Orginal Titel

Assessing current livestock-induced biomass flows in Europe's NUTS2 regions for evaluating feasible food option spaces in 2050

How to address tradeoffs and synergies in livestock farming systems?

Starting with livestock induced biomasse flows and feasible food systems in 2050 and ending with choices at the farm level

Claudine Egger, Michaela C. Theurl, Andreas Mayer, Lisa Kaufmann, Sarah Matej, Karlheinz Erb

7oth EAAP Annual Meeting in Ghent, 27 Aug. 2019

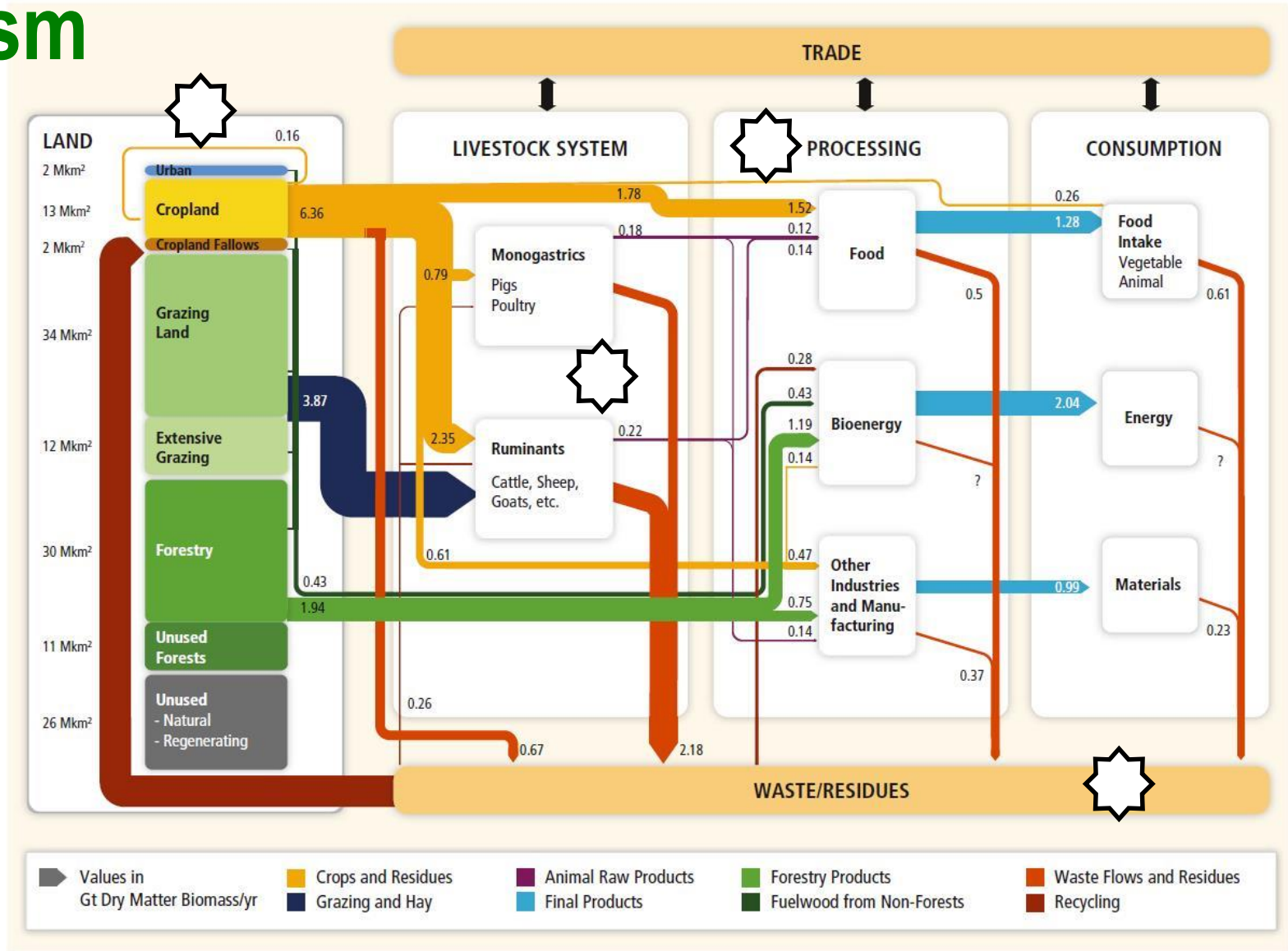
Livestock‘s pivotal role in the global biomass metabolism

Competing land uses

Livestock mix (rumi vs. Mono)

Feed basis (grain/roughage)

Environmental dimenesions (GHG mitigation vs. N-use efficiency)



