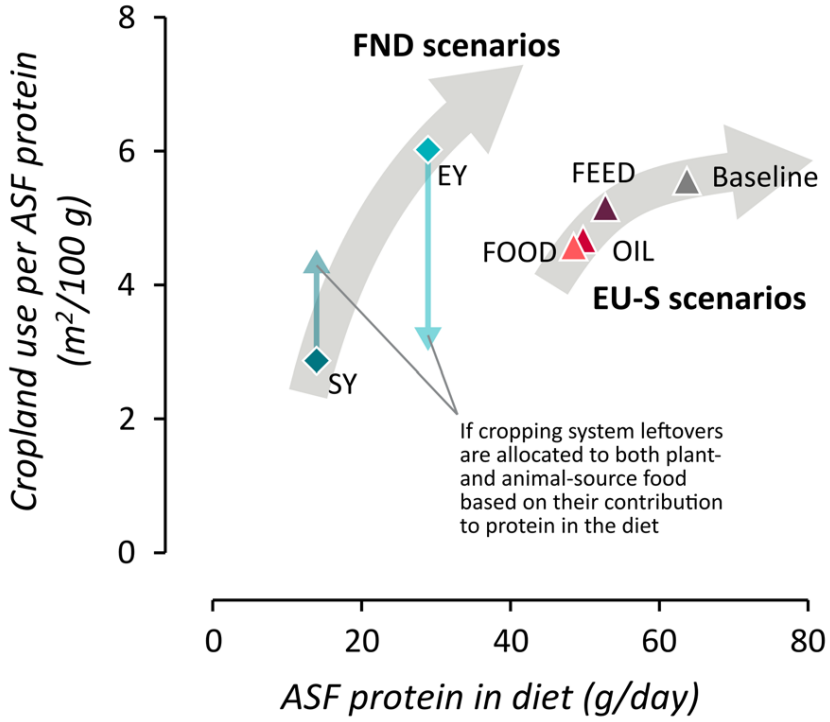
CIBUSmod

A biophysical agri-food systems model for studying intervention scenarios

Johan Karlsson

Modelling environmental impacts of future food systems scenarios

- Guide policy, What is needed to reach goals? Synergies and trade-offs
- Changed diets and waste, changes in agriculture
- Common approach:
  Impact factors per food (LCA data)
  - Does not account for systemic effects (Frehner *et al.* 2020)
  - May e.g. underestimate resource savings from reduced animal-source food consumption



(Karlsson *et al.* 2022)

Modelling environmental impacts of future food systems scenarios

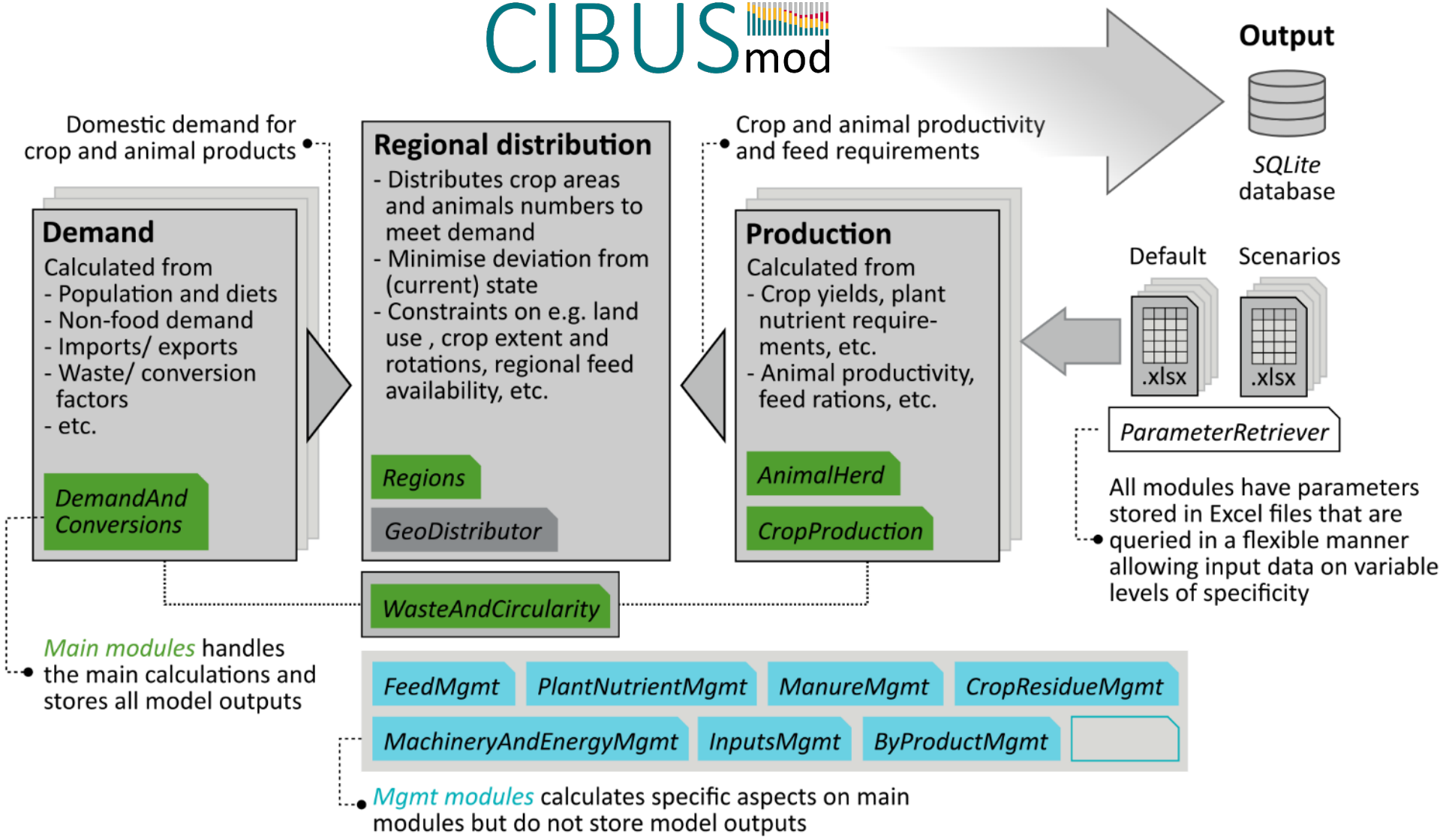
- Integrated Assessment Models (IAMs)
  - E.g. GLOBIOM, MAgPIE
  - Economic models balance supply and demand based on price elasticities
  - Very complex, large scope, limited detail

