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Optimizing the LCA data processing for food products in the context of Life Cycle Sustainability Assessment: challenges and opportunities

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LCA Food San Francisco - 10.08.2014

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Context

LCA research group and importance of tools

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Agroscope LCA Research Group

- A Group of the Institute for Sustainability Sciences, section Biodiversity and Environmental Management

- The group cohesion is defined by a **methodology**

    - **SALCA (Swiss Agricultural Life Cycle Assessment)**
    - **ecoinvent (Swiss Centre for Life Cycle Inventories)**

- Two main strands of research activity:
    - the **methodology** itself
    - the **application** of the methodology

- **The tools are the essential link between the methodology and the applications**

Methodology

Tools

Applications
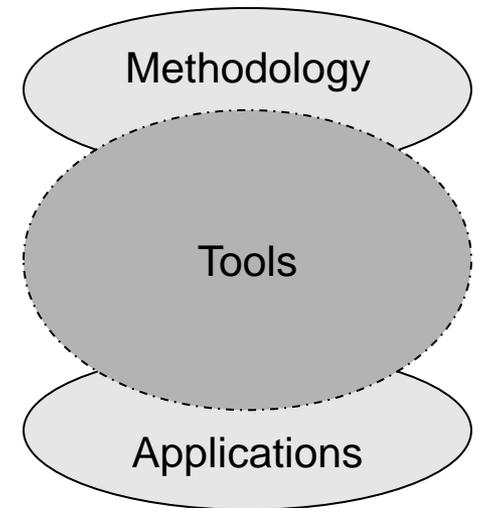
LCA calculations for food products

- Agricultural production: generally one of the main origin of impacts

- Agricultural activities are represented **various type of input data**:
  - Field operations (tillage, sowing, fertilization, irrigation, harvest,…)
  - Purchased inputs (energy carriers, fertilizers, pesticides, feedstuff,…)
  - Animal production (feeding, milking, grazing, manure management)
  - Infrastructure (buildings, equipment, machines)
  - Emission factors (relation to soil, location, type of animals, weather,…)

Modelling of direct and indirect farm emissions

- Agricultural production systems can provide **multiple product outputs**:
  - Emissions to water, air and soil compartments, Vegetal and animal products, energy production

Allocation of inputs/outputs into product groups

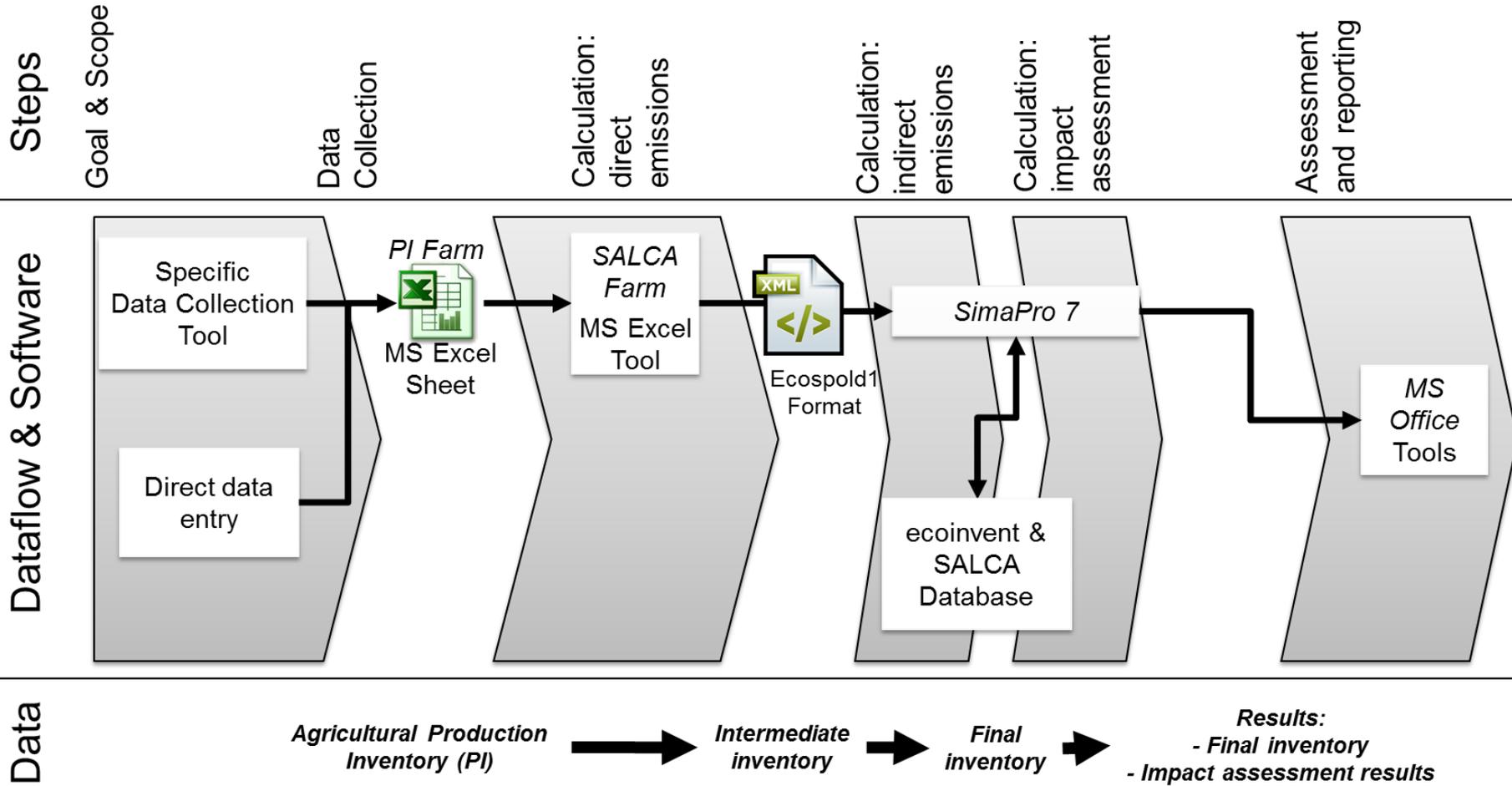**Complex modelling, calculation and data treatment chain:**
SALCA*crop* and SALCA*farm*