Farm LEVEL

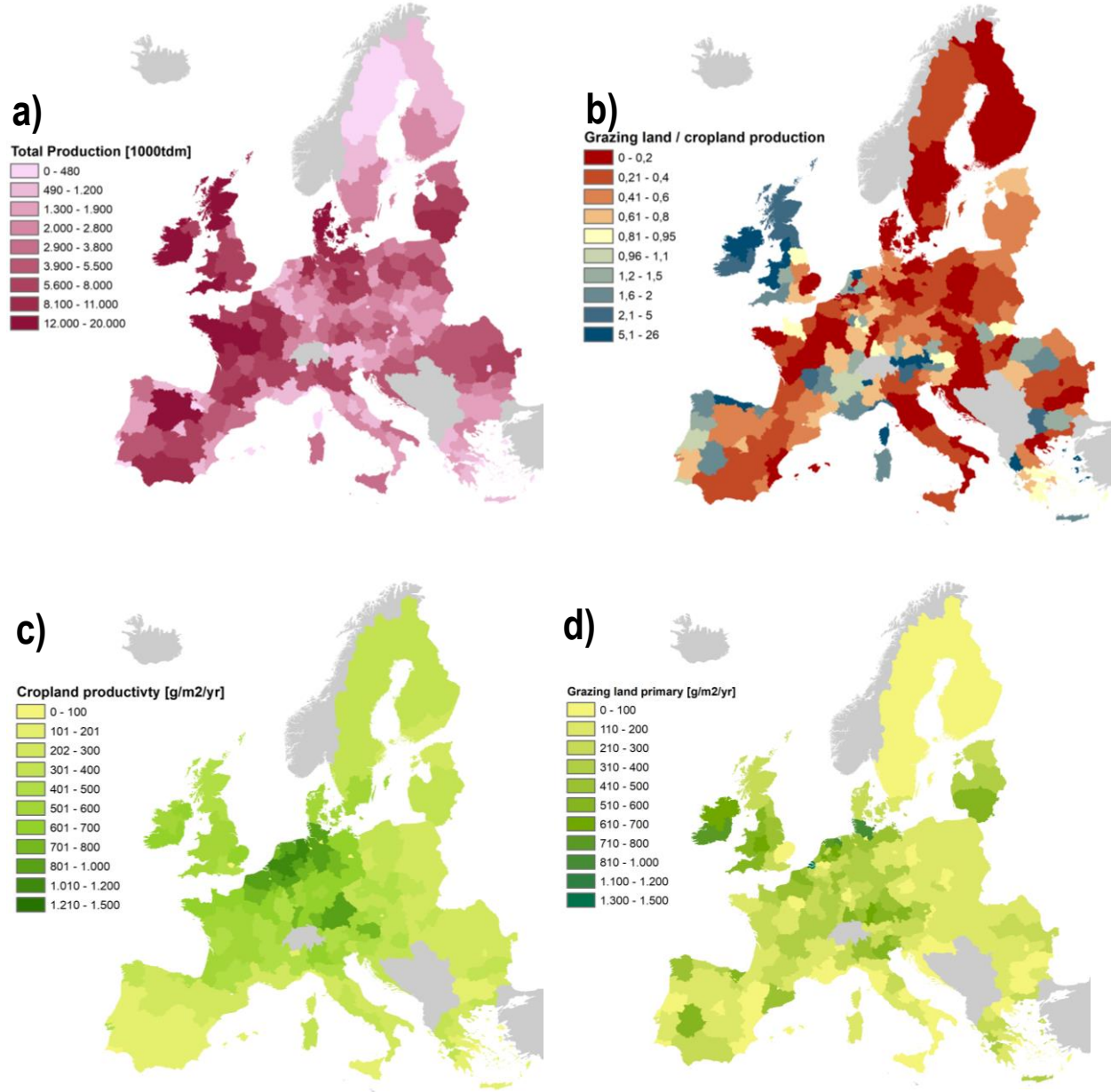
Farmer face different trade-offs/synergies

Smith et al., 2014, based on Krausmann et al., 2008, Wirsenius 2000, 2003, Haberl et al., 2007, Sims et al., 2007, Kummu et al., 2012, Faostat

Europe‘s production system

Total production on arable land and grazing land (a)

- high-producing regions: NW parts of France, central and Southern Spain, Denmark, and the UK and Ireland (a)
- In the majority of NUTS2 regions: share of biomass harvested from grazing land is smaller than cropland production (b)
- Cropland and grazing land productivity:
  c) Ober-&Niederbayern, Benelux d) UK, Ireland, Schleswig-Holsein, NL



Datasource: CAPRI 2012

The biophysical option space 2050 in a Zero-Deforestation World

Our: **BioBaM Modell** (biomass balance model)

