Chair of Ecological Systems Design, ESD

Stephan Pfister & Carl Vadenbo

IRCADA – USYS TdLab – IfU-ESD workshop

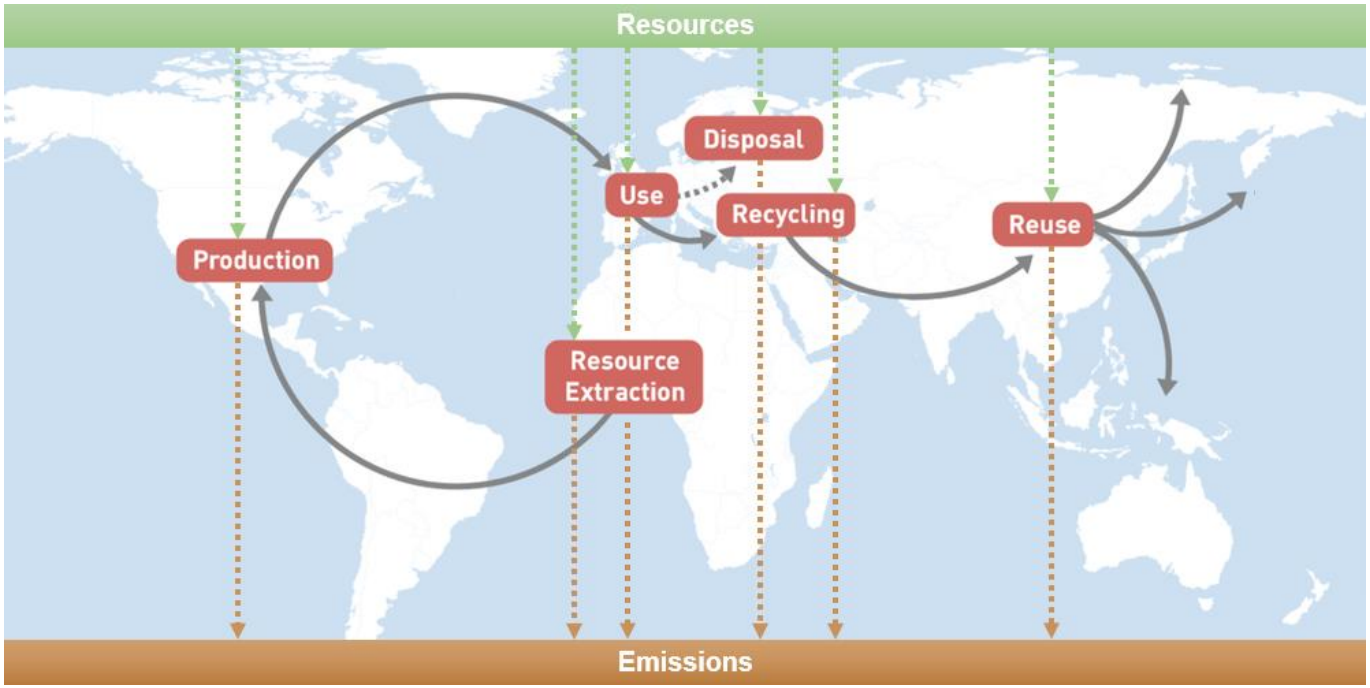
2016-02-28

Chair of Ecological Systems Design, ESD

- Chaired by Prof. Dr. Stefanie Hellweg since 2006
- Currently employing
  - 2 senior researchers
  - 1 postdoc
  - 11 PhD candidates
  - 1 secretary
- Belongs to the **Institute of Environmental Engineering** (IfU), Department of Civil, Environmental and Geomatic Engineering (D-BAUG)

ESD mission statement

Our mission is to model, analyze, evaluate, and improve the resource efficiency and environmental performance of products and processes, new technologies, and consumption patterns.

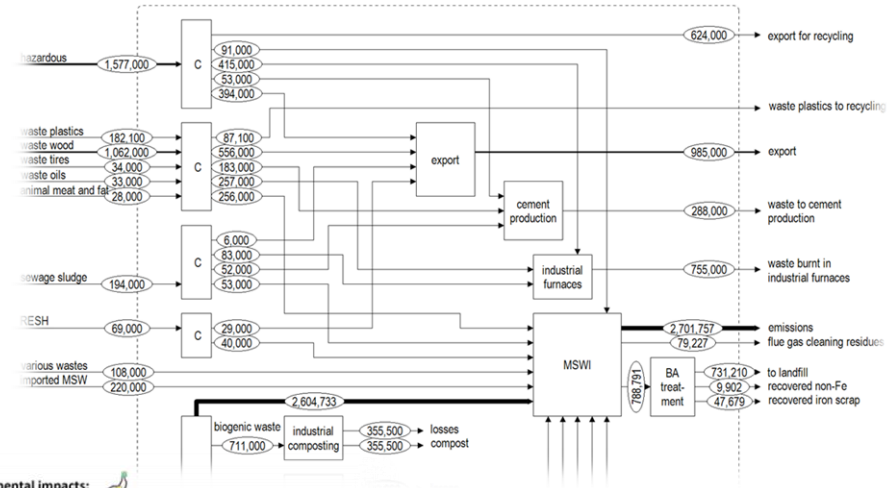


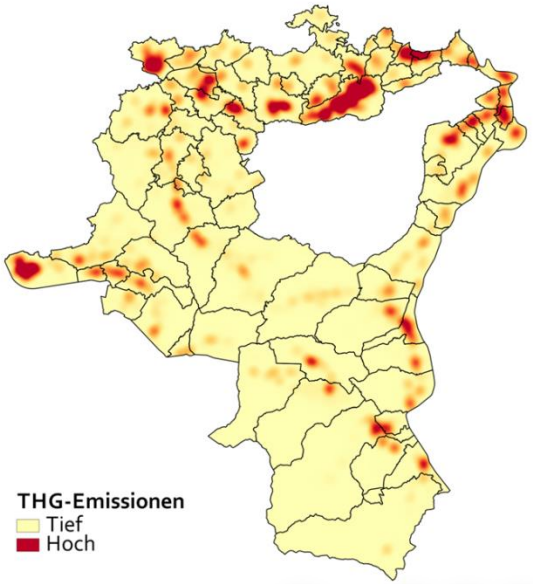
Research focus @ESD – *past & present*

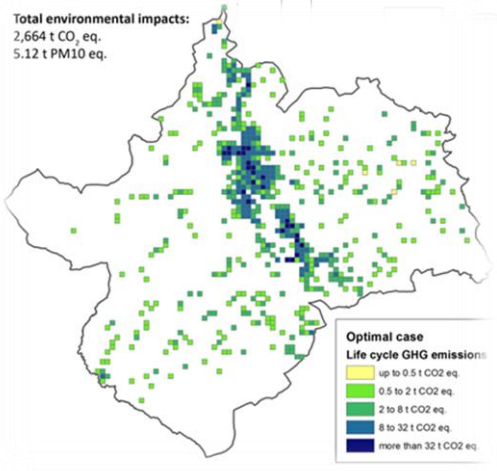
- Research areas – methodological foci:
  - Systems analysis & design
    - MFA, LCA, & optimization
    - Regionalisation (spatial LCA) & temporalisation (dynamic LCA)
    - Scaling- & learning-effects in LCA
  - Risk & impact assessment
    - Water
    - Land use & biodiversity
    - Resources
    - Water & air pollution
    - Noise & accidents
    - (Nano-)toxicology