- Bio-physical mass-flow models
  - E.g. BioBAM, SOLm, CiFoS
  - Relatively more simple
  - Demand is generally a user input

Ambitions with CIBUSmod

- National-scale
  - Relevant to stakeholders and policy makers
  - Possible to include national priorities and nuances
- Detailed
- Flexible
  - Not locked to certain foods, crops, livestock systems
  - Modular, possible to build upon
- Useable
  - Excel interface
  - Possible to use in participatory modelling (we will see today ☺)

CIBUSmod


Output
SQLite database
Domestic demand for crop and animal products
Crop and animal productivity and feed requirements
Demand
Calculated from
- Population and diets
- Non-food demand
- Imports/ exports
- Waste/ conversion factors
- etc.
DemandAnd Conversions
Regional distribution
- Distributes crop areas and animals numbers to meet demand
- Minimise deviation from (current) state
- Constraints on e.g. land use , crop extent and rotations, regional feed availability, etc.
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AnimalHerd
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ParameterRetriever
All modules have parameters stored in Excel files that are queried in a flexible manner allowing input data on variable levels of specificity
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Main modules handles the main calculations and stores all model outputs
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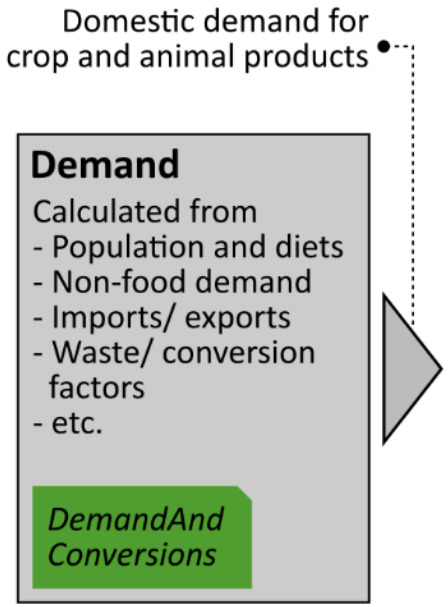
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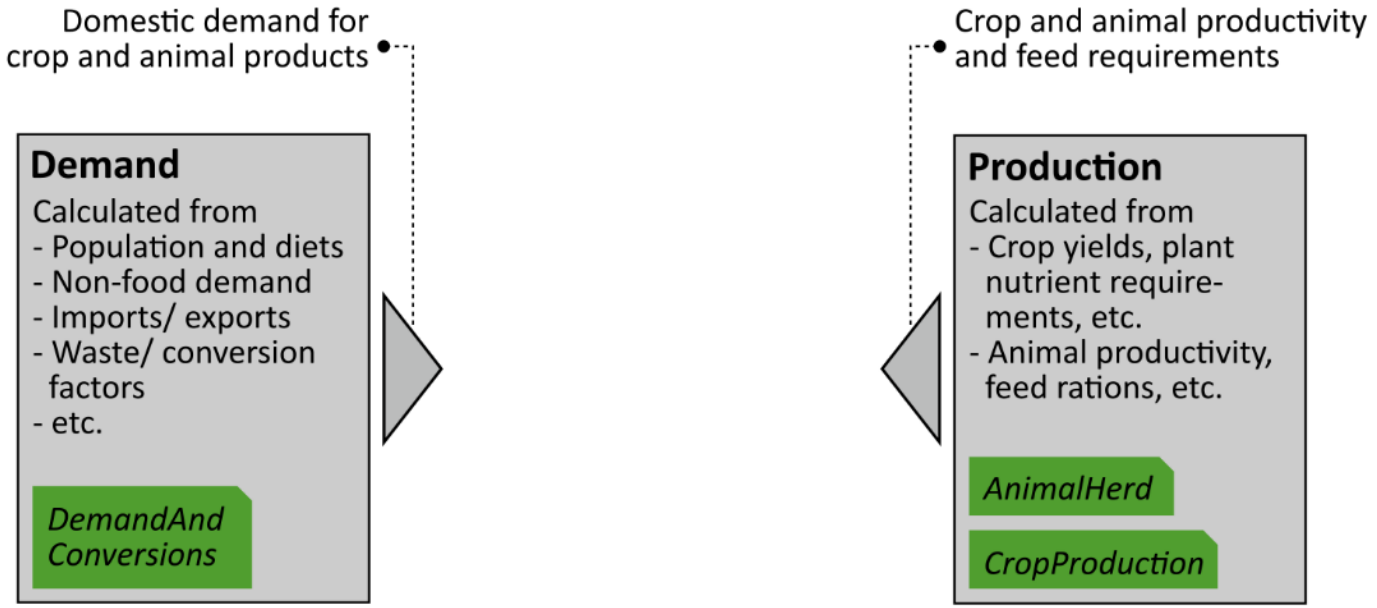
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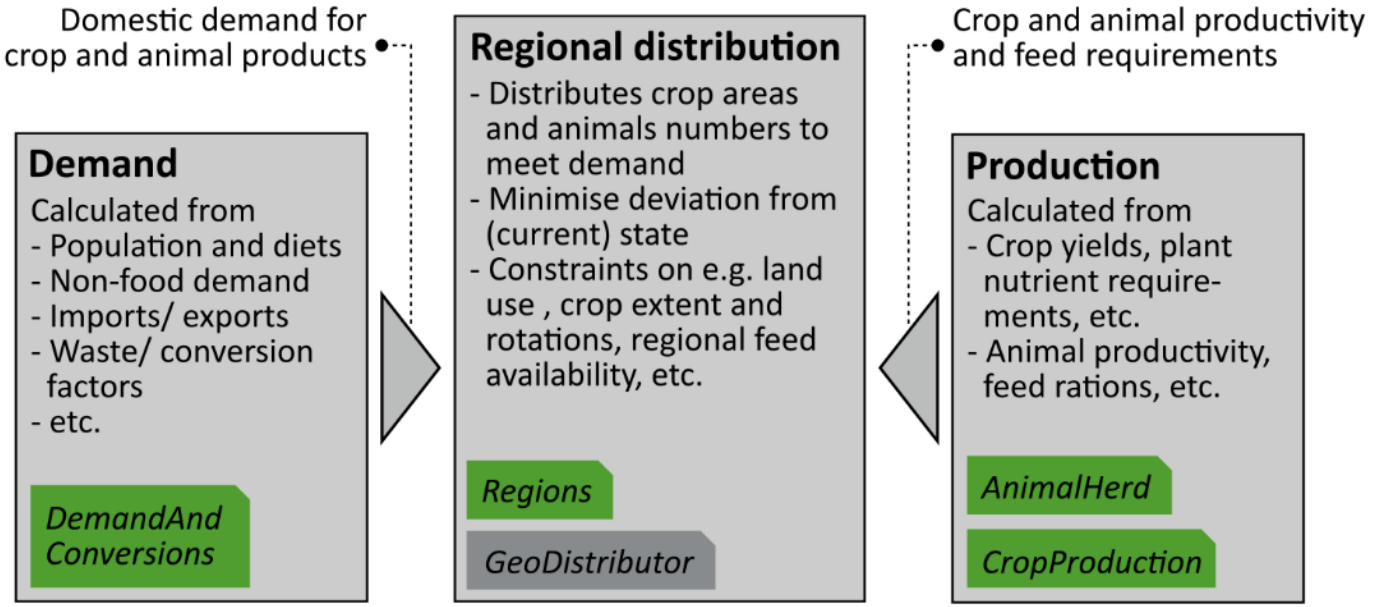
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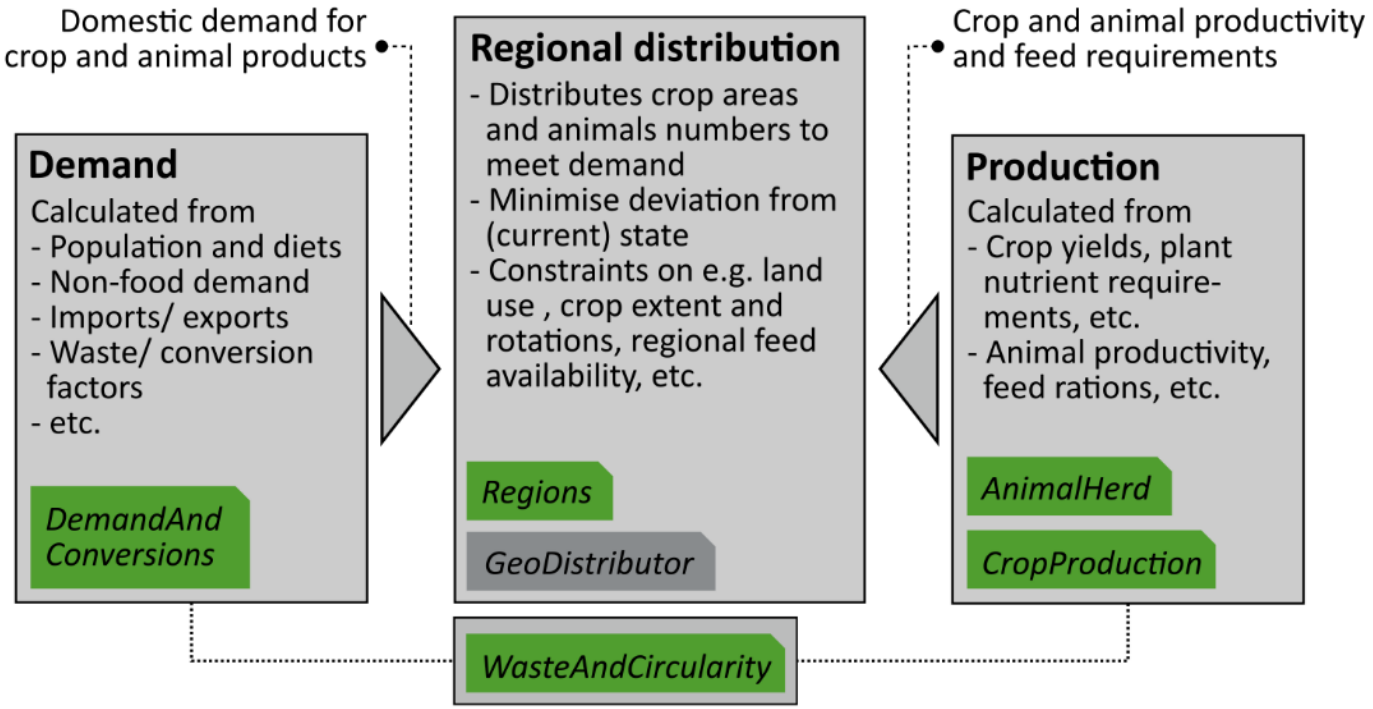
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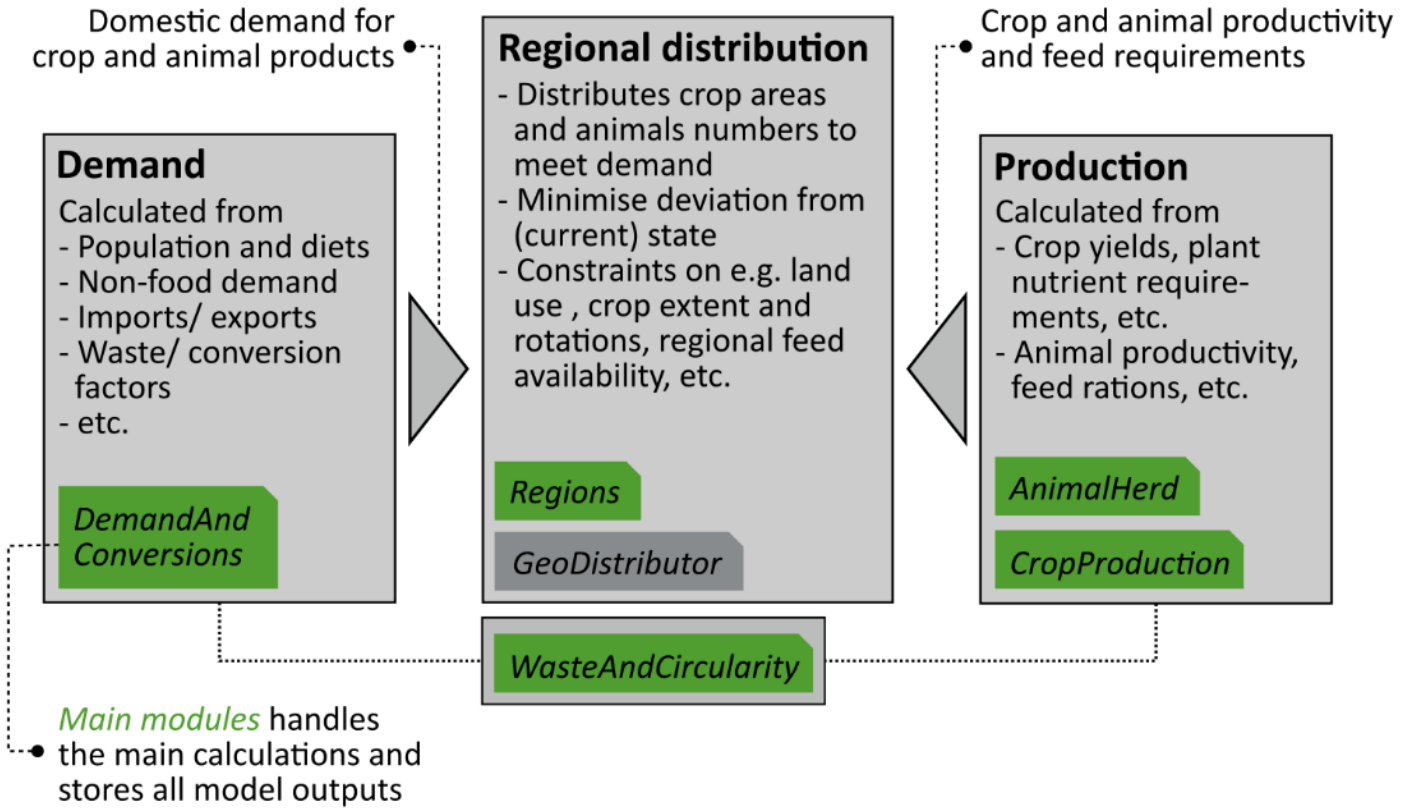