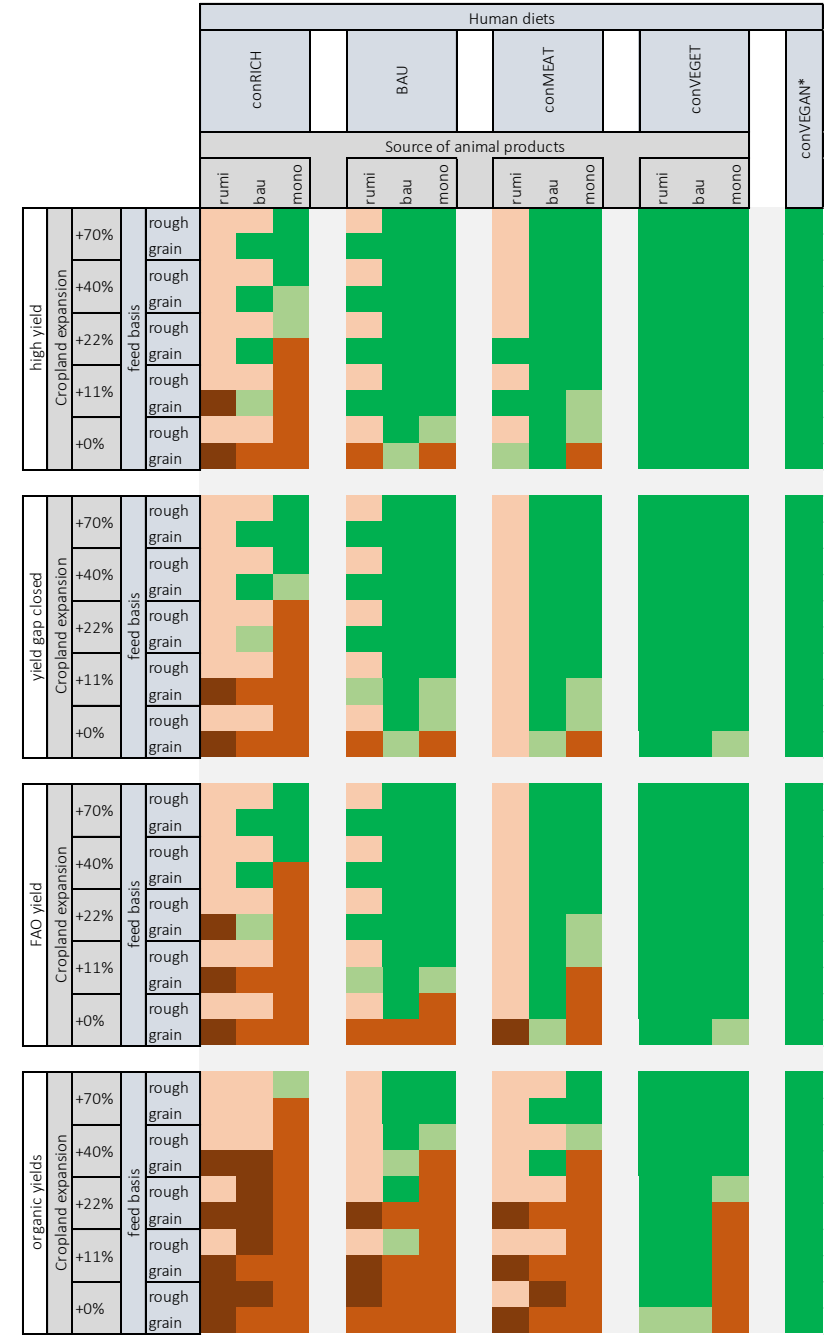
>> Objective: analyzing the biophysical dimension of trade-offs with food security

Systematic variation of 5 crucial parameters:

- 5 human diets.
- Within diets: 3 animal product compositions.
- 2 types of livestock feed.
- 4 crop yield projections.
- 5 assumptions of cropland expansion.

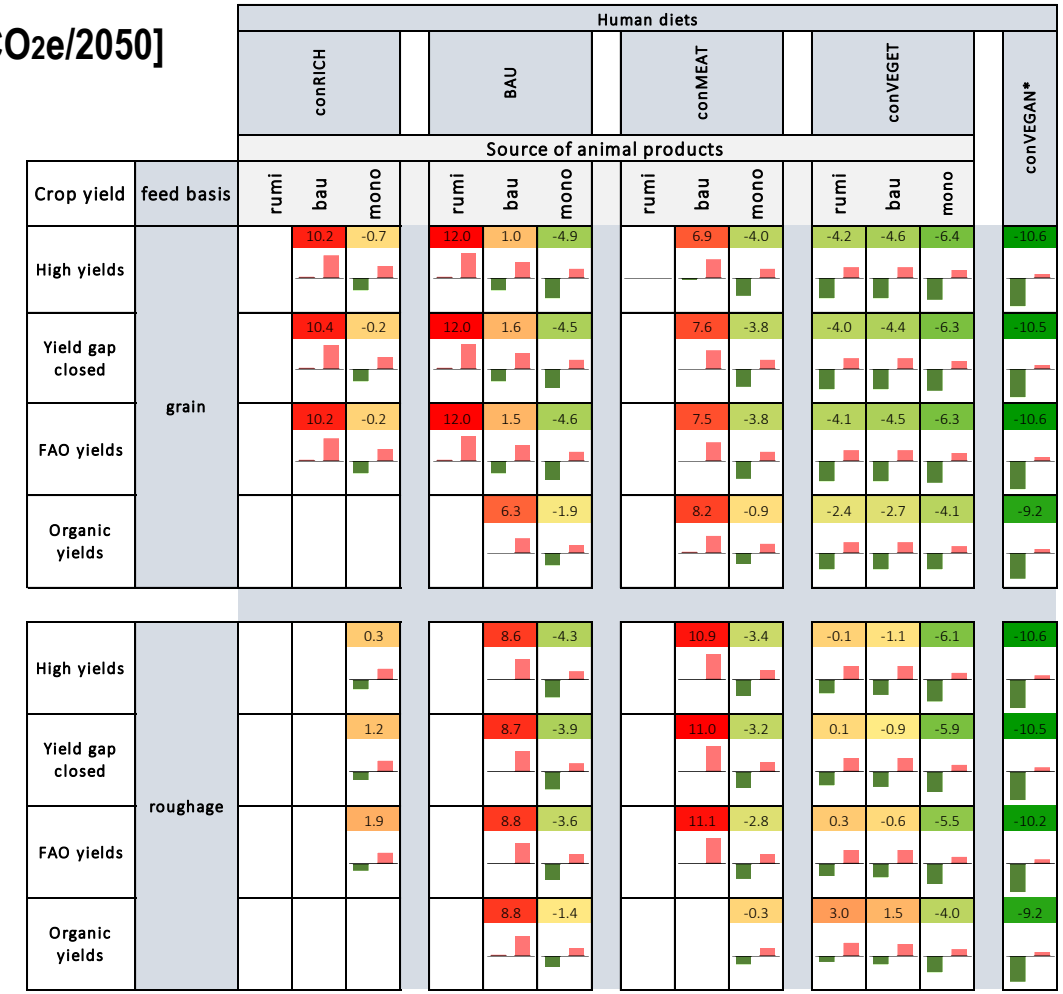
>> All combinations: 520 scenarios.

