Quantifying trade-offs between bioenergy production, food production, water quality and water quantity aspects in a German case study

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Soil & Water Assessment Tool SWAT

TECHNISCHE UNIVERSITÄT DRESDEN

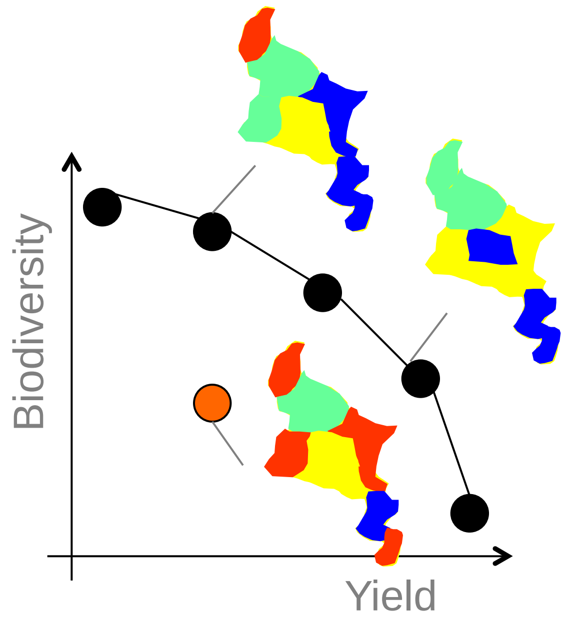
USDA

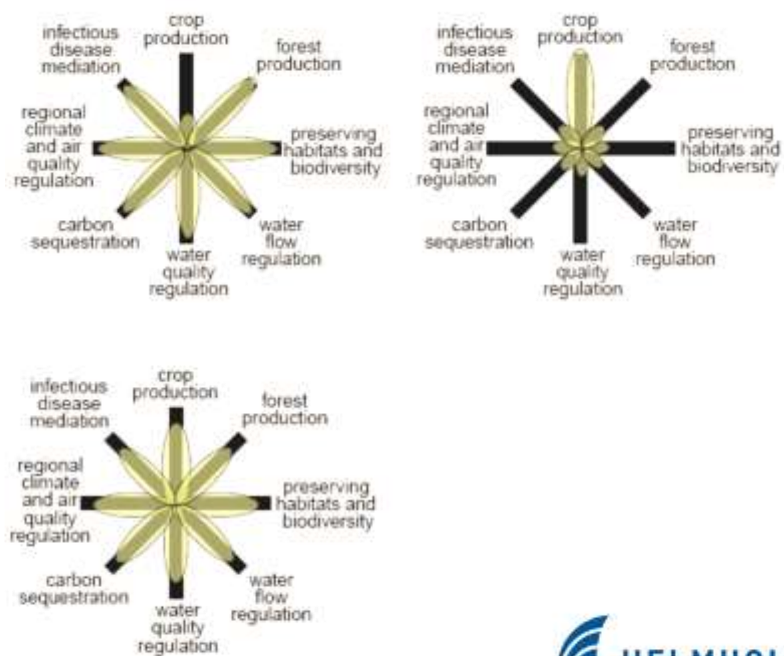
HELMHOLTZ CENTRE FOR ENVIRONMENTAL RESEARCH – UFZ

Trade-offs

- What are the searching for? -

- How much do we gain in goal A if we decrease goal B?
- Functional relationships between different goals?
- Functional relationships between goals and policy instruments?





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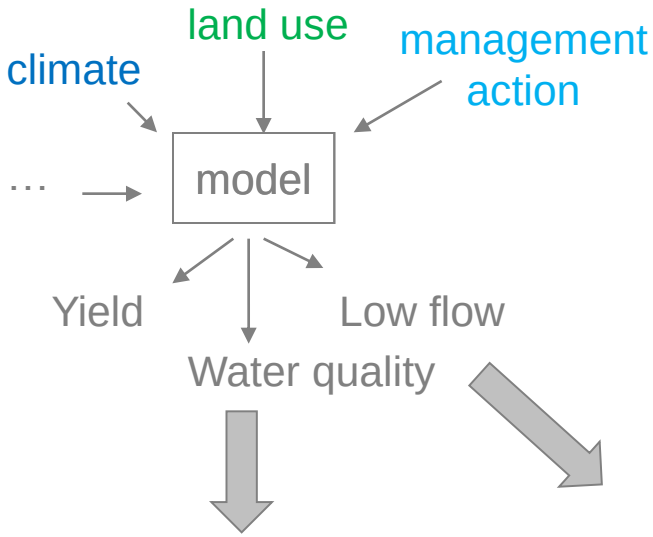
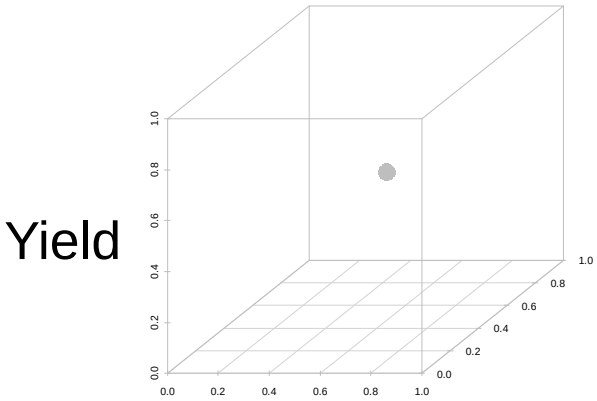
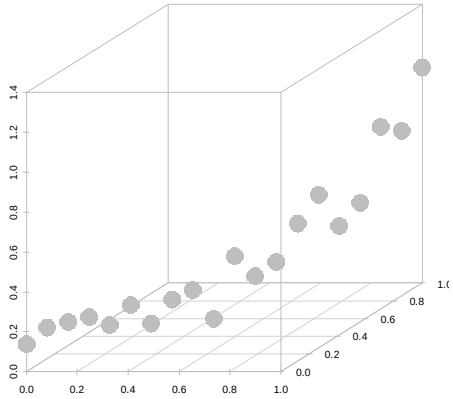
International SWAT Conference, Toledo, Spain, June 15 – 17, 2011