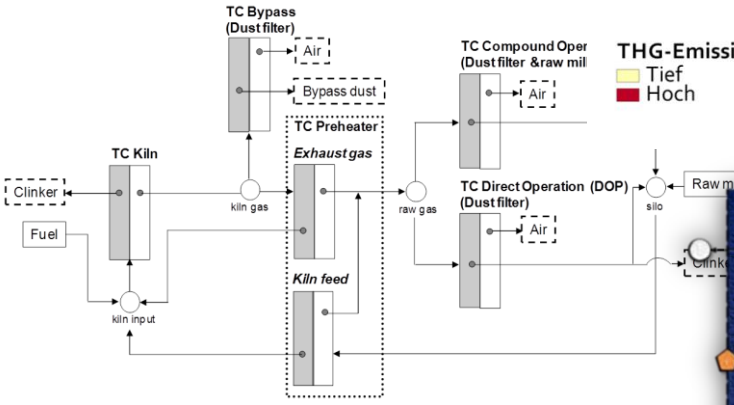
Research focus @ESD – *past & present (cont'd)*

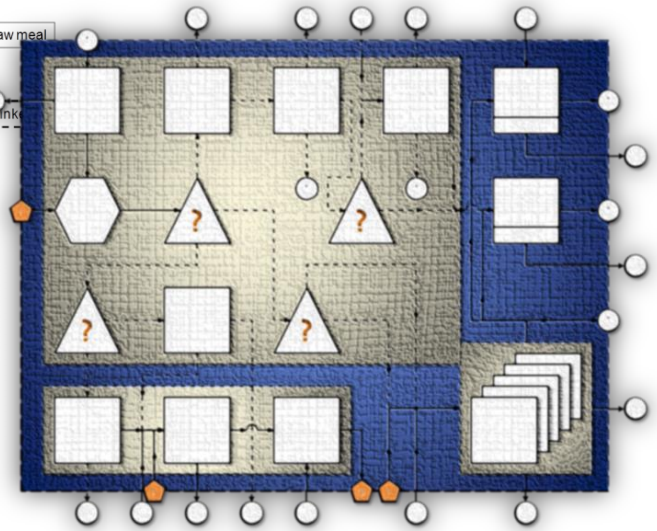
- Research themes
  - Agriculture
  - Food & nutrition
  - Energy technologies & systems
  - Steel & cement production
  - Wood & bio-based products
  - Nano-technology
  - Household consumption
  - Waste & secondary resource management











Systems analysis & design

Systems analysis & design

With the aim to analyze & optimize, we model…

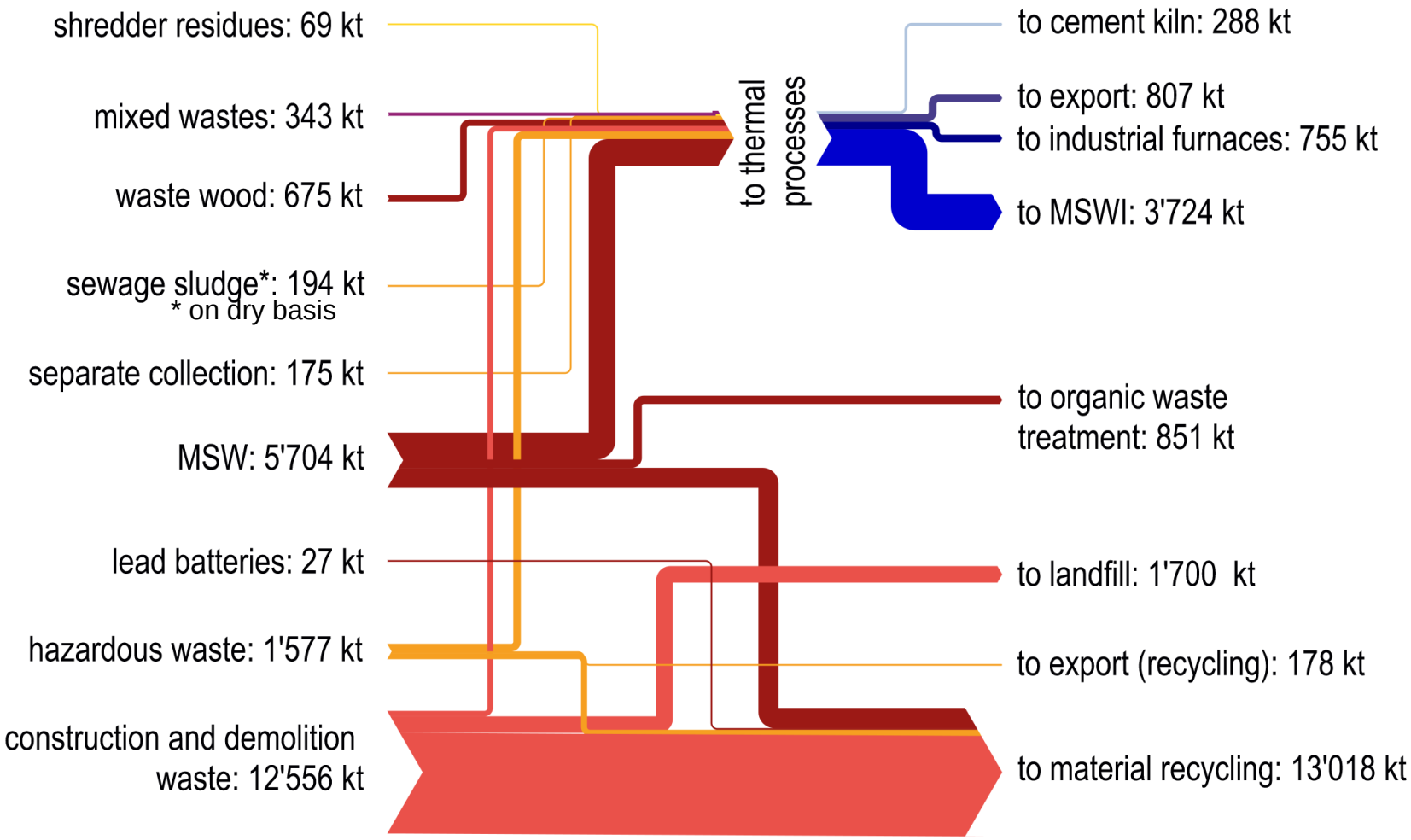
- Resource-intensive industrial processes (cement & steel)
- Energy technologies
- Bioenergy, bio-based materials, & the wood value chain
- Urban energy systems
- Building stocks
- Household consumption
- Waste management, e.g. MSW, food waste, industrial residues

