

An optimization model for Sustainable Intensification of agriculture in the basin

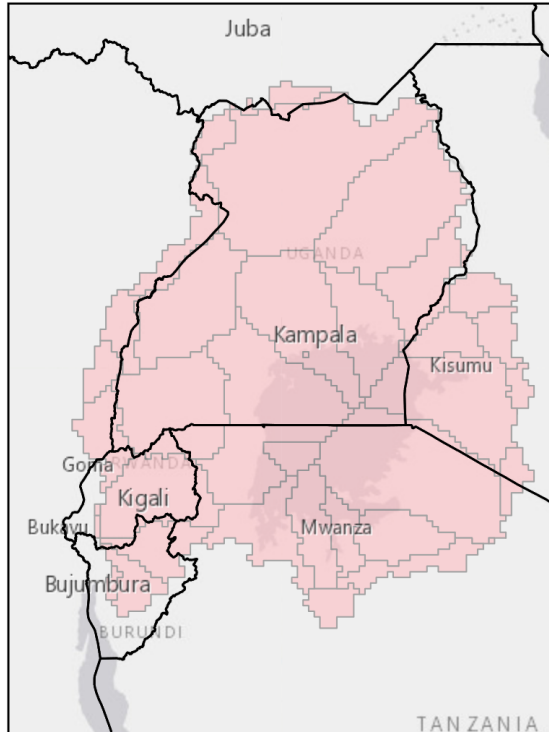
Julian Joseph

Water Security Research Group

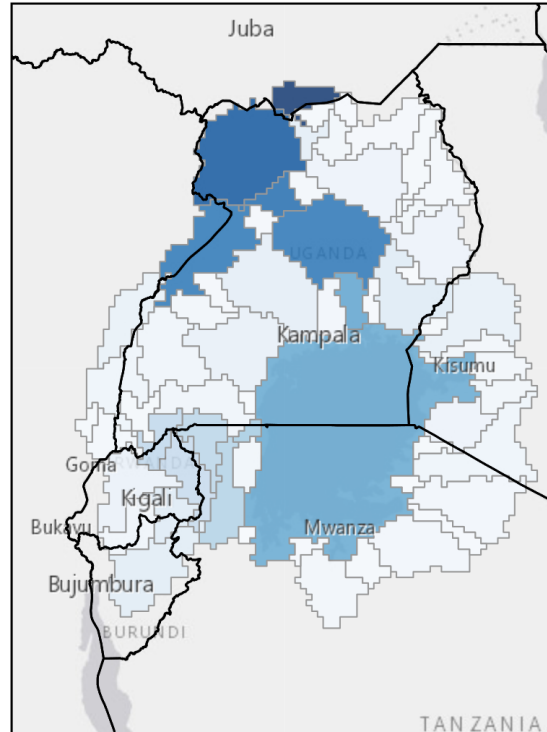
International Institute for Applied Systems Analysis (IIASA)



Extended Lake Victoria Basin



Marketsheds in the extended Lake Victoria Basin

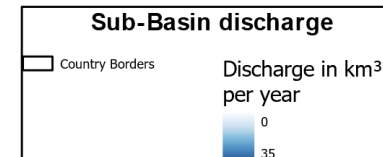


Sub-basins in the extended Lake Victoria Basin