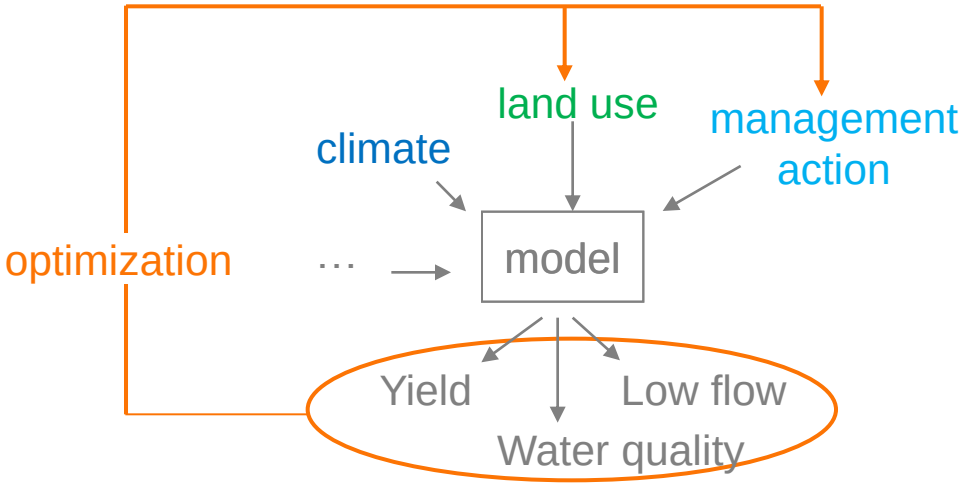
From model results to management support?

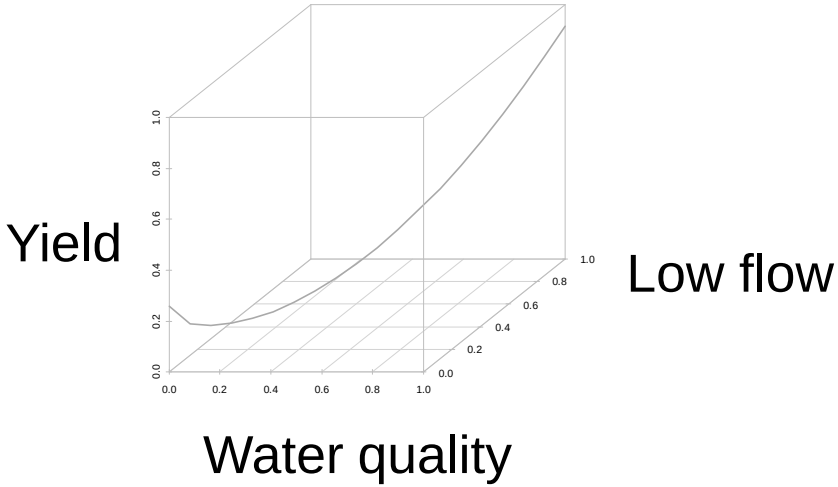






From model results to management support?