… by integrating of MFA, LCA, & mathematical optimization

… by coupling large datasets & complex models

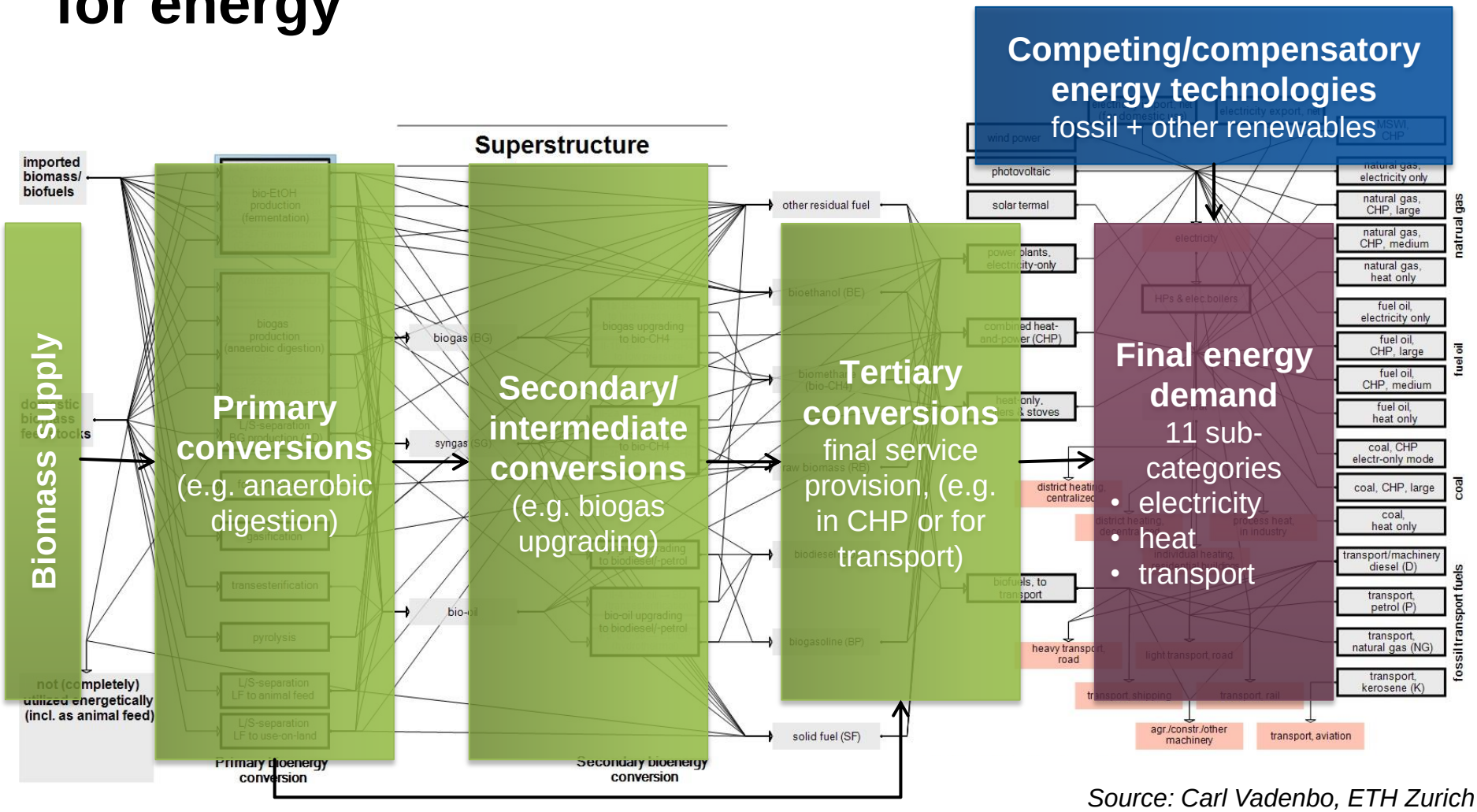
… by adding spatial and/or temporal resolution

Waste flow analysis in Switzerland (excerpt)