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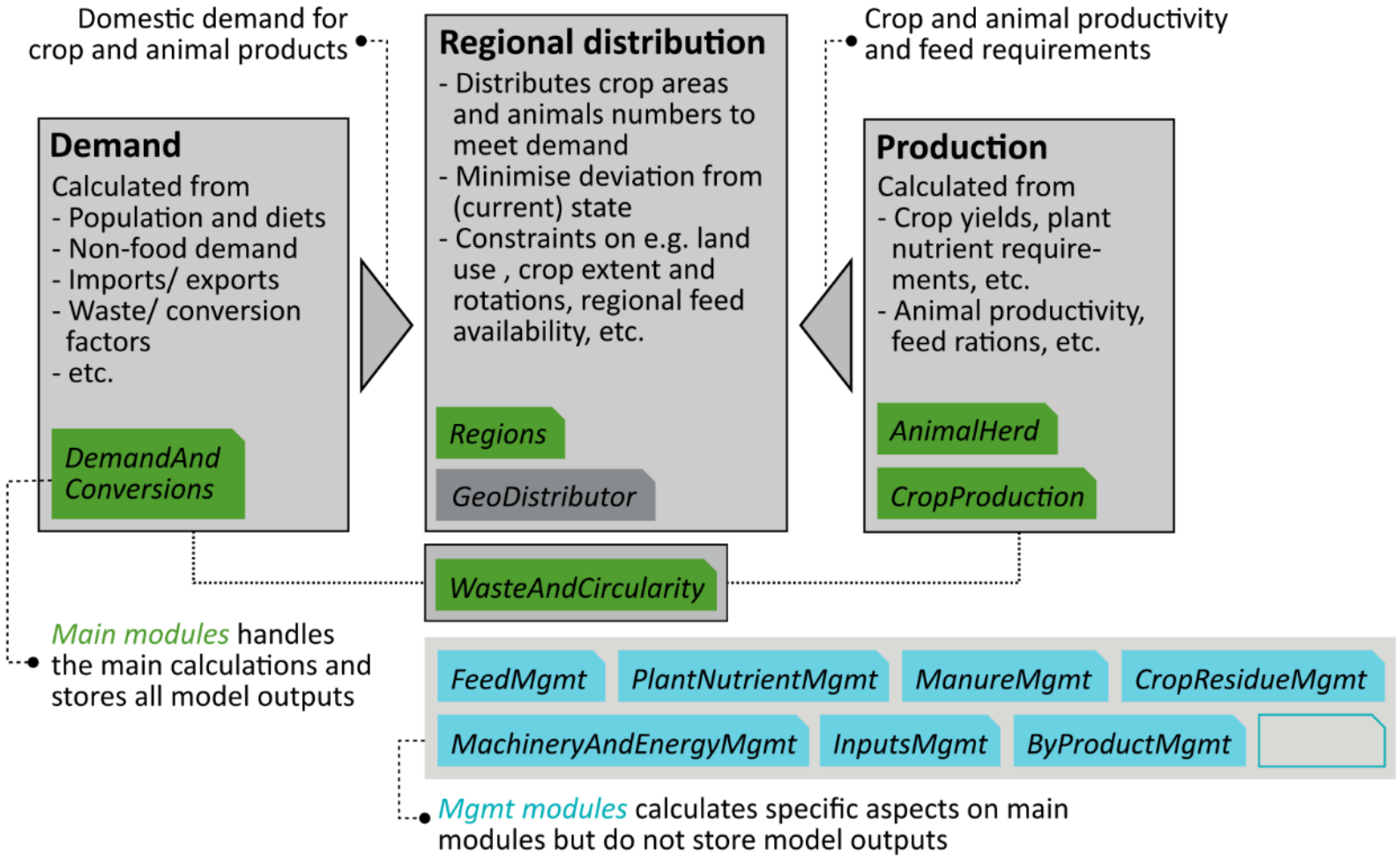
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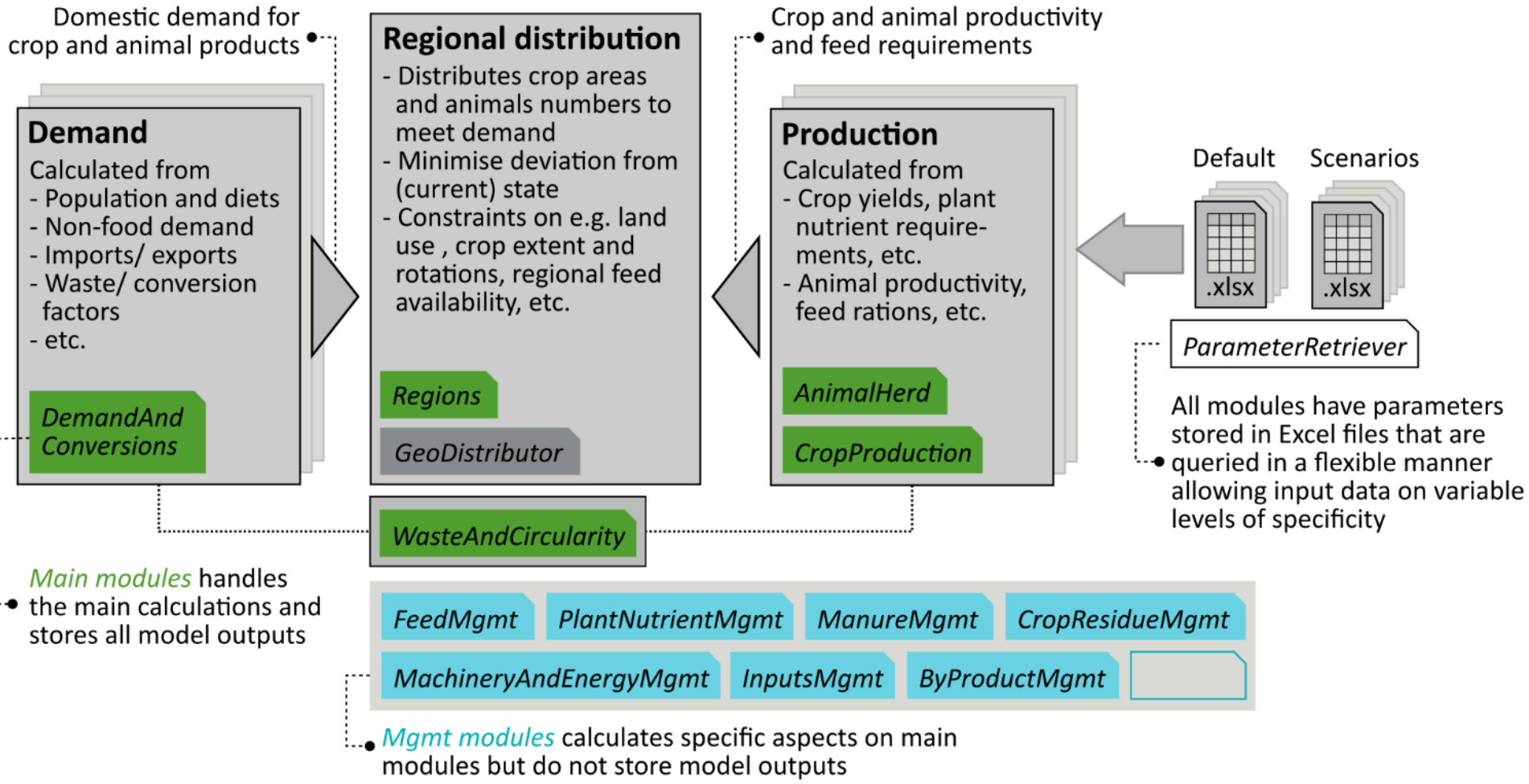
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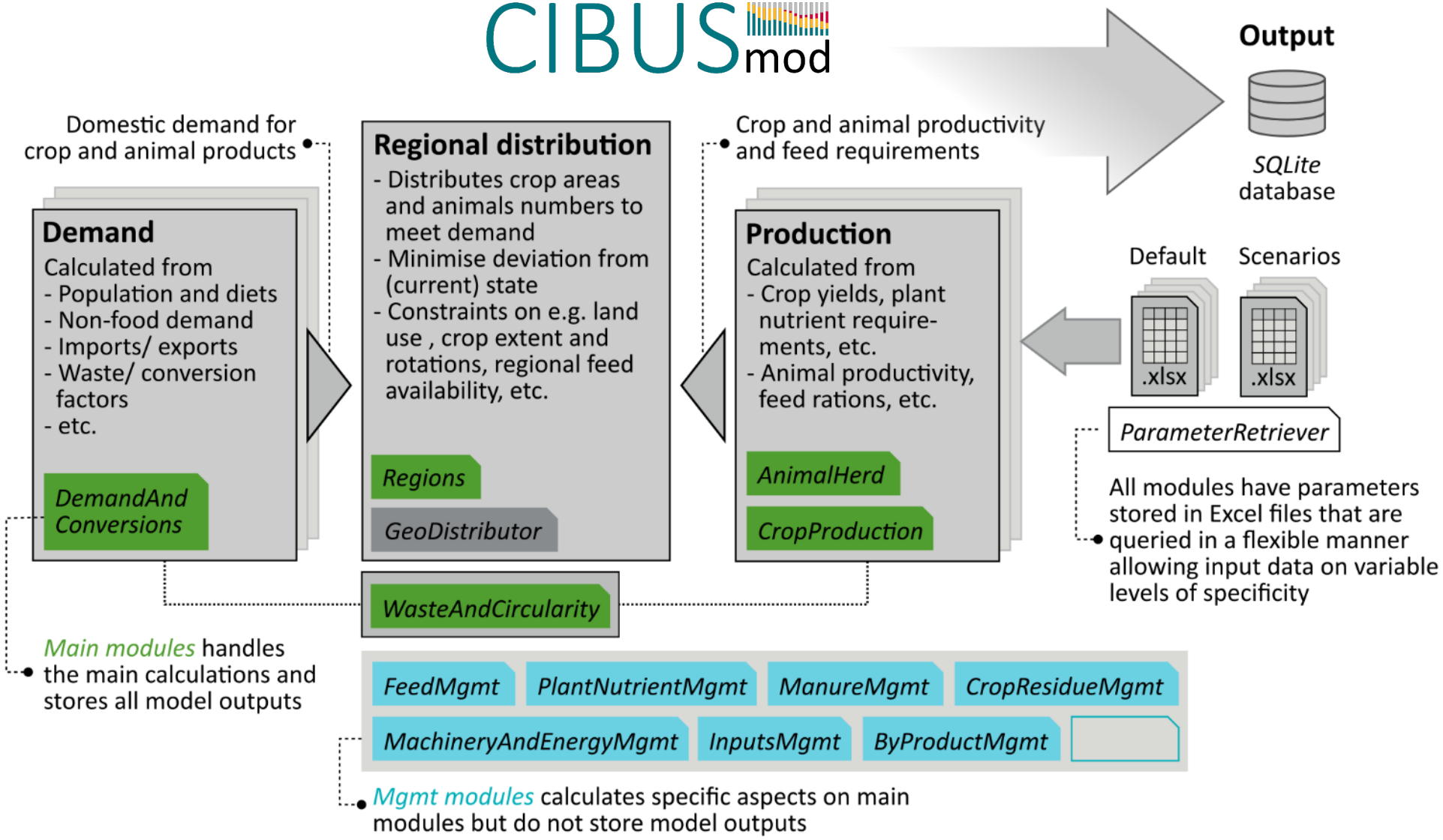
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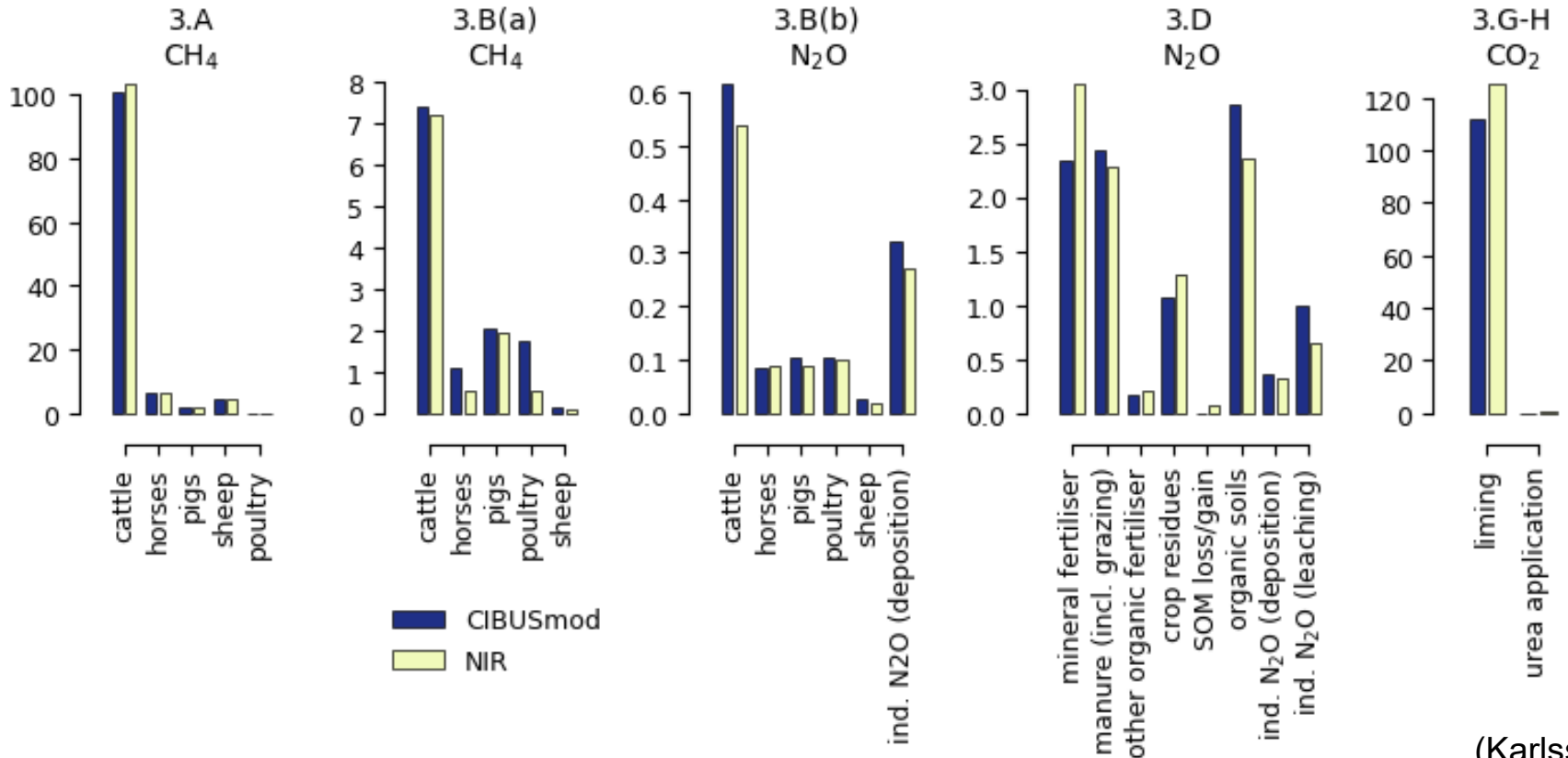
Application in Sweden (dataset for ~2020)