Of this: 317 scenarios feasible (“option space”)



Erb et al. 2016

Net-GHG emissions of the biophysical option space

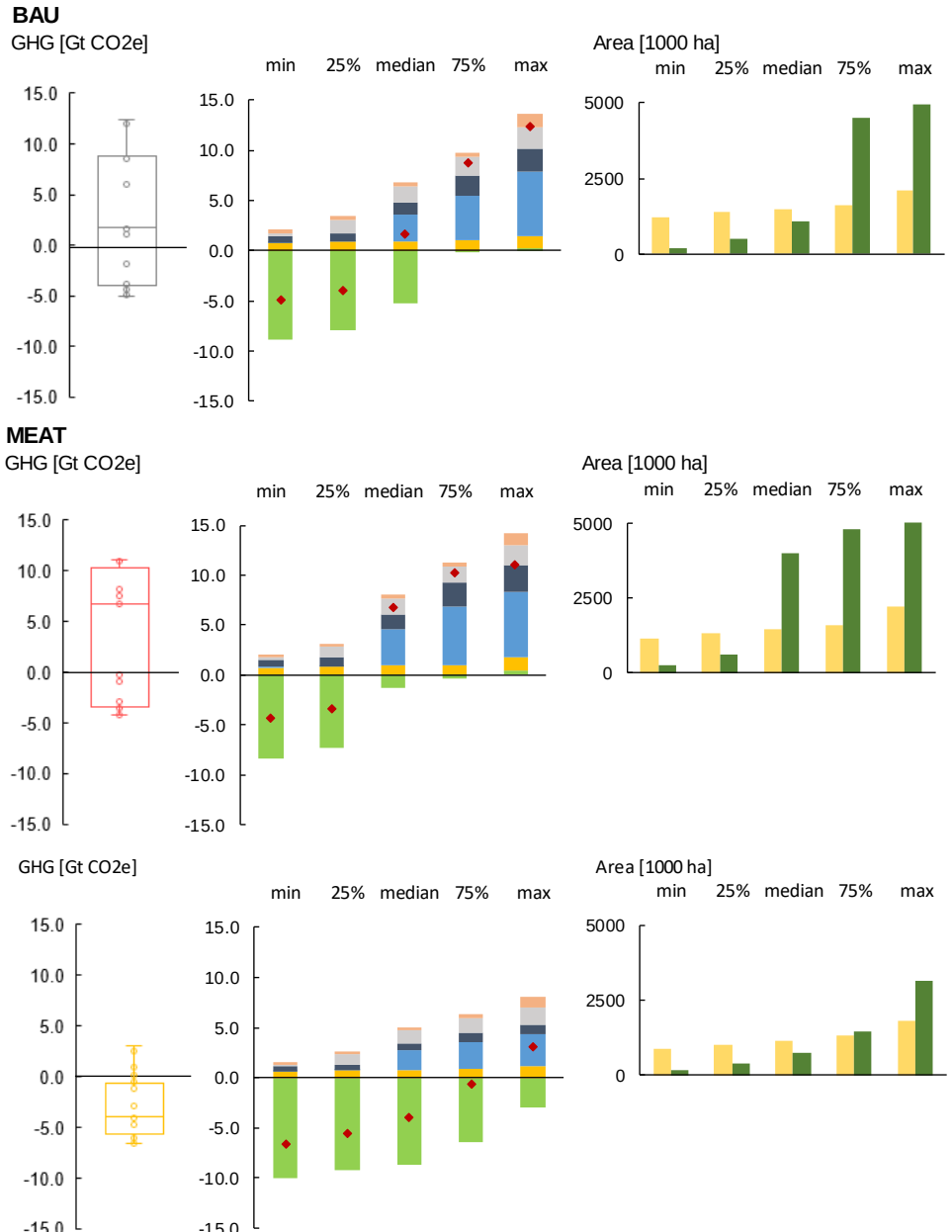


Theurl et al. in prep.