Source: Melanie Haupt, ETH Zürich

Environmental optimization of use of biomass for energy



Source: Carl Vadenbo, ETH Zurich

Food and agriculture

Chair of Ecological Systems Design

Professor Stefanie Hellweg

Freshwater Consumption

Stephan Pfister
Laura Scherer

Land Use

Stephan Pfister
Abhishek Chaudhary

Erosion & Phosphorus Emissions

Laura Scherer

Soil Compaction

Franziska Stössel

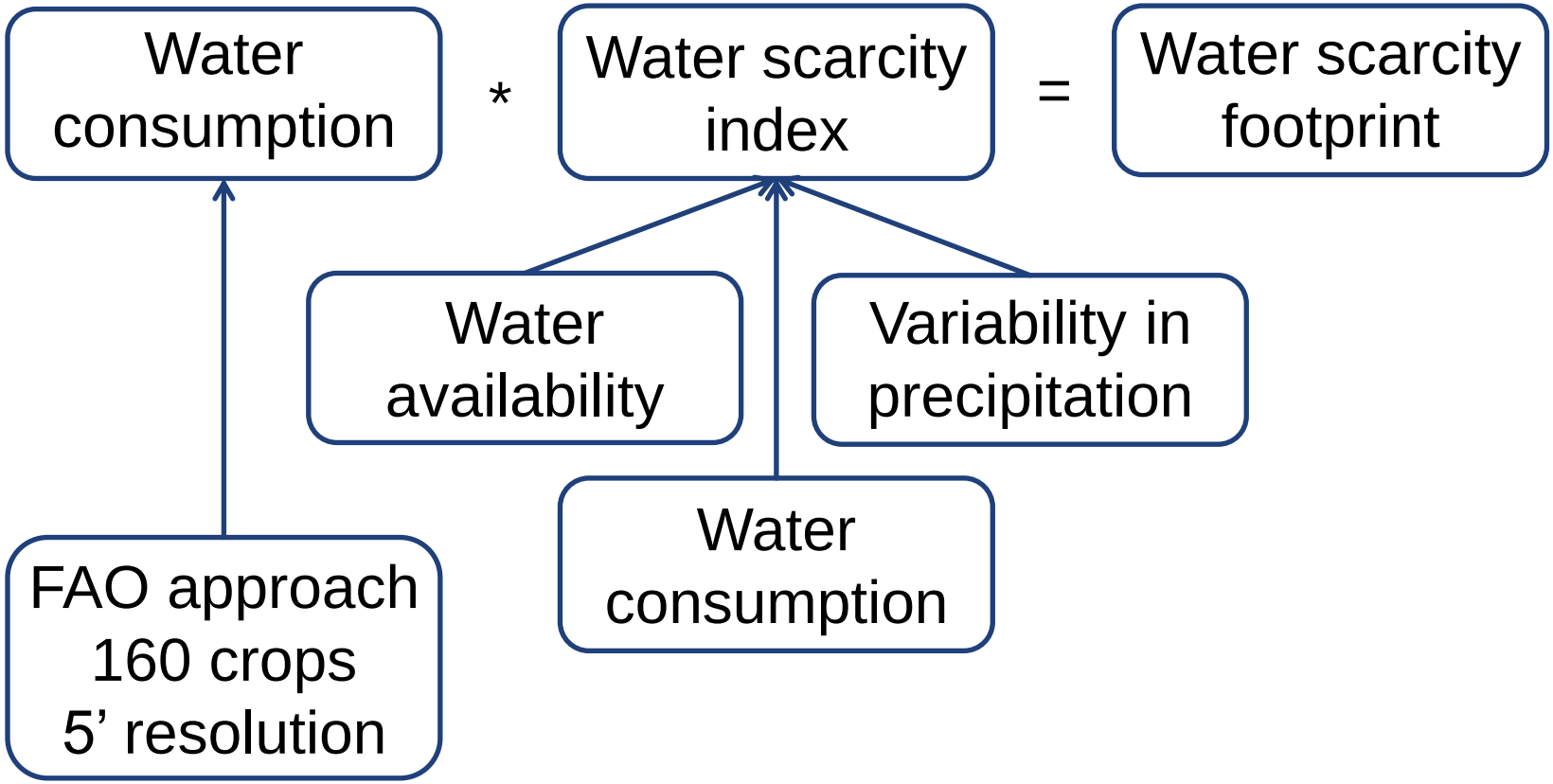
Food Waste

Claudio Beretta