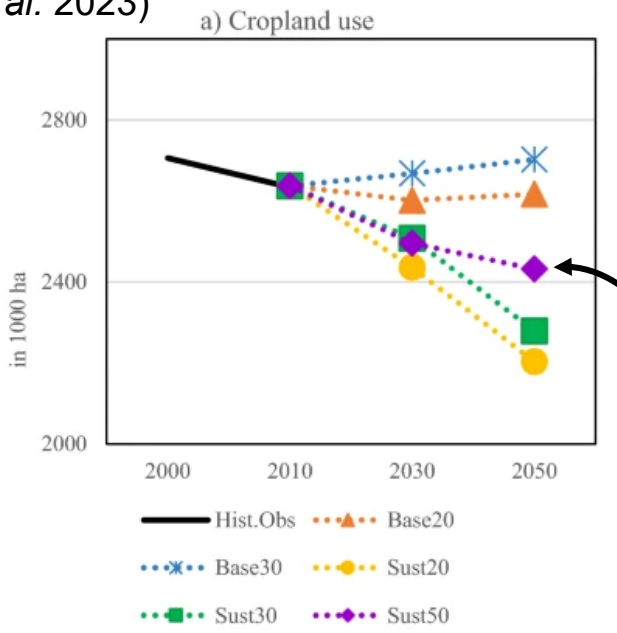


(Karlsson *et al.* n.d.)