- Trade-off: roughage based livestock systems are confronted with grazing land availability
- Trade-off: grain-feed livestock systems show lower GHGs compared to roughage systems in scenarios where enough grazing land is available, but put pressure on croplands with high GHG emissions
- Synergy between high yields and freeing-up land for C-sequestration > huge potential for GHG savings through vegetation regrowth (not afforestation)

Reference 2000: 6.3 Gt CO_2e

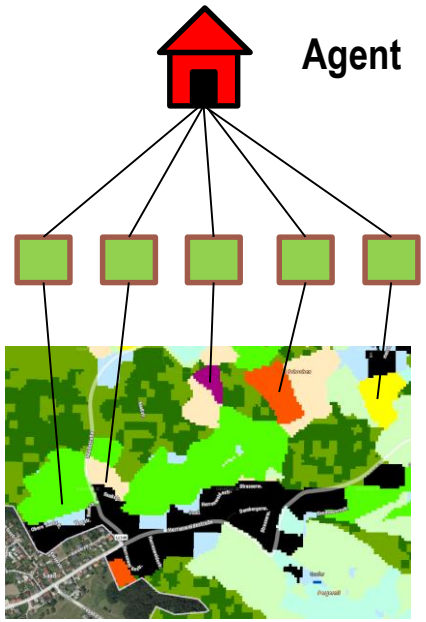
GHG from different agricultural stages in 2050



- GHGs vary between option spaces
- Trade-offs result within each dietary pathway

- MEAT and BAU world: depending on type of livestock product > free areas!
- global convergence to MEAT diets can have negative emissions and contribute to reach climate targets due to vegetation regrowth
- >> guaranteed: free areas for vegetation regrowth only

Agent-based model (ABM)



ABM

GIS

„real world“

Our: SECLAND Modell

>> Objective: analyzing the socio-ecologic dimension of land use changes for future scenarios (SSPs and RCPs)

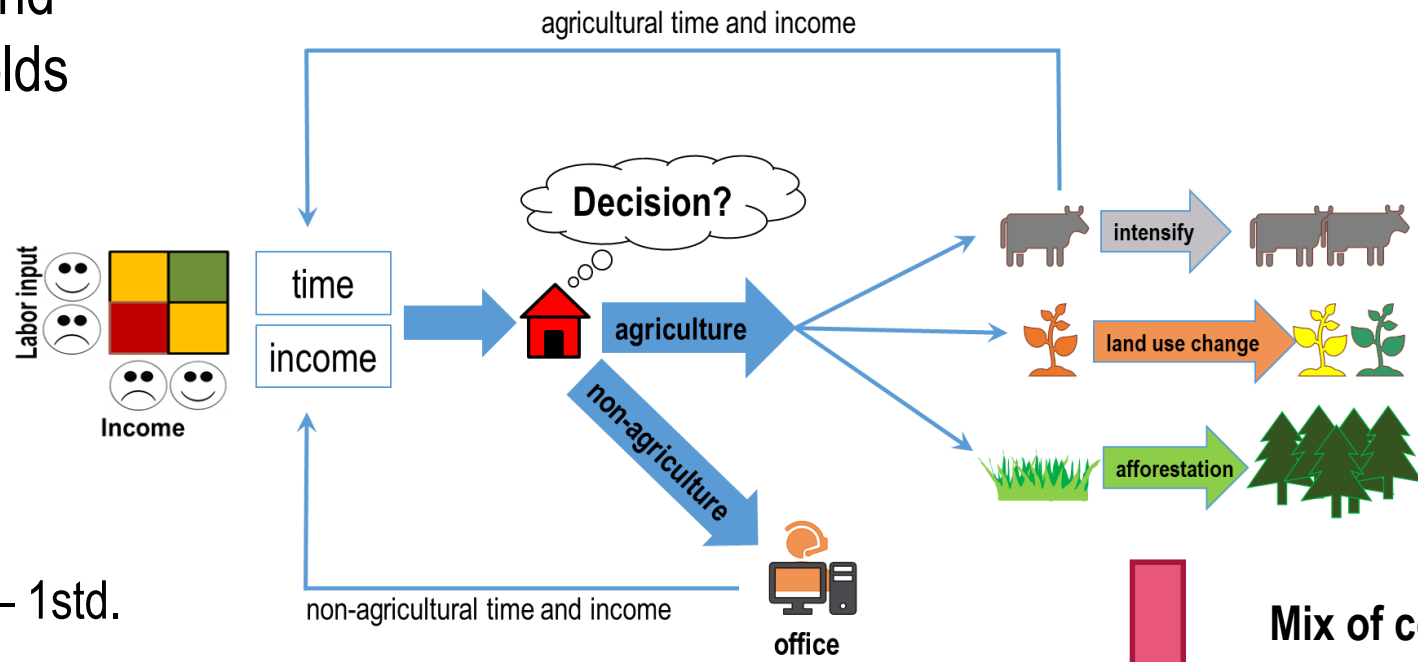
- The ABM focuses on individual agents (farms) for a study region (Eisenwurzen AT)
- Agents represent different farming types (crop, processing, livestock) and farming styles (value systems: e.g. idealist, tradionalist)
- 3 Scenarios:
  - BAU (business as usual)
  - Sustainability (no fossil fuels, subsidies for lowinput production and energyplants)
  - Globalisation (strong globalisation,dependence on fossil fuels, subsidies decline to 0)