Weidema BP, Meeusen MJG (2000) Agricultural data for life cycle assessments. The Hague, Agricultural Economics Research Institute (LEI), ISBN 90-5242-563-9.

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Current workflow

related to SALCAcrop and SALCAfarm

Current workflow

SALCA*crop* and SALCA*farm*

- **SALCA (Swiss Agricultural Life Cycle Assessment)**
  - Calculation of emissions related to agricultural production
    → NH4, NH3, direct N2O, indirect N2O, heavy metals…
  - Link to the technosphere (ecoinvent / SALCA databases)
    → Fertilizers, seeds, pesticides, diesel, buildings, electricity mix,…
  - Calculation of indicators:
    → Soil quality, biodiversity (SALCA-BD)

- **Main Applications:**
  - Broad range of assessment at various level:
    Food, crops, animals, farm, energy, resources, regional,…
  - LCI databases:
    SALCA, ecoinvent, World Food LCA Database,…

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Nemecek T, Knuchel RF, Alig M, Gaillard G (2010) The advantages of generic LCA tools for agriculture: example SALCAcrop and SALCAfarm). Proceeding of the 7th Int. conference on life cycle assessment in the agri-food sector, Bari, Italy, 22-24 September 2010, pp. 433-438

✚ **Strengths and opportunities**

- **Main strengths:**
  - **High scientific quality**, consistency
  - **reliability, automation, and efficiency** of the calculation of emissions at field, farm and product level
  - **modular** construction of emission models (models parameters and calculation can be adapted to the goal and scope)
  - possibility to perform **batch calculation** of several farms or crops
  - based on a commercial software (Excel) that is understood by a important share of the LCA practitioners or agriculture specialists, and that allows flexibility

