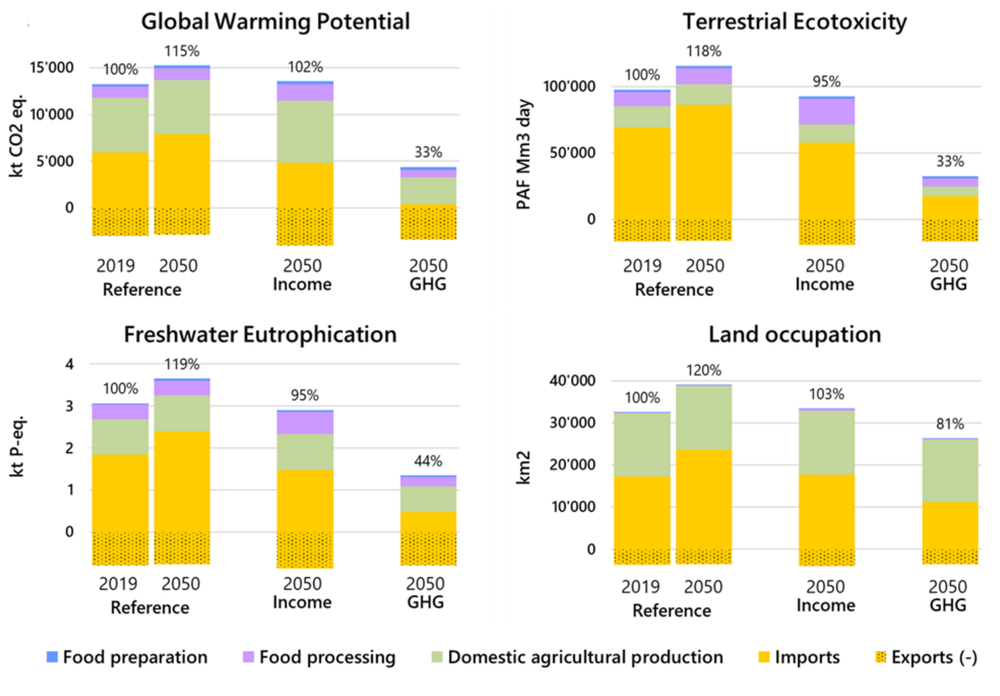


Figure 2: Aggregated impacts of the Swiss food system across a selection of midpoint indicators, as simulated by the SWISSfoodSys model for the years 2019-2050 under three alternative scenarios (*Income* = maximising agricultural income; *GHG* = minimising total GHG emissions of the food system). Labels on the bars indicate values relative to the 2019 reference.

Conclusions & Outlook

- allows capturing variations and differentiate the environmental impacts of agricultural products according to the specific regional conditions and management systems where they are produced.
- enables comprehensive sectoral assessments of agri-food scenarios across multiple impact categories.
- ensures methodological consistency, application across multiple sectoral models, and comparability across scenario studies.



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