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Trade-offs

- for bioenergy/food production in the Parthe -

optimization

crop rotation schemes

existing land use distribution

objective function

food

bioenergy

arable land

non arable land

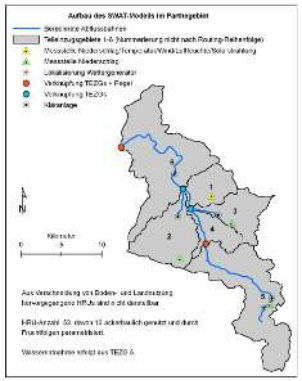
SWAT

5 perc. min discharge

average NO_3^- conc

yield food

yield bioenergy



Lautenbach, Seppelt, Strauch, Volk, in prep

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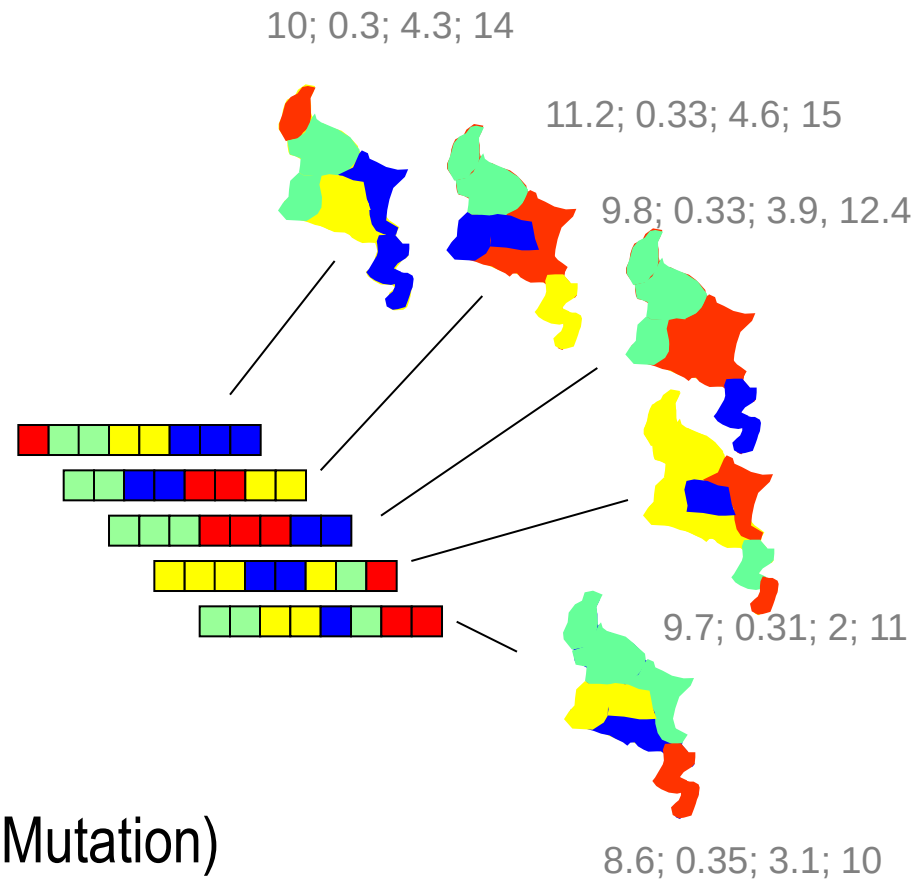
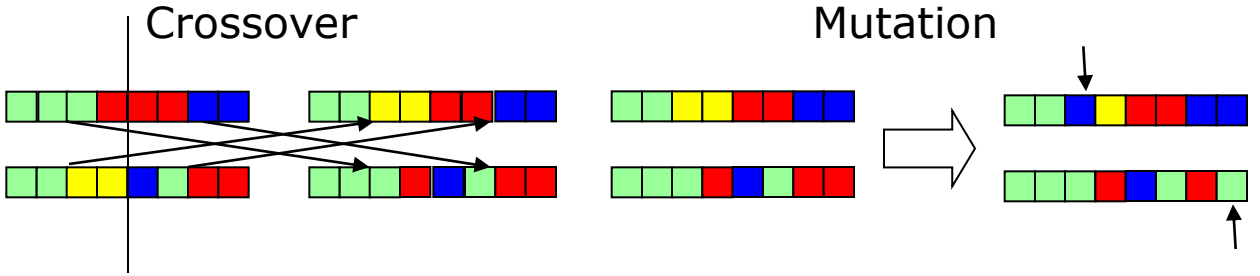
Genetic algorithm

- Population of Genoms
- Objective function
- Selection
- Genetic Operators (Crossover, Mutation)





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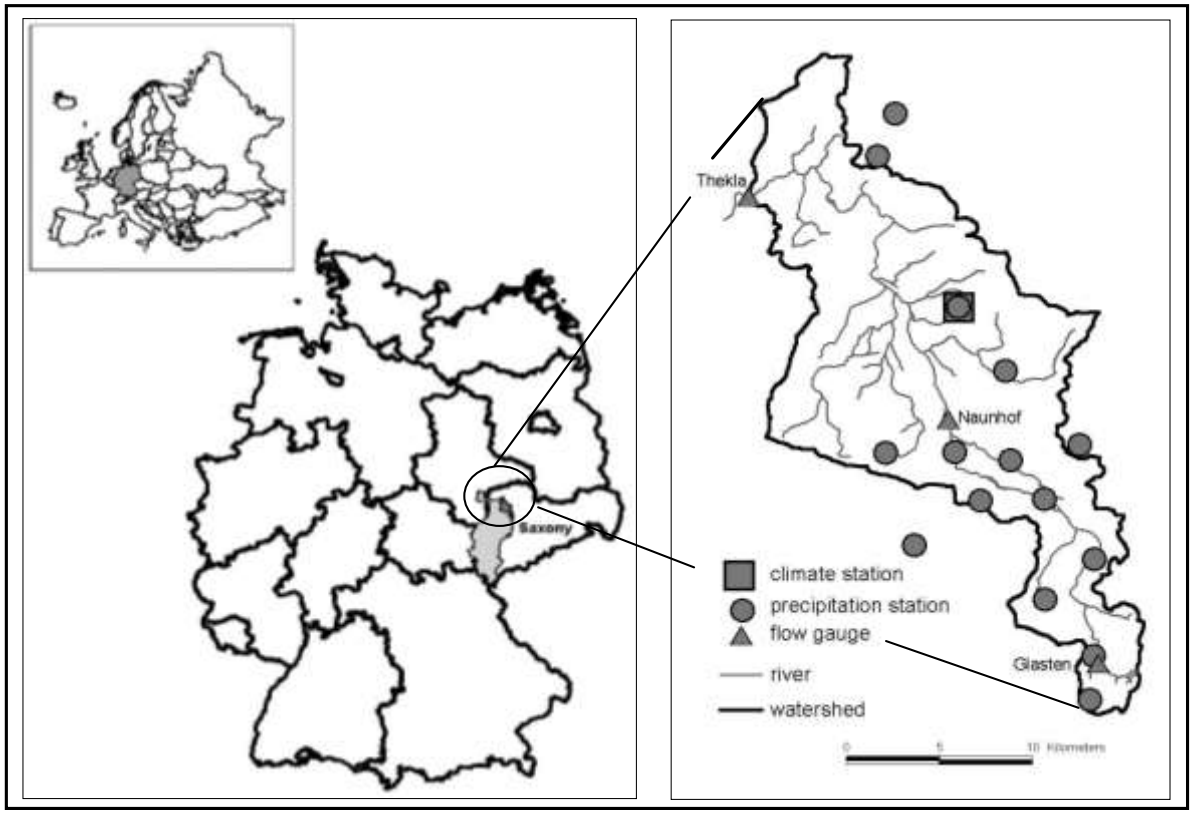
The study area: Parthe watershed



- **Area:** 315 km² - **Topography:** Flat (106 m and 230 m a.s.l.)
- **Precipitation:** 590 to 640 mm/a (1981-2000).
- Typical lowland river.
- **Runoff dynamics:** High flows in spring (snow melt and rainfall); Low flows in summer with occasional storm flow events.