Revisiting scenarios for 50% organic farming in Sweden

- 50% organic cropland + sustainable diets + improved productivity
- We find lower (but still large) emissions reductions potential and land use savings
- Important to account for nutrient flows
- But… we likely overestimate N requirements in organic farming… 🔧 WIP 🔨

(Basnet *et al.* 2023)



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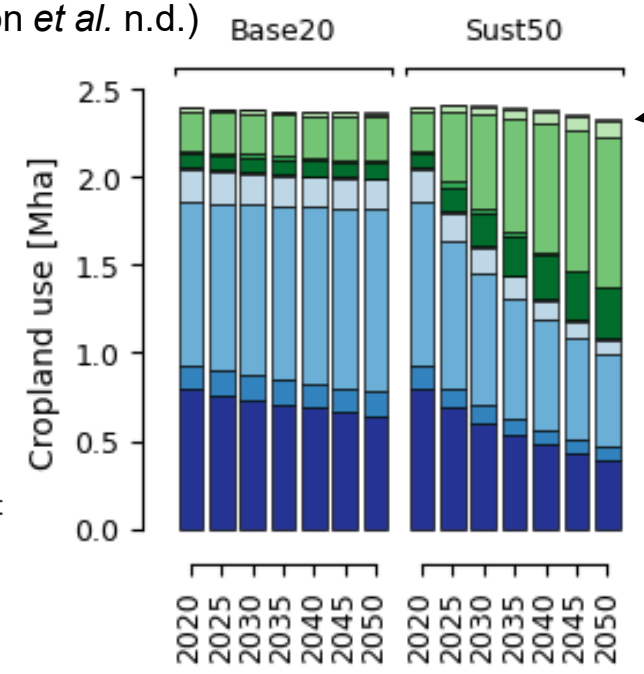


Co-design a scenario

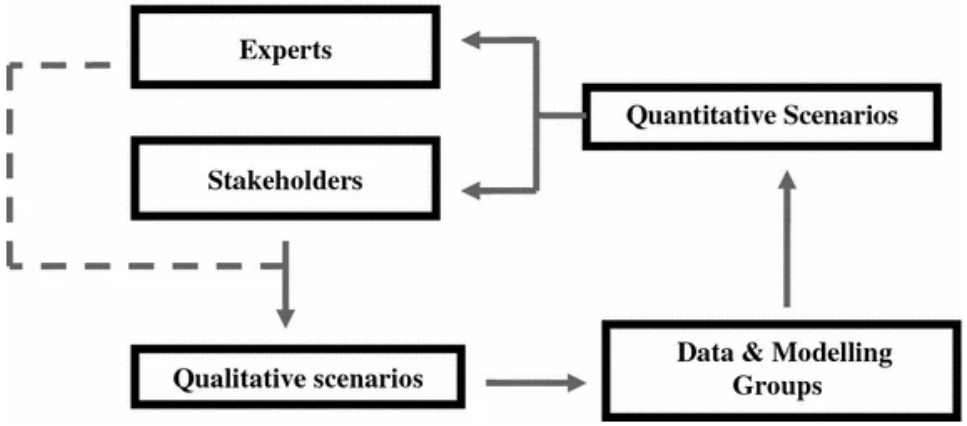
- Teams files > CIBUSmod lab > **scenario_lab_A.xlsx** and **scenario_lab_B.xlsx**
  - **Open in browser** (not desktop app) to avoid problems!
- ~30 min – Design your own scenario
  - What future?
  - What does it mean for quantitative values?
  - What are realistic changes up until 2050?
- Sheets (different modules)
  - **Diets:** DemandAndConversions
  - **Crop yields & rotations:** CropProduction
  - **Livestock productivity:** CattleHerd, PigHerd, BroilerHerd, LayerHerd
  - **Waste management:** WasteAndCircularity

What popped out?

https://github.com/karlssonjo/CIBUSmod-PhD-course-lab/blob/main/run_CIBUSmod.ipynb

Participatory scenario development and modelling

- "Story-and-Simulation" (Volkery *et al.* 2008)
  - Develop **qualitative** storylines (experts and stakeholders)
  - Translate qualitative information to **quantitative** model input
  - **Iterative process** of refining storylines and quantification



Discussion session

Participatory scenario development and modelling

- Would such an approach suit your PhD project?
- What do you see as **benefits**?
- What do you see as **barriers**?

References

Karlsson, J.O., Karlsson-Potter, H., Lagnelöv, O., Ericsson, N., Einarsson, R., Hansson, P-A. (n.d.) CIBUSmod: A spatially disaggregated biophysical agri-food systems model for studying national-level demand- and production-side intervention scenarios. *Manusript in preparation* (available on Teams)

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Basnet, S., Wood, A., Röös, E., Jansson, T., Fetzer, I. & Gordon, L. (2023). Organic agriculture in a low-emission world: exploring combined measures to deliver a sustainable food system in Sweden. *Sustainability Science, 18(1), 501-519. https://doi.org/10.1007/s11625-022-01279-9*