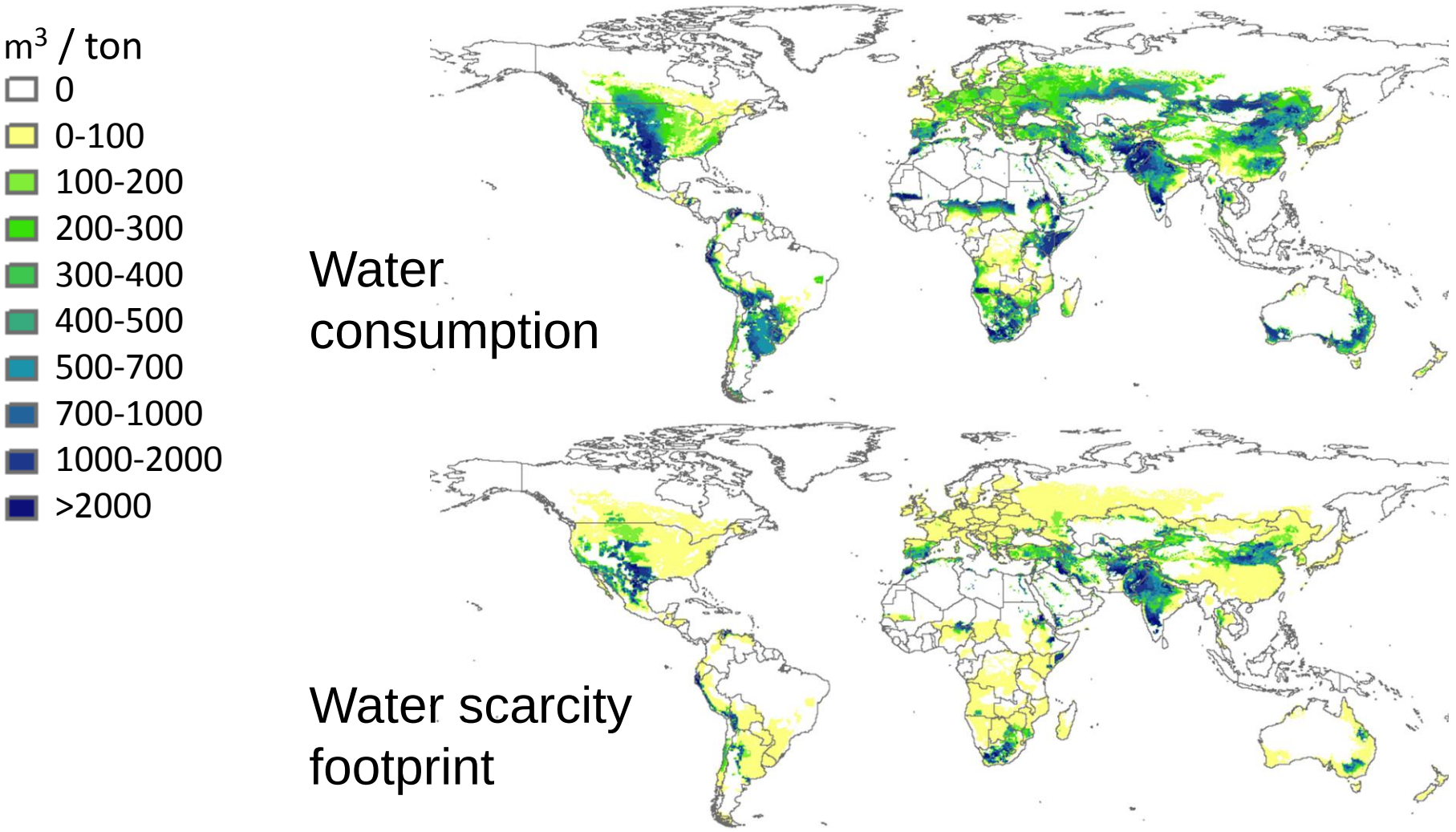
Diets

Christie Walker

Water scarcity footprints

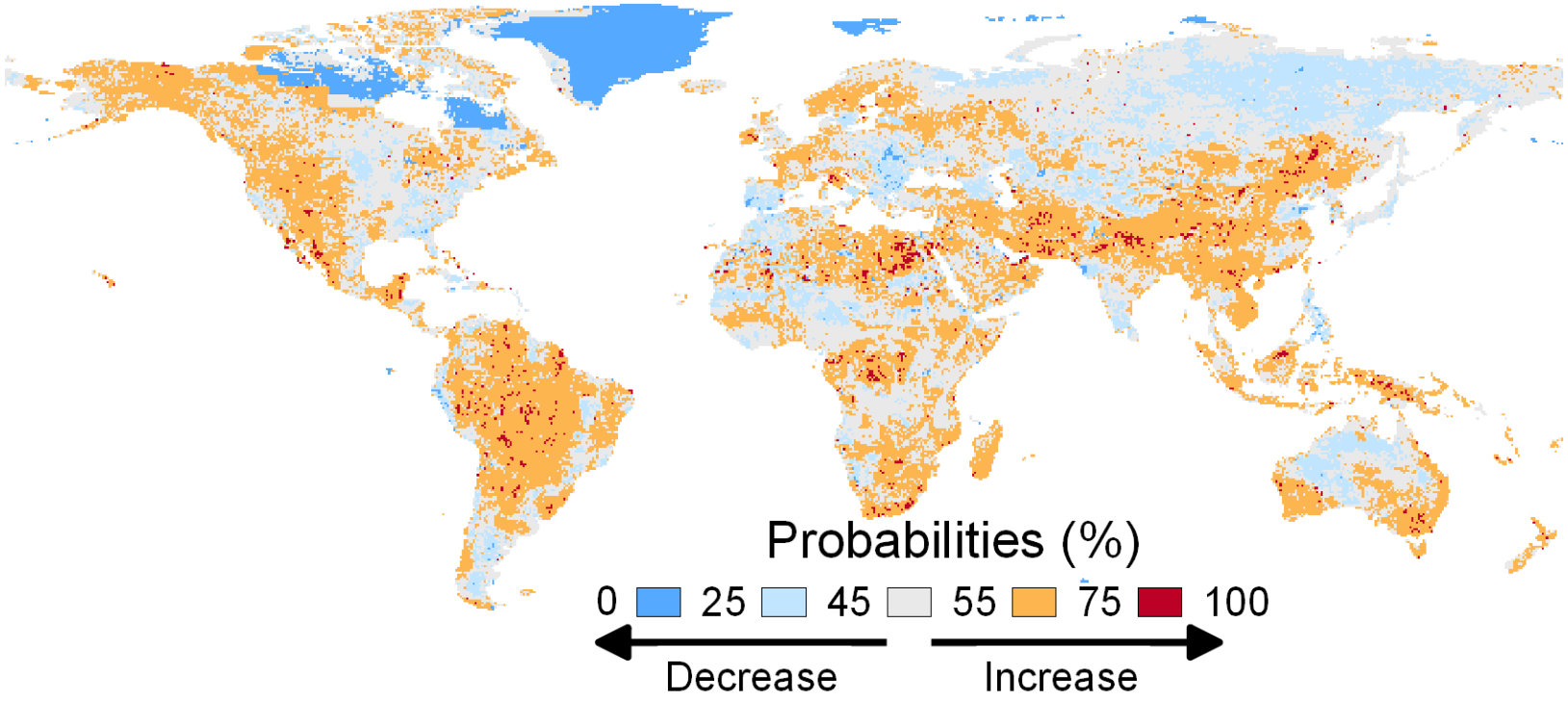


Water scarcity footprints of wheat cultivation



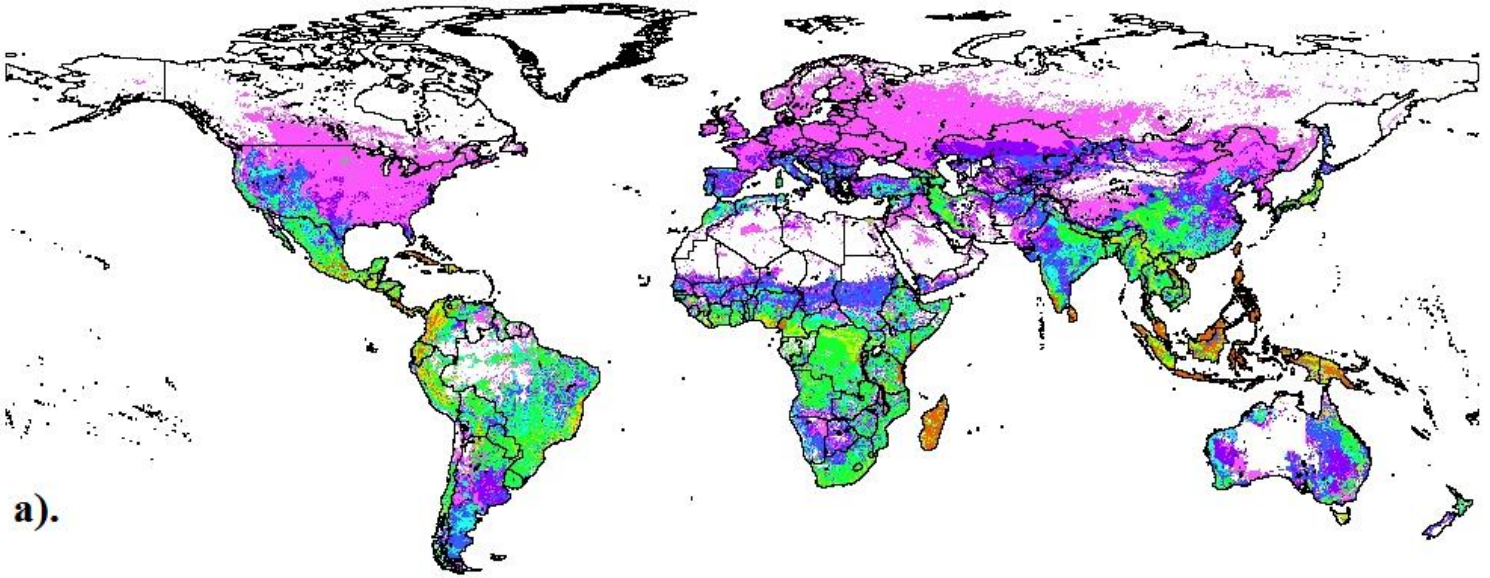
Probability of increasing water scarcity

1981-1990 compared to 2001-2010



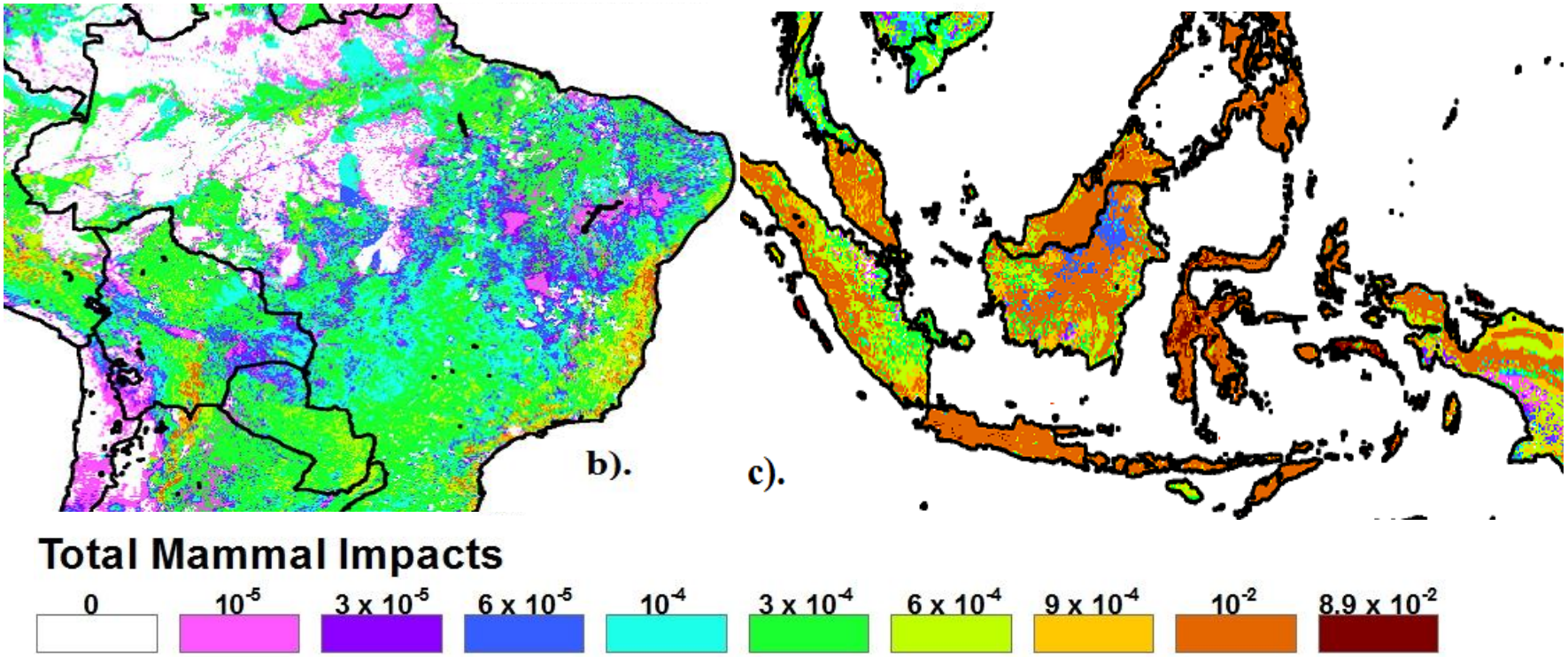
Land use impacts

- Calculating endemic species loss caused by land use (forestry pasture and cropland) for different taxa