Decision making in the SECLAND model

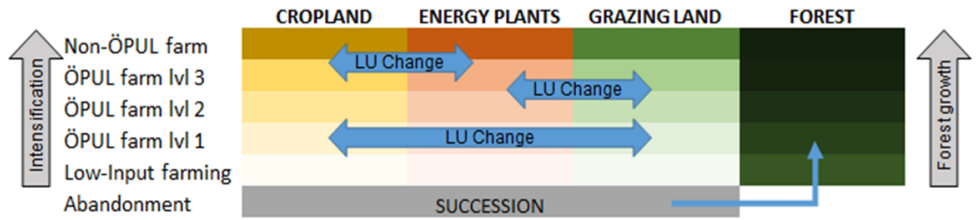
- Farms seek „happiness“ and want to stay within thresholds for time use and income

- Baseline Assumptions:
  - <=1800 hrs
  - >=20’000 € total income per year
  - >=Agri.income per hour – 1std.

- Farmers take new choices every 3 years



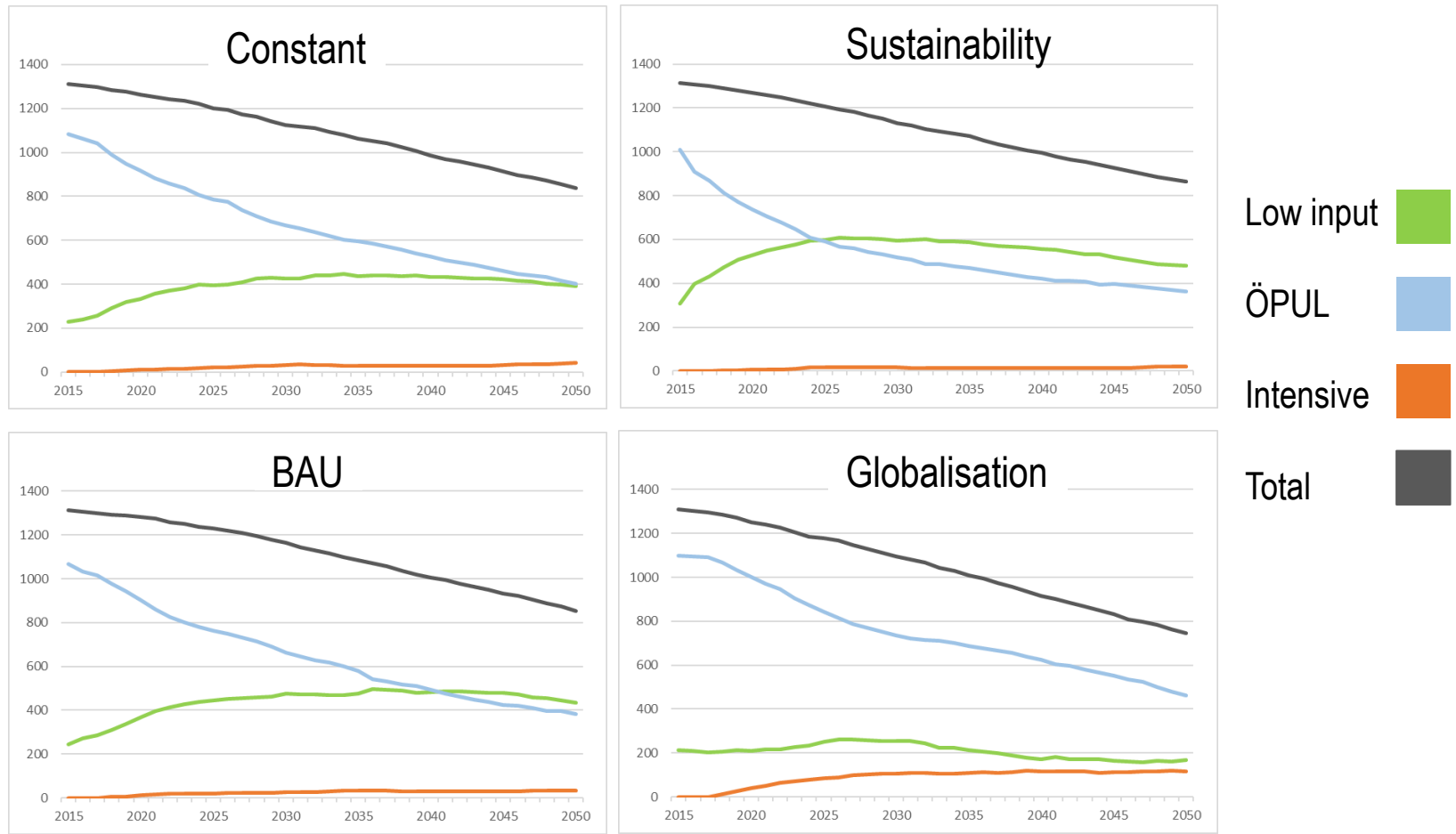
Mix of combinations Land use matrix



Active farms intensity trends until 2050 for the Eisenwurzen

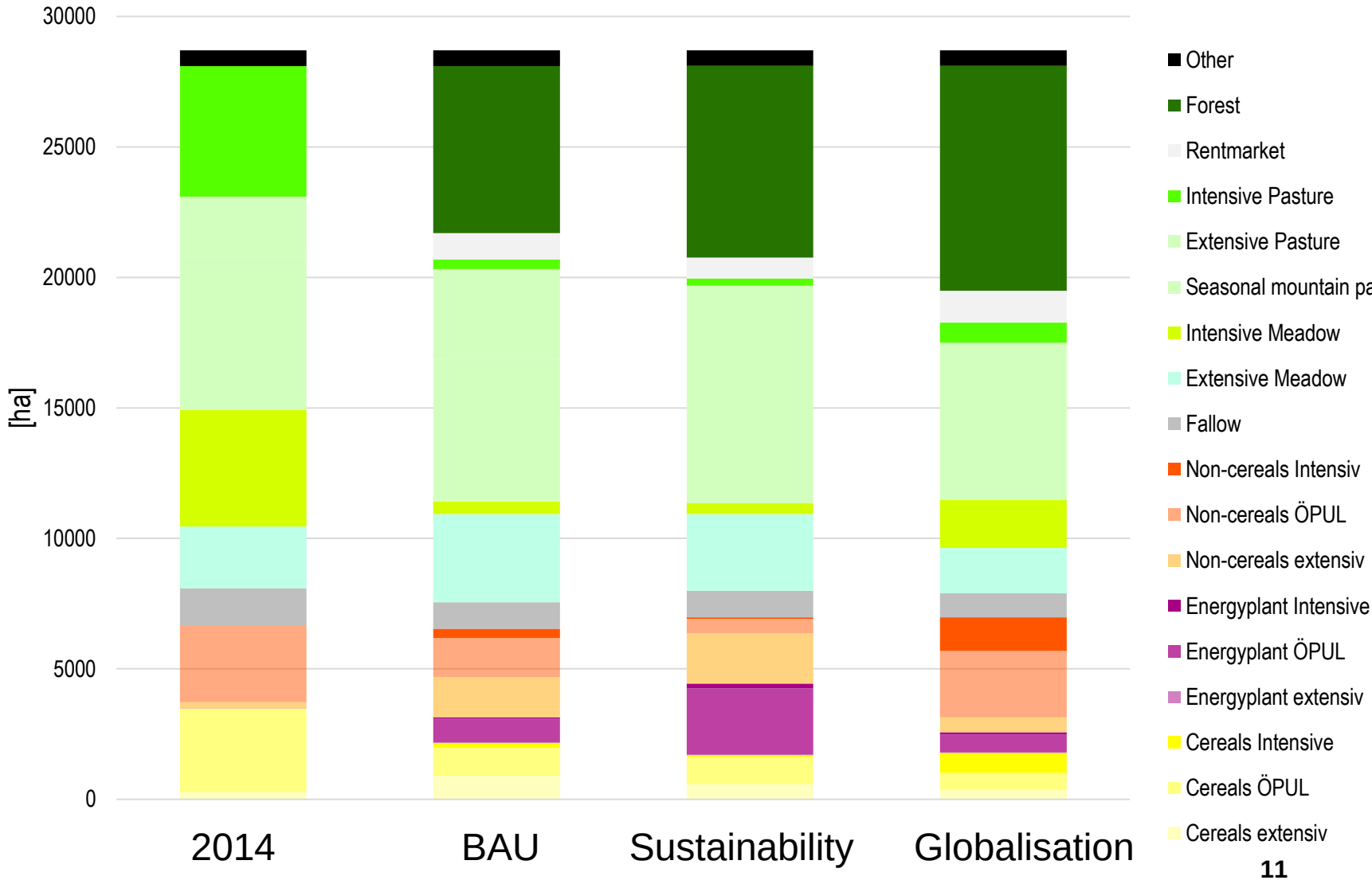
- Reduction of active farms in all scenarios (-35% to -44%)
- Extensivation vs. globalisation
- **Trade-off:** scenario vs. socio-demographic factors

[number of active farms]