- **Main opportunities:**
  - **Data Collection**: improvement of the functionality and flexibility
  - **Calculation and modelling**: Version management of emissions models, central database for products, processes and EFs
  - **Assessment and interpretation**: full automation and flexibility
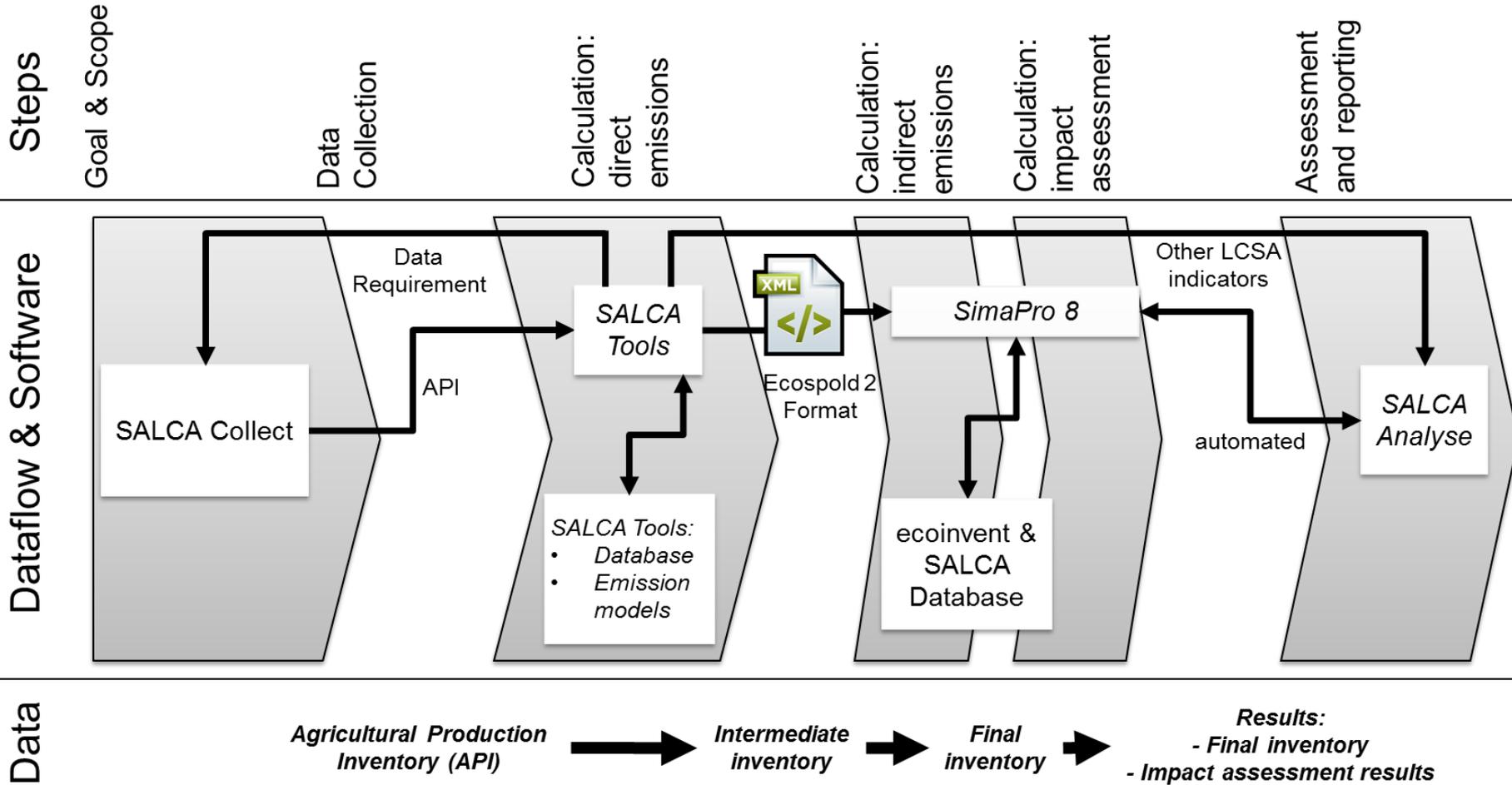 - →Overall: Reducing the development/adaptation time and cost for each project

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Future workflow

project SALCAfuture

Future workflow

Steps: Goal & Scope | Data Collection | Calculation: direct emissions | Calculation: indirect emissions | Calculation: impact assessment | Assessment and reporting

Dataflow & Software:

SALCA Collect → API → SALCA Tools

Data Requirement

SALCA Tools:
- Database
- Emission models

SALCA Tools → XML Ecospold 2 Format → SimaPro 8

ecoinvent & SALCA Database

Other LCSA indicators → SALCA Analyse

automated

Data:

Agricultural Production Inventory (API) → **Intermediate inventory** → **Final inventory** → **Results:**
- Final inventory
- Impact assessment results