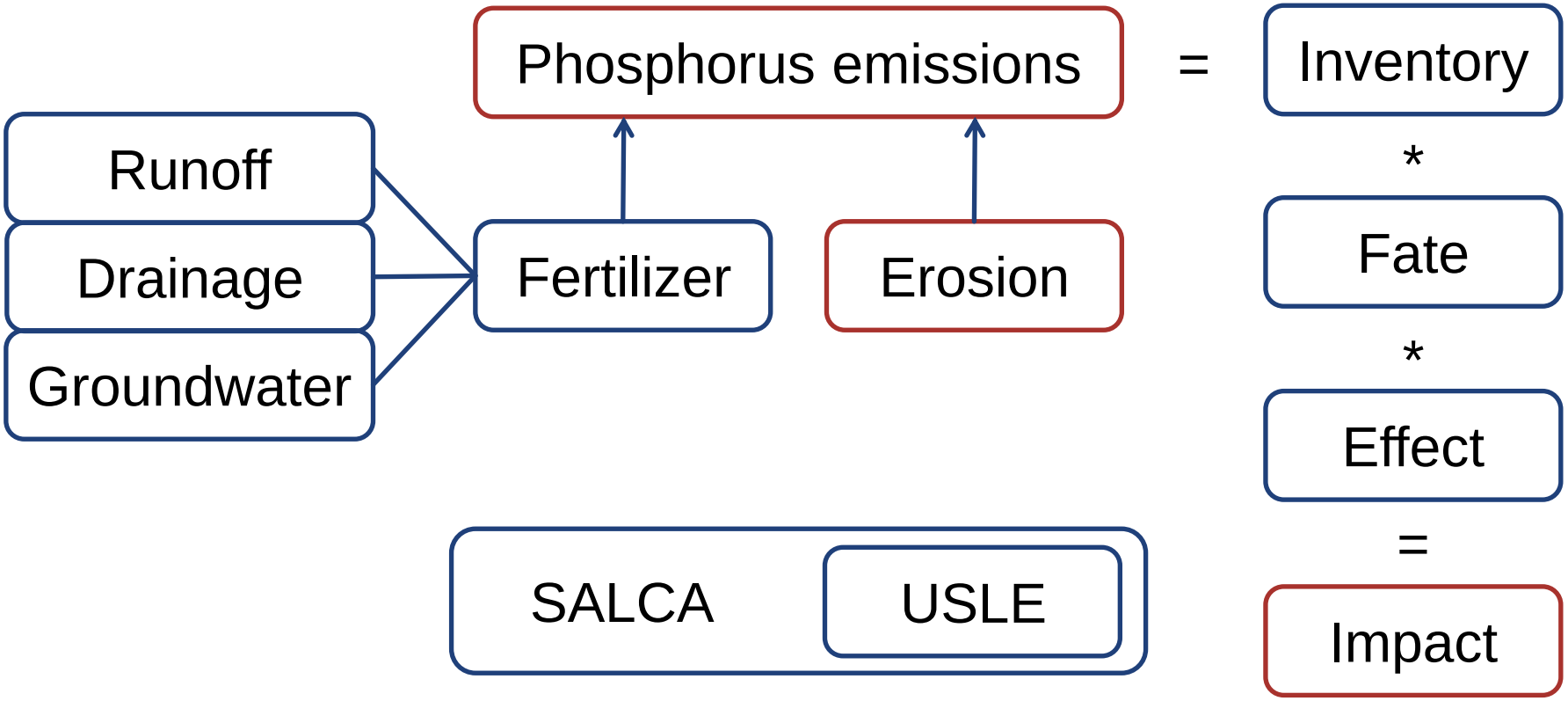


Land use impacts

- Calculating endemic species loss caused by land use (forestry pasture and cropland) for different taxa

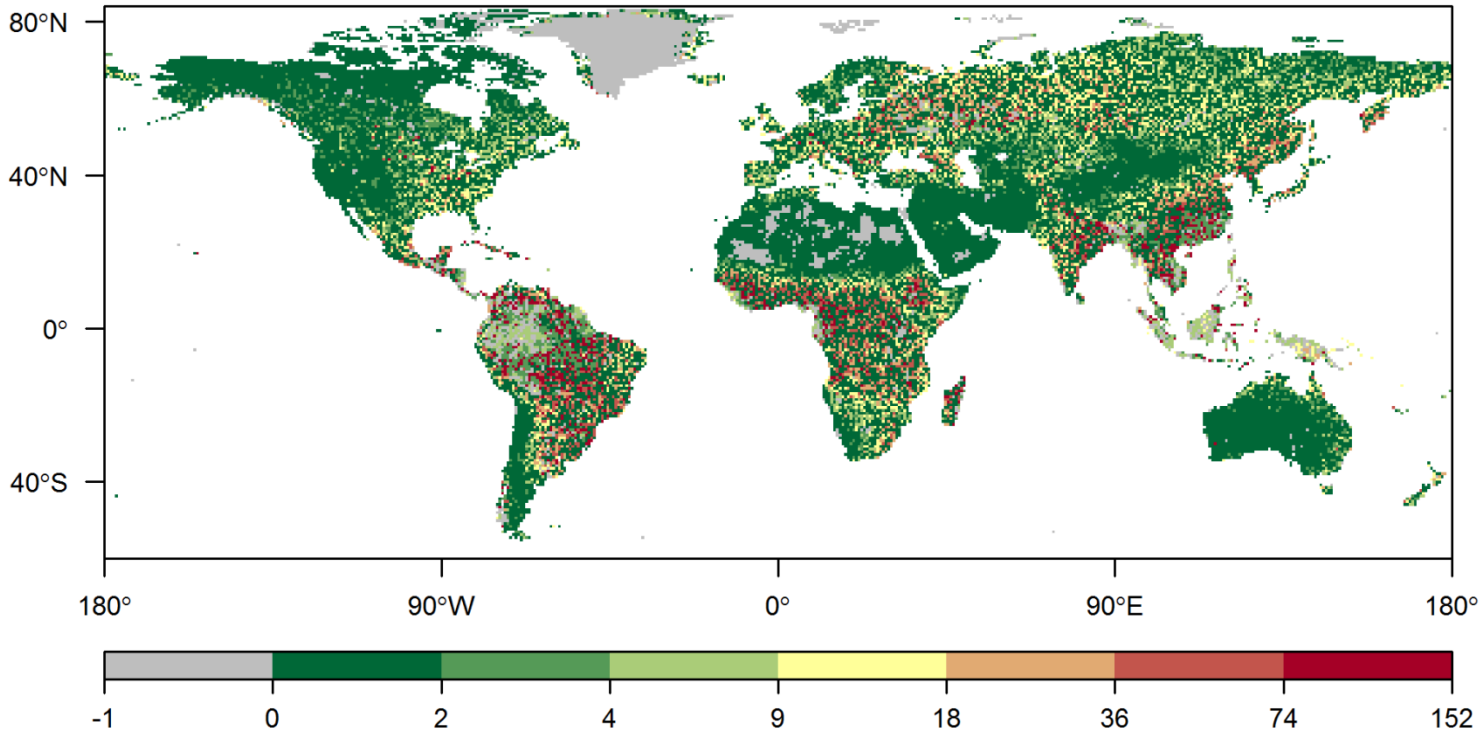


Erosion and freshwater eutrophication



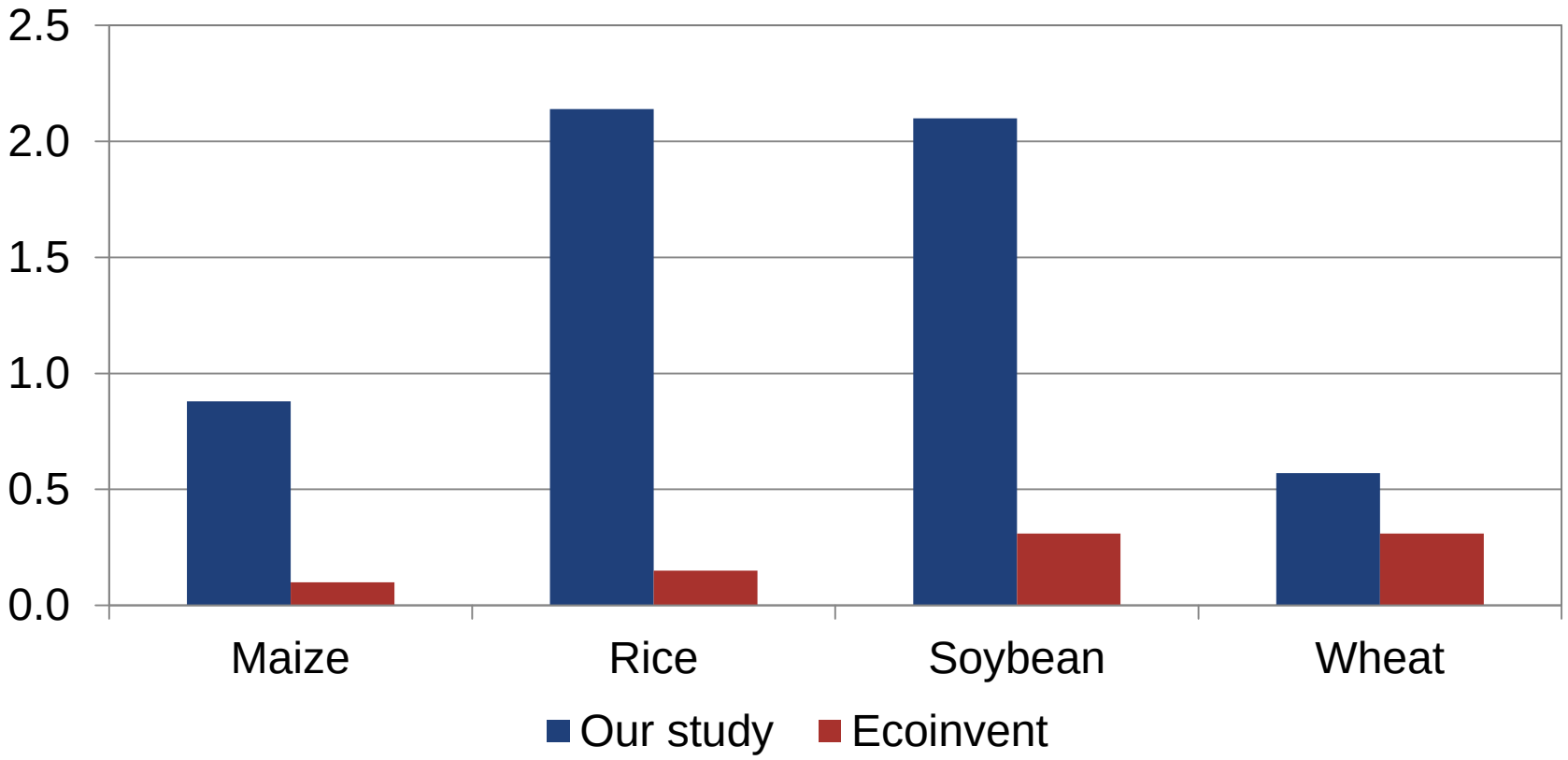
Soil erosion per land use

Unit: tonne soil / (ha · a)

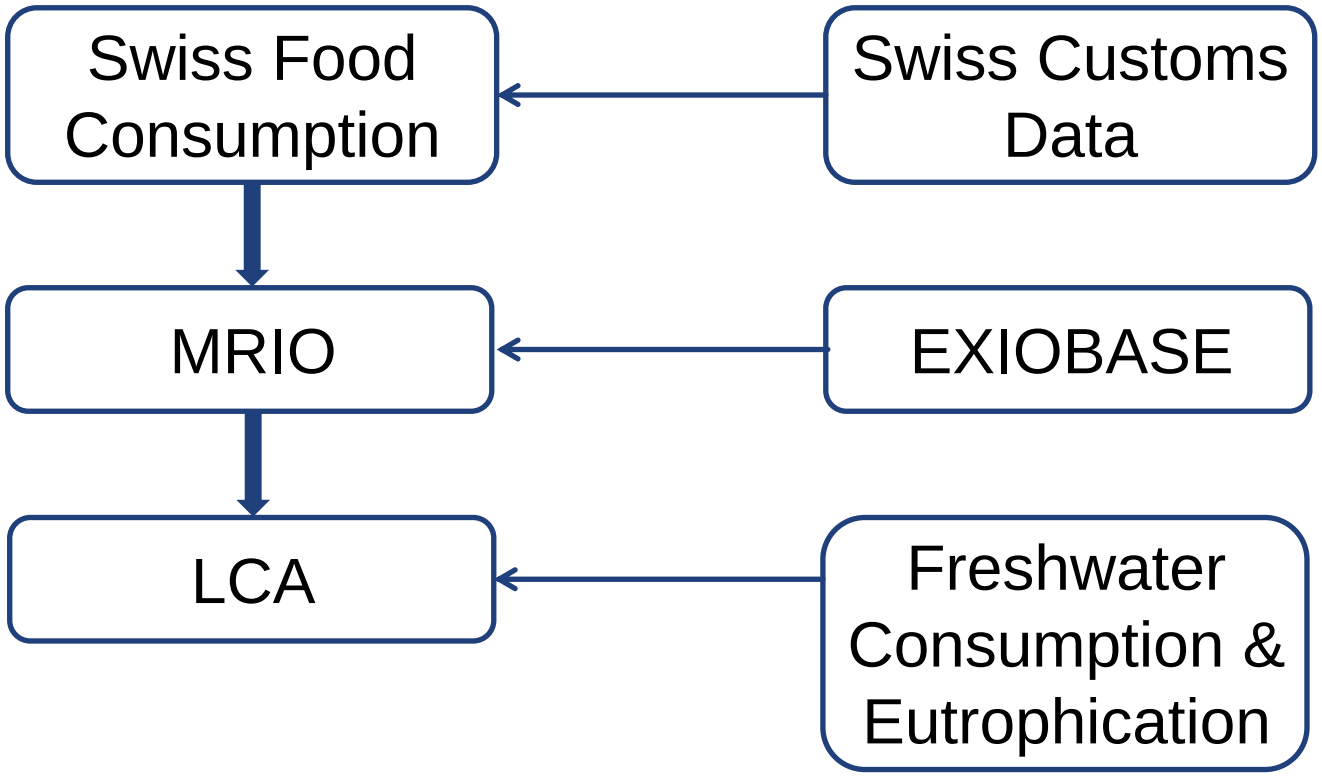


Freshwater eutrophication

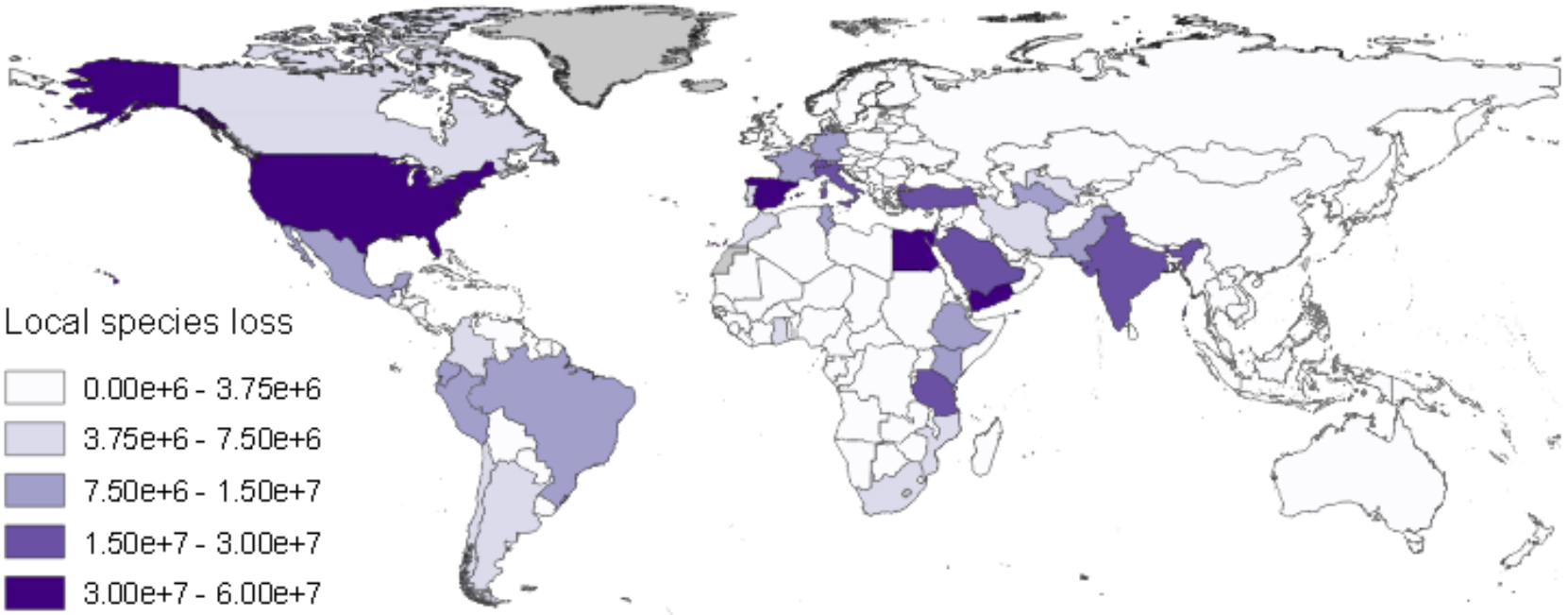
Global average phosphorus emissions (g P / kg crop)



Swiss food consumption

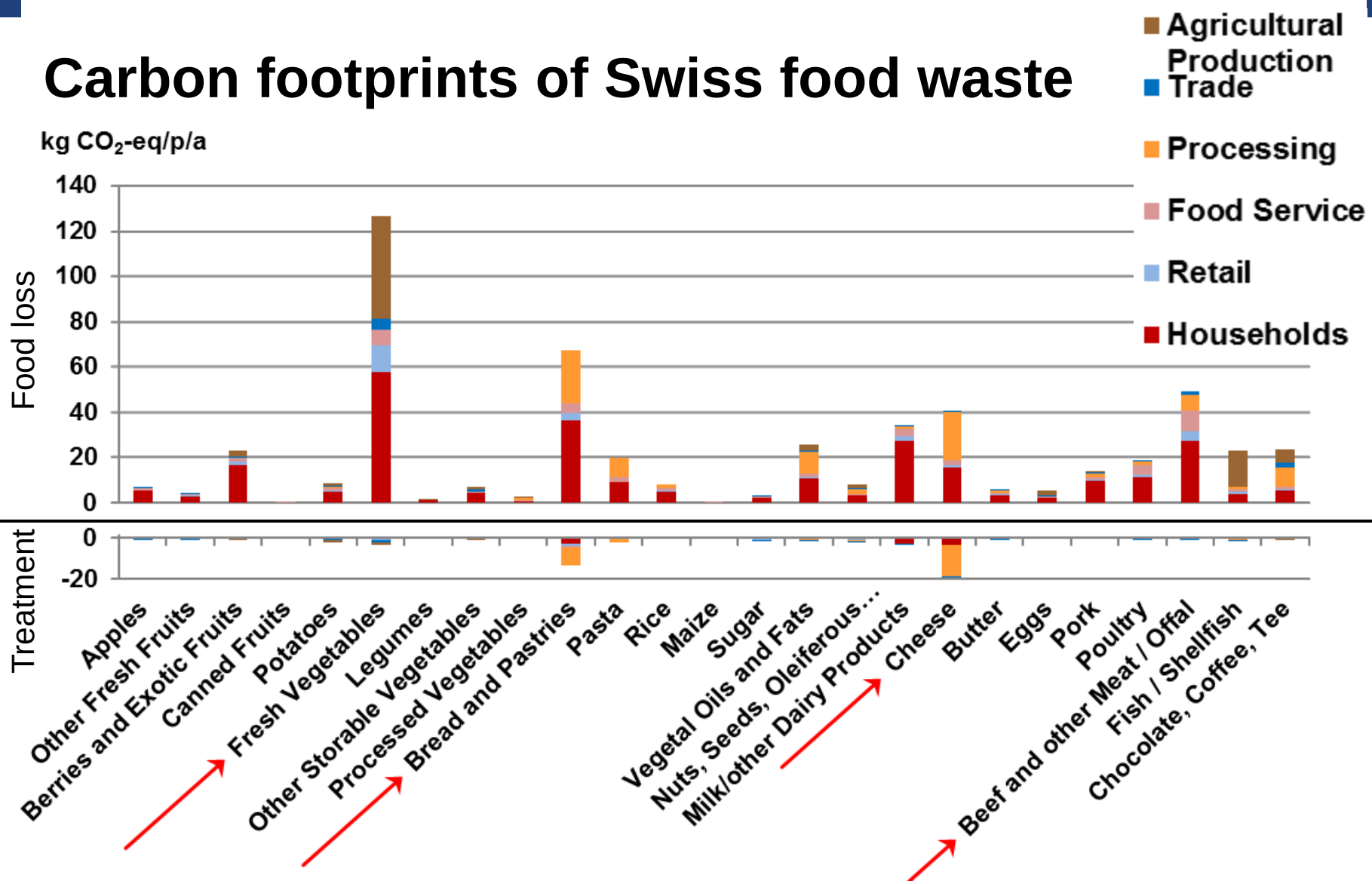


Swiss food consumption



Unit: PDF m^2 a

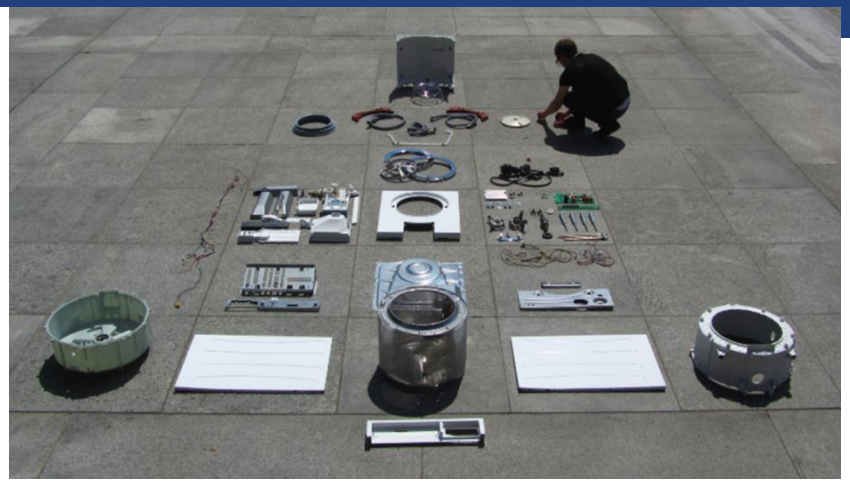
Carbon footprints of Swiss food waste



Additional Projects in Agriculture

- Biodiversity impacts of total agriculture
- Impacts of soil compaction
- International trade analysis using trade stastistics and MRIO
- Improving the global assessment of crop production (details on nitrogen & greenhouse gas emissions and pesticide application)
- Food processing and Personal diets

Education @ESD



- Bachelor study level
  - Ecological systems analysis
  - Environmental engineering seminars
  - *Waste management (given exclusively by external lecturers)*
  - Bachelor thesis projects
- Master study level
  - Advanced environmental social and economic assessment
  - Prospective environmental assessment
  - Environmental computer laboratory
  - Energy systems analysis
  - Supply and responsible use of mineral resources I
  - *Biological processes for waste treatments*
  - *Waste recycling technologies*
  - Industry internships, semester and master thesis projects


Thank you for your attention!
http://www.esd.ifu.ethz.ch/