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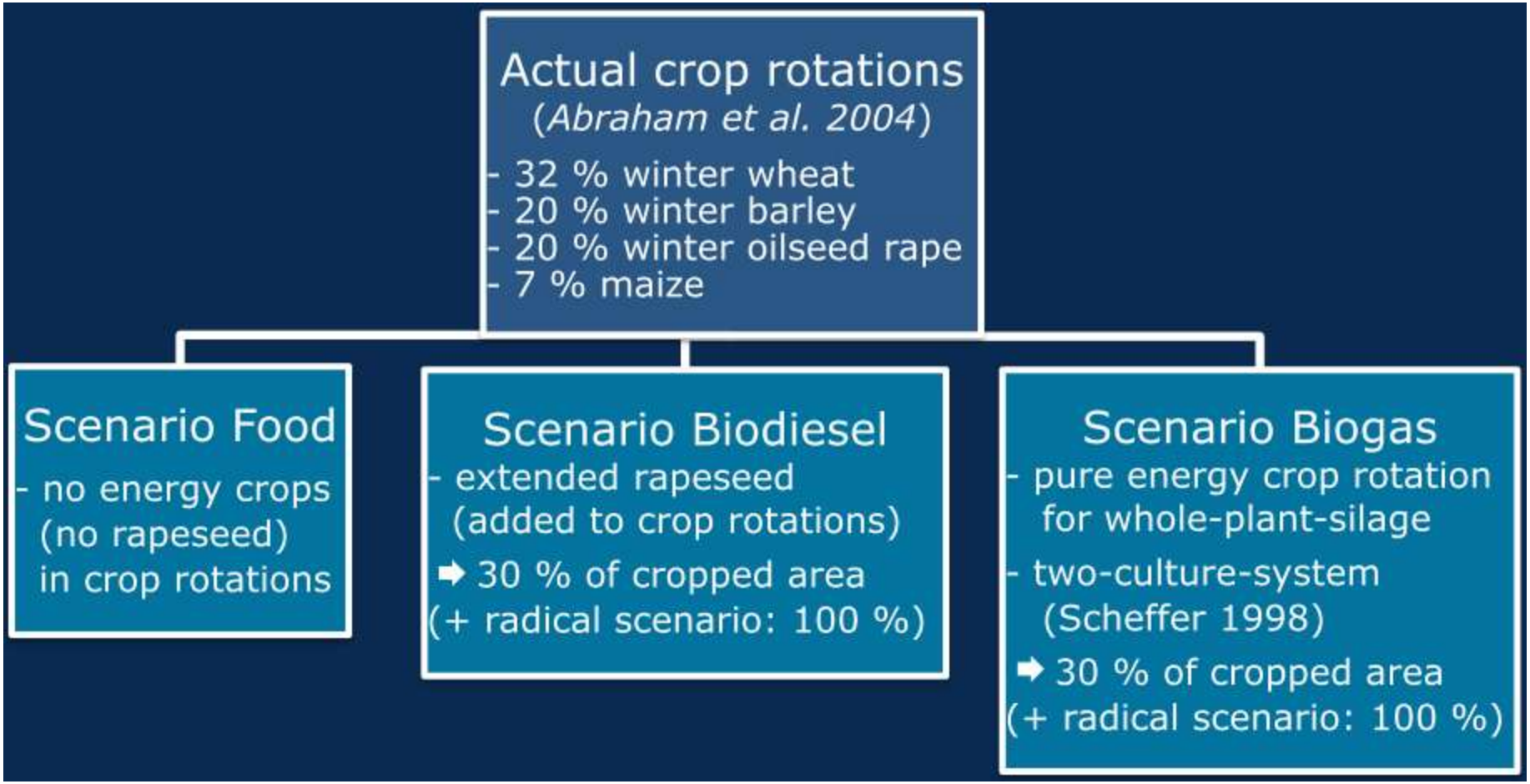
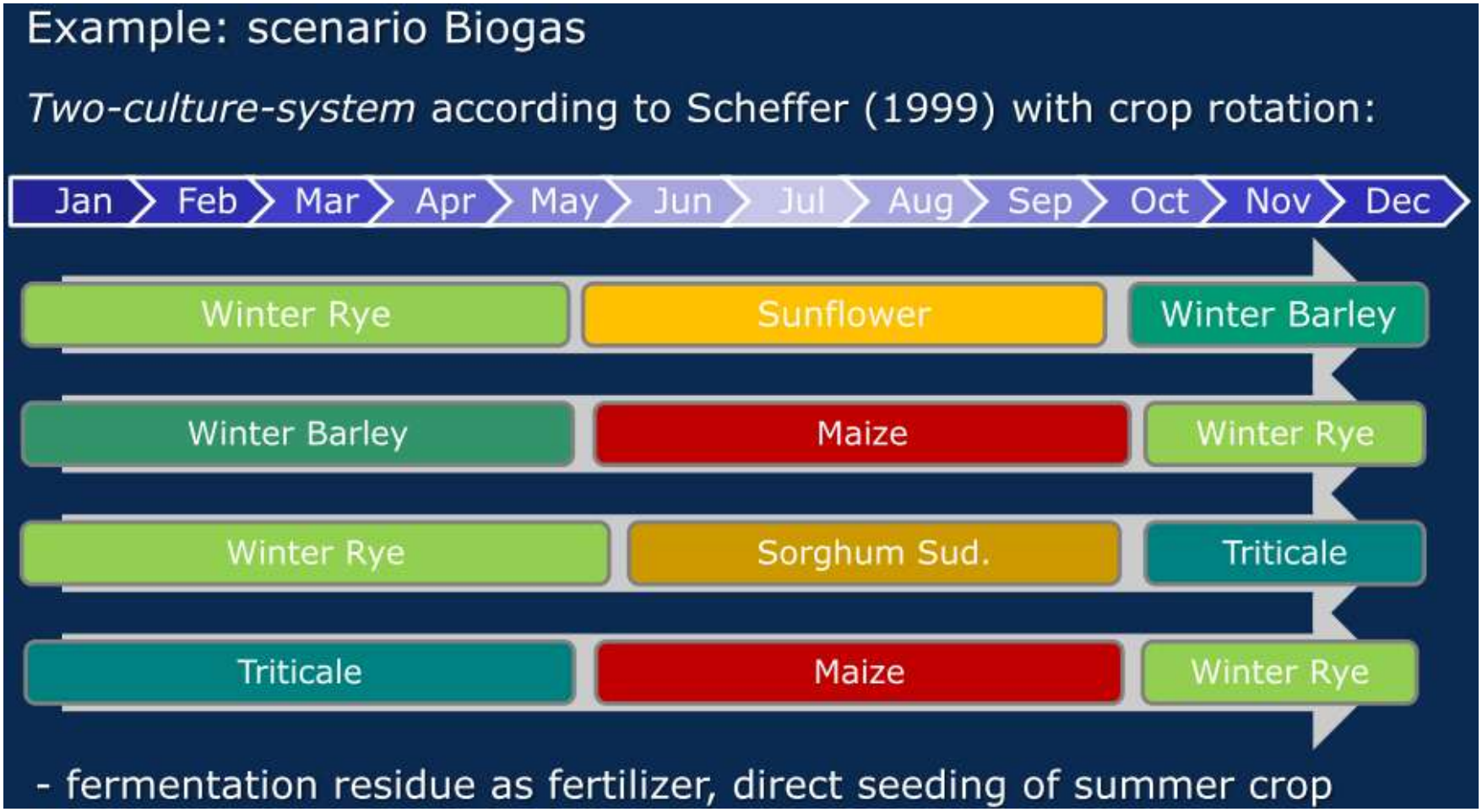
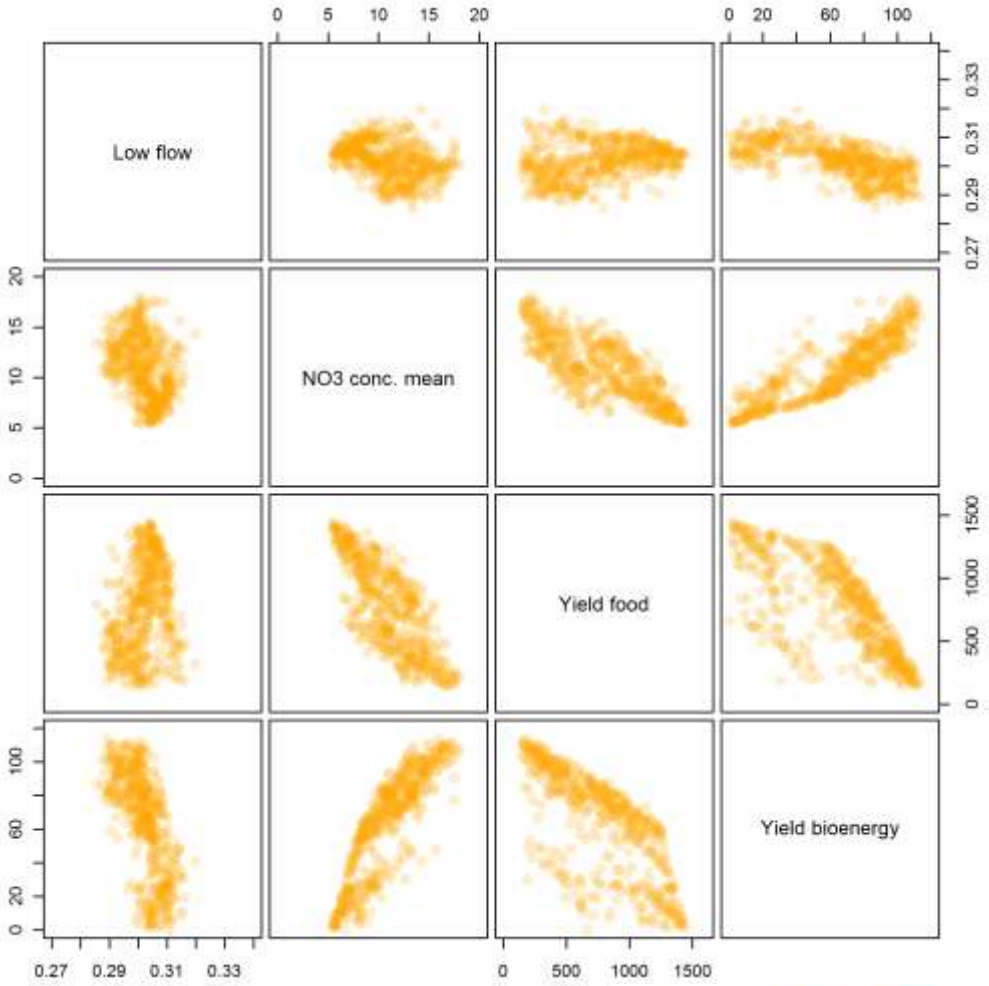
Management scenarios



Management scenarios



Biodiesel - rapeseed



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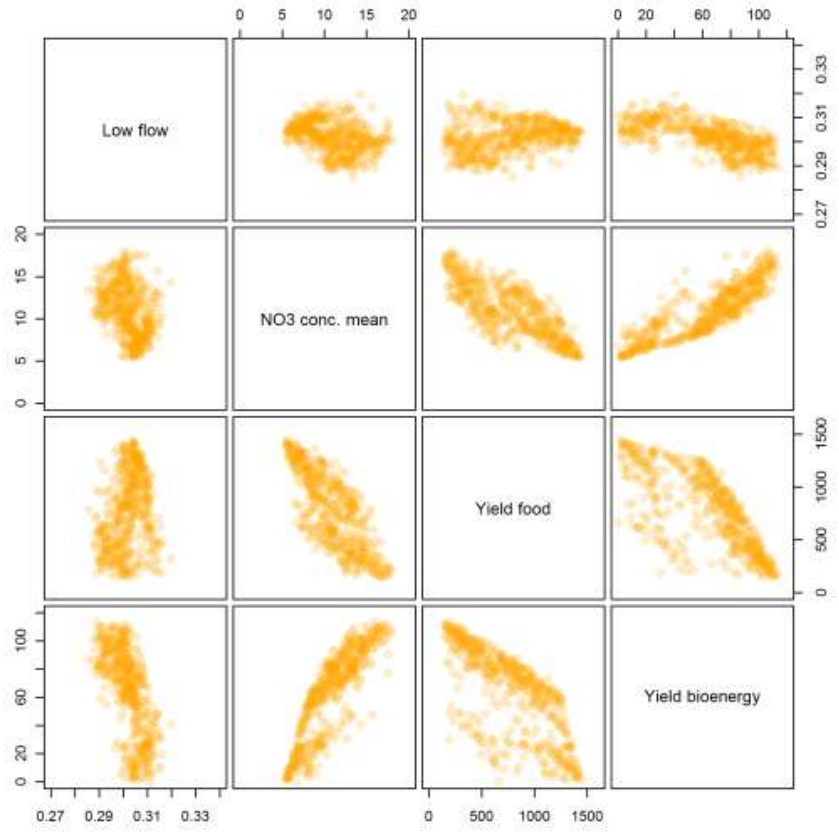
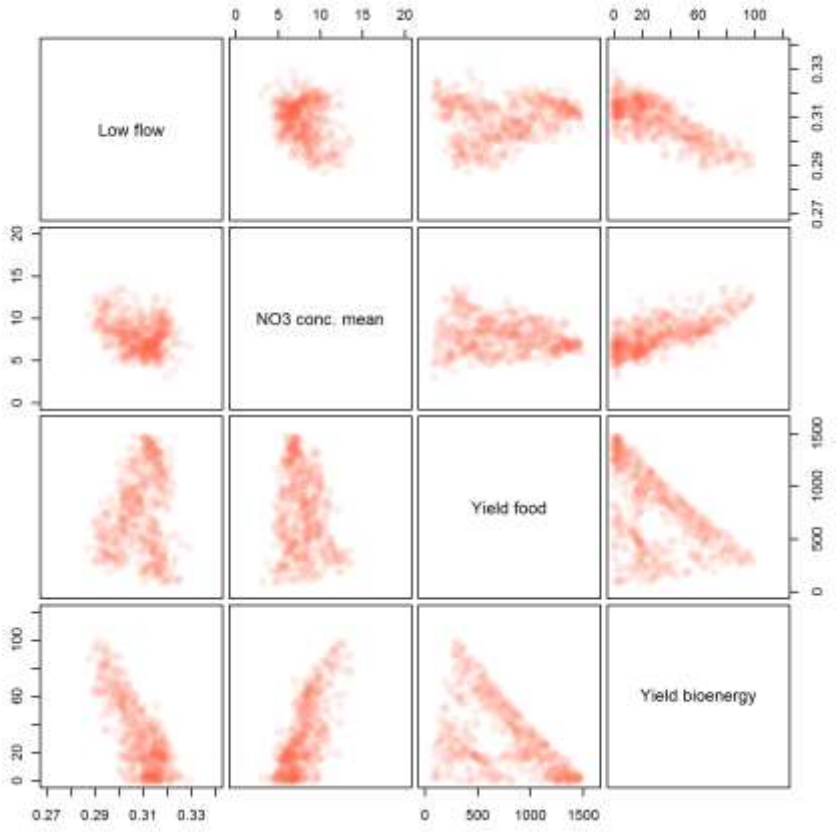
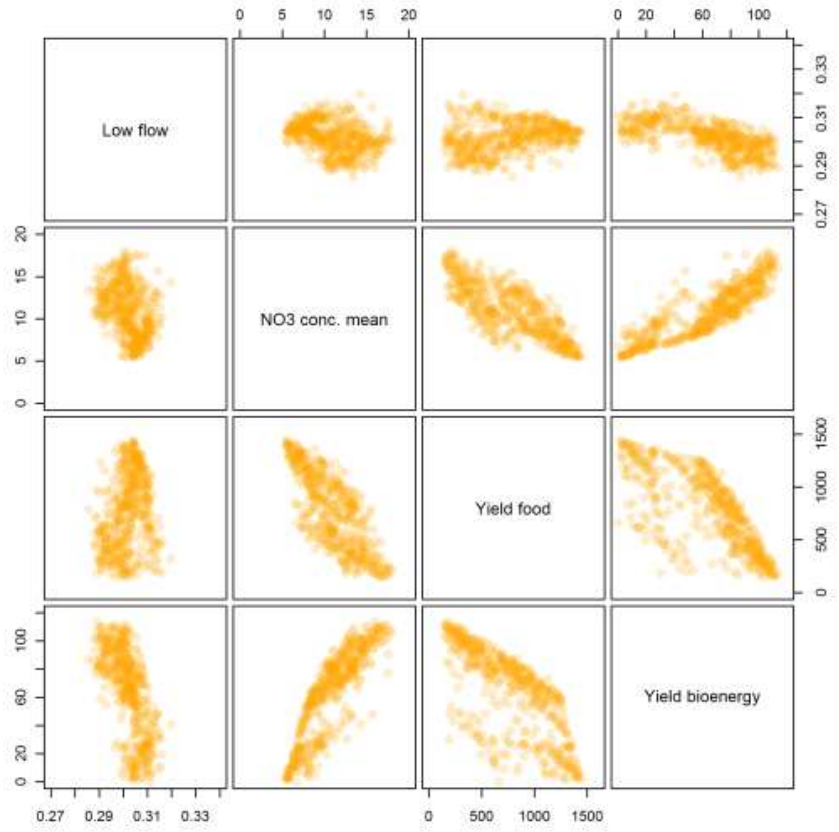
Biogas - rapeseed



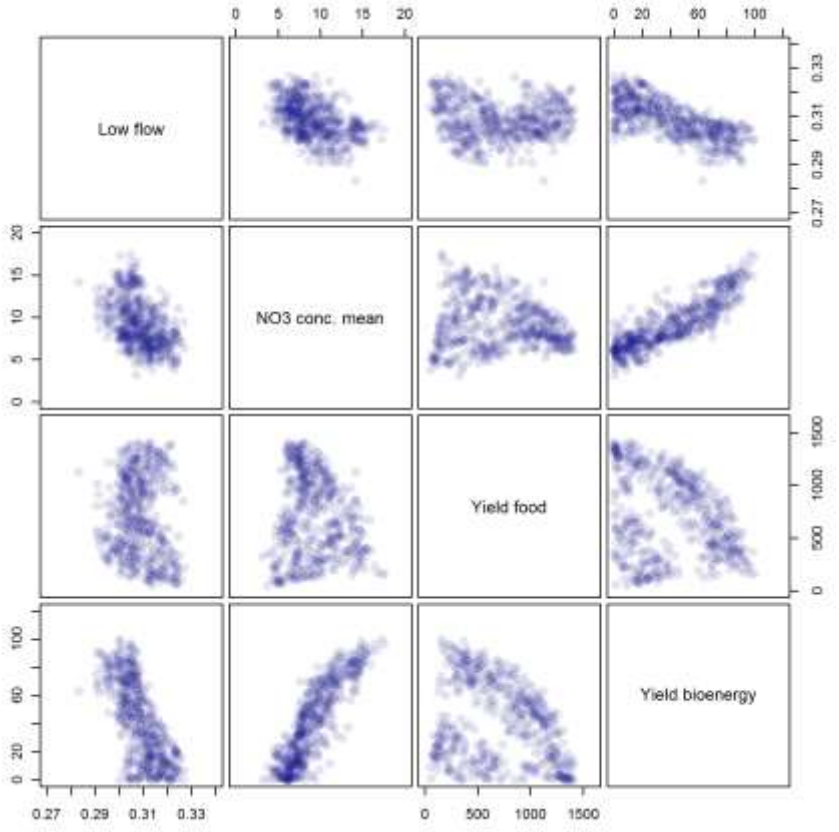
Biogas – two-culture system



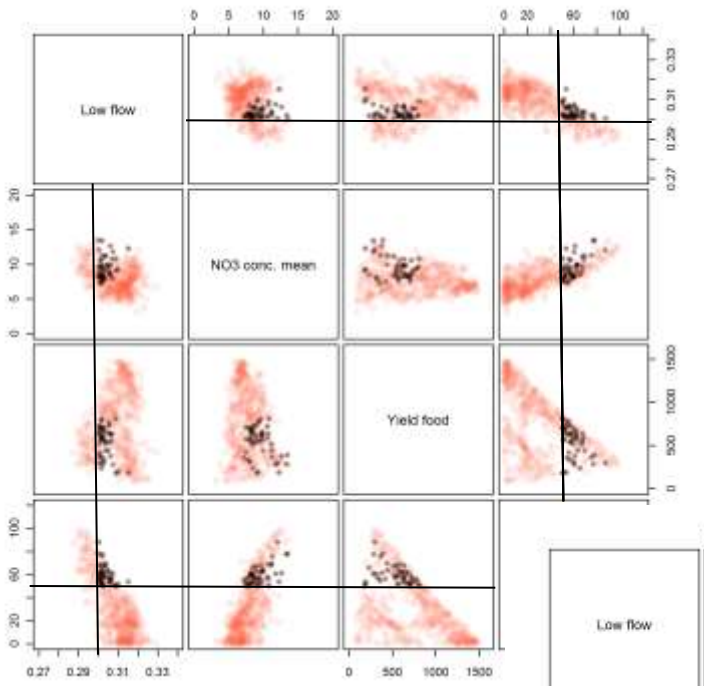
Biogas - rapeseed



Biogas, biodiesel, food only

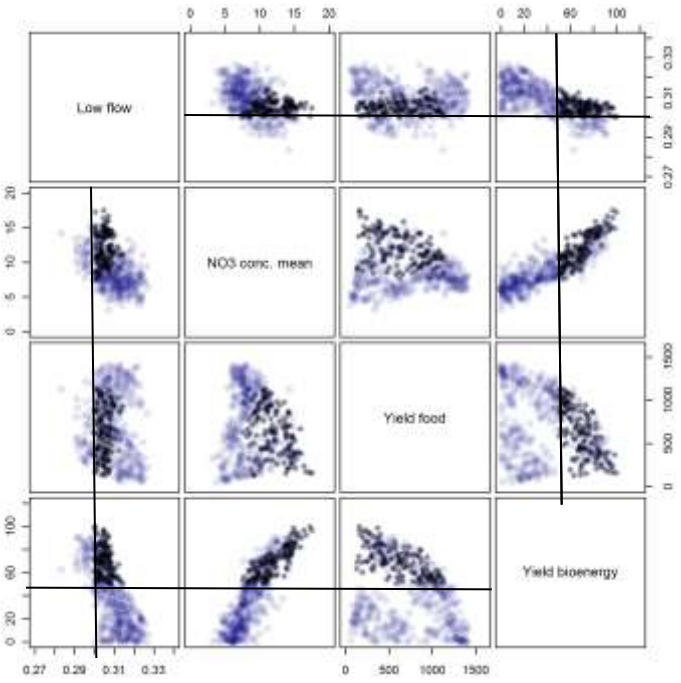


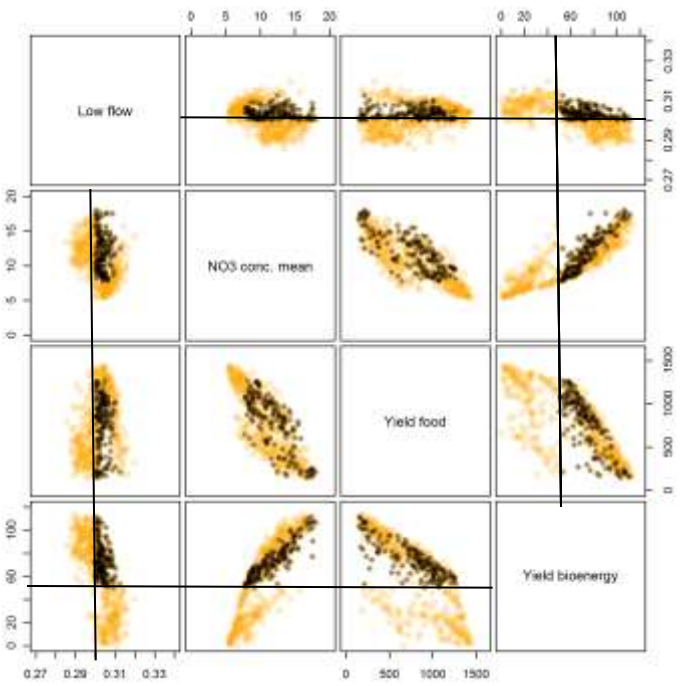
Considering policy constraints



Two-culture

All





Rapeseed

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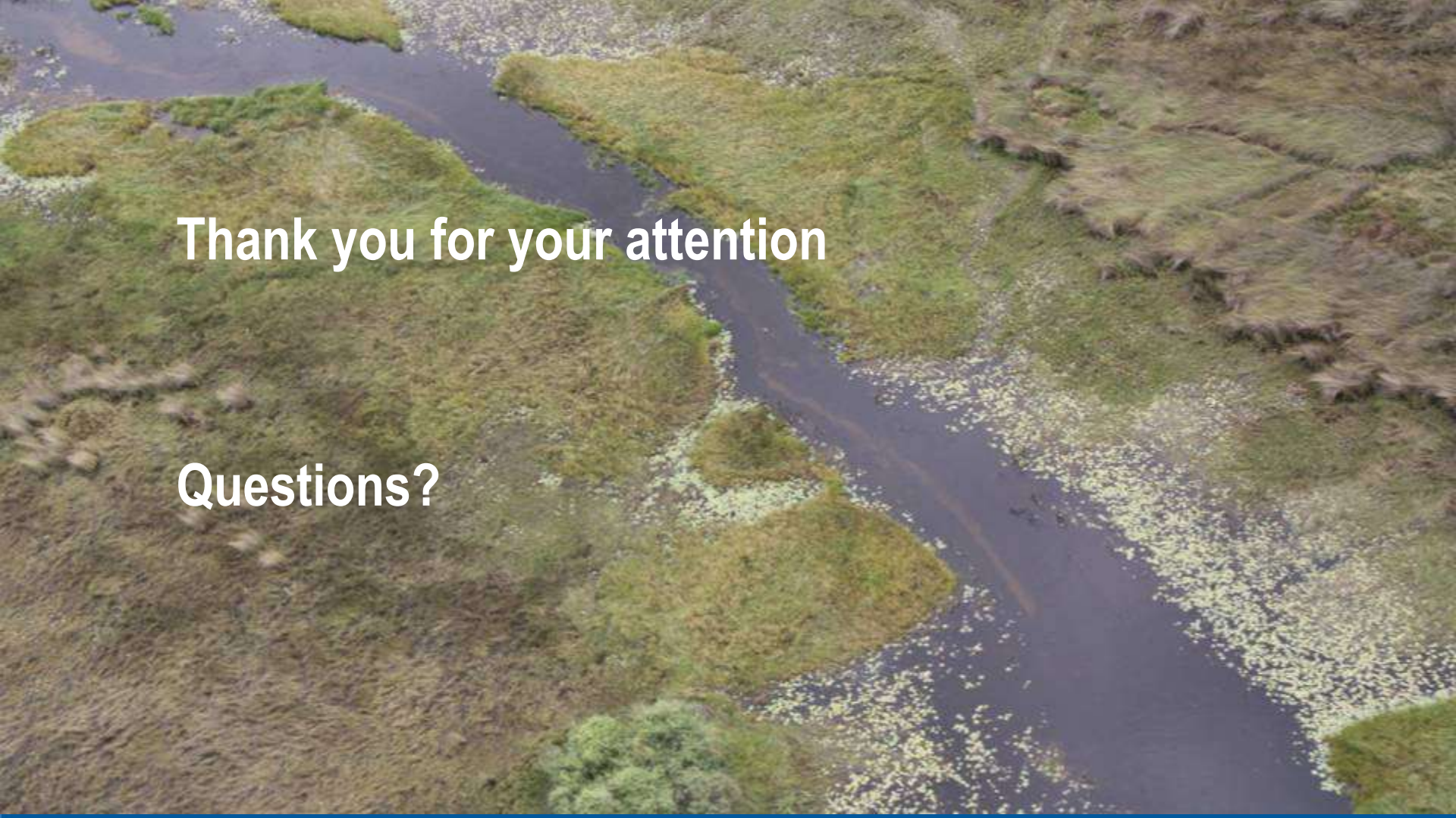
Conclusions/Outlook/Vision

UFZ image gallery

- Importance of spatial configuration
- Policy support needs functional trade-offs
  - Optimization techniques are an important tool for that
- To dos:
  - Additional crop rotation schemes
  - Adaptation of management schemes depending on HRU properties
  - Include contribution margin or /and protein content?



Thank you for your attention

Questions?

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