Future use-cases

Farmers, Consultants, Partners, Specialists, Administrator
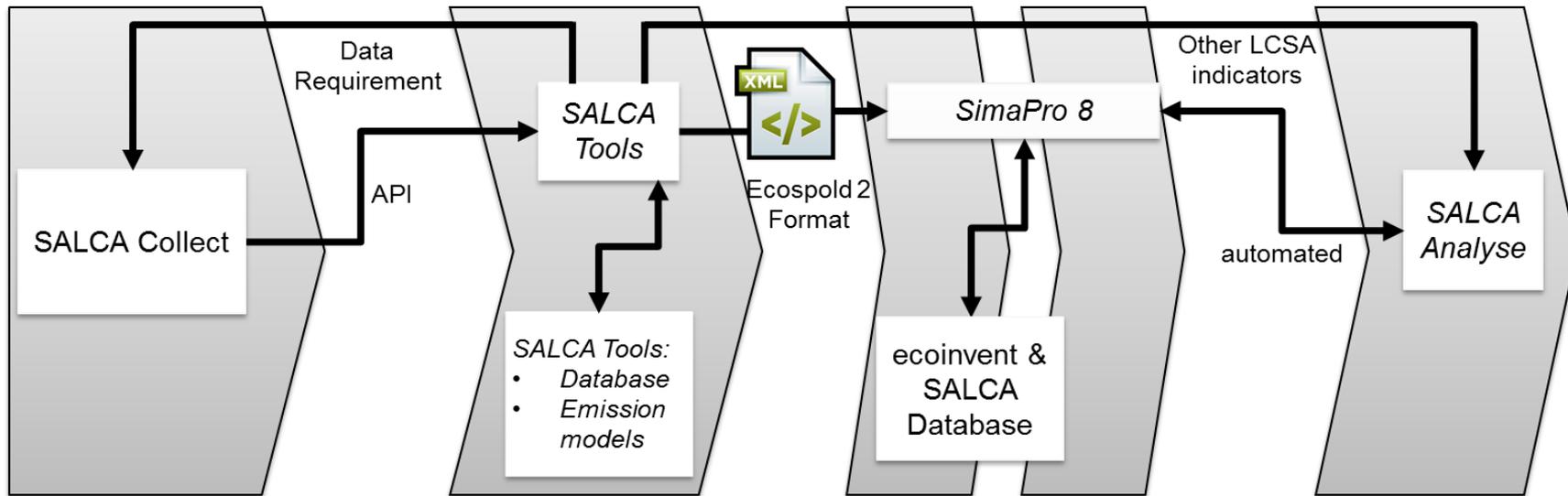
Web-Interface

Client-Software with two-step SMS verification

number of users

Non-specialists

Internal / external specialists & trained users

Dataflow & Software

Data Requirement

API

SALCA Collect

SALCA Tools

SALCA Tools:
- *Database*
- *Emission models*

XML
Ecospold 2 Format

SimaPro 8

ecoinvent & SALCA Database

Other LCSA indicators

automated

SALCA Analyse

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Compatibility with the LCSA road-map

▪ According to the LCSA road-map proposed by (J.B. Guinée et al. 2011):

Broadening the scope of indicators (social, economic):

→New indicators are currently assessed and might be integrated in the future framework. For example:

- ▪ Workload
- ▪ Animal welfare
- ▪ Landscape quality

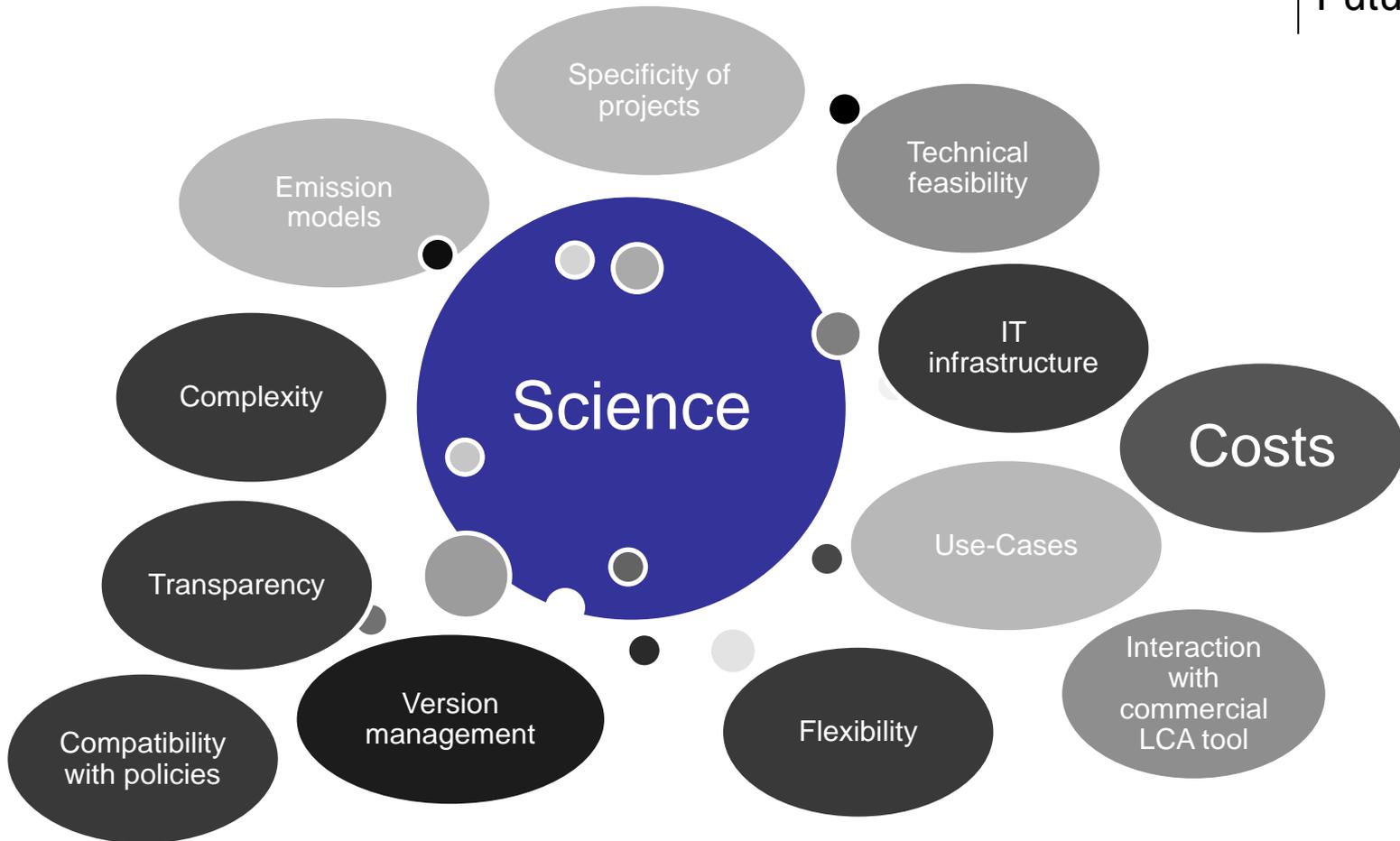***Broadening the object of the analyses (meso-level, economy-wide)*:**

→The current tools already allow regional analysis (batch calculation)

→This will be supported and improved further by the overall efficiency of the future workflow

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Guinée JB, Heijungs R, Huppes G, Zamagni A, Masoni P, Buonamici R, Ekvall T, and Rydberg T (2011) Life Cycle Assessment: Past, Present, and Future. Environmental Science & Technology 45 (1), 90-96.

Challenges

Conclusions

- **Context:**

→ Direct and indirect emissions from agricultural production are generally significant

→ **Tools are key for the application of the methodology**

- **Current workflow**

→ Strong solution already existing:
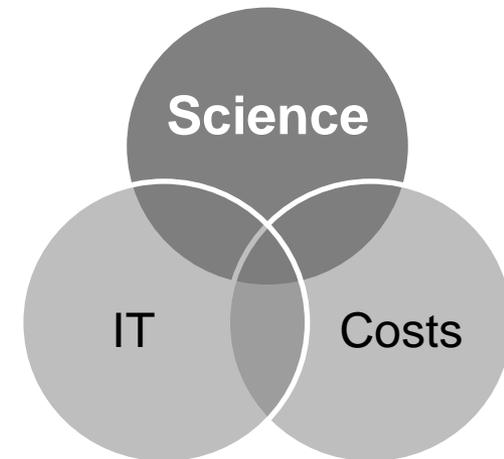
SALCA*crop* and SALCA*farm*

→ Potential for improvement

- **Future workflow**

→Improvements of data collection, calculation and analysis stages

→Compatibility with **future LCSA indicators**

→**The final solution will be a compromise.**

→**The priority is scientific quality !**

Science

IT   Costs

Thank you for your attention

Agroscope   good food, healthy environment