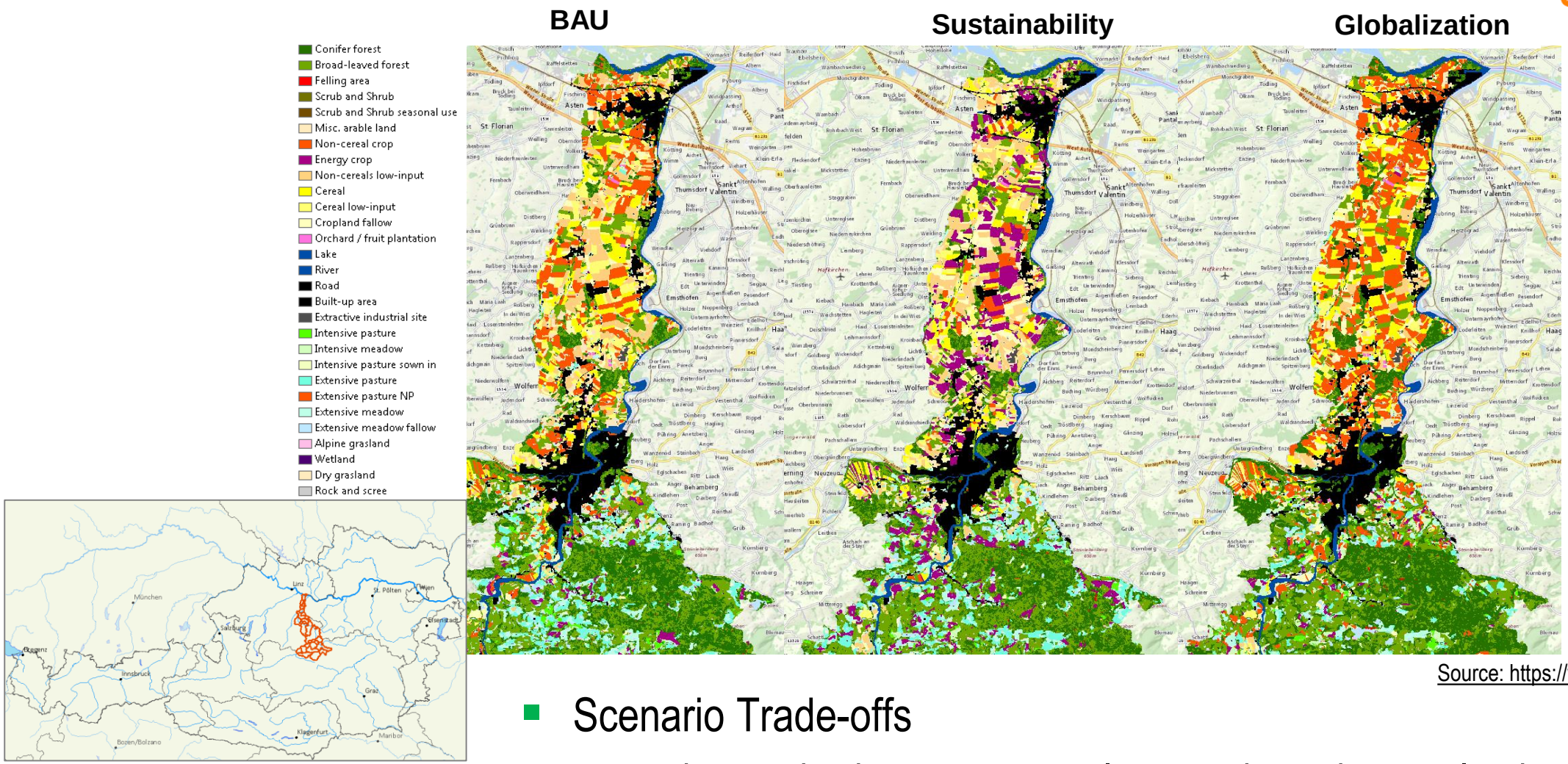


Land use shifts 2014 to 2050 in the Eisenwurzen

- Strong land use shifts
  - grassland to forest
    - max. -47% grassland
  - cropland to energyplants
    - max. -40% Cropland
- Intensity shifts
  - intensive to extensive
- Trade-off:
  - Food vs. fuel



Land-use maps for the northern Eisenwurzen in 2050



Source: https://www.gisualize.org/lubio/

- Scenario Trade-offs

  extensive production vs. energy plants vs. intensive cropland and forest

Conclusion & outlook

- We showed different perspectives on analyzing trade-offs and synergies
- Important to analyze supply and demand to complement the picture
- Exploring future option spaces top-down and bottom-up
  - Analyze scenarios form different angles:

    Low-in/out vs. High-in/out
- our assessment here serves as a starting point which allows to model the territorial impacts of e.g. the implementation of livestock-related innovations and to assess limitations in land availability and emissions at the European level.

University of Natural Resources and Life Sciences, Vienna
Department of Economics and Social Sciences

Institute of Social Ecology

Dr. Michaela C. Theurl
michaela.theurl@boku.ac.at

MMag. Claudine Egger
Claudine.egger@boku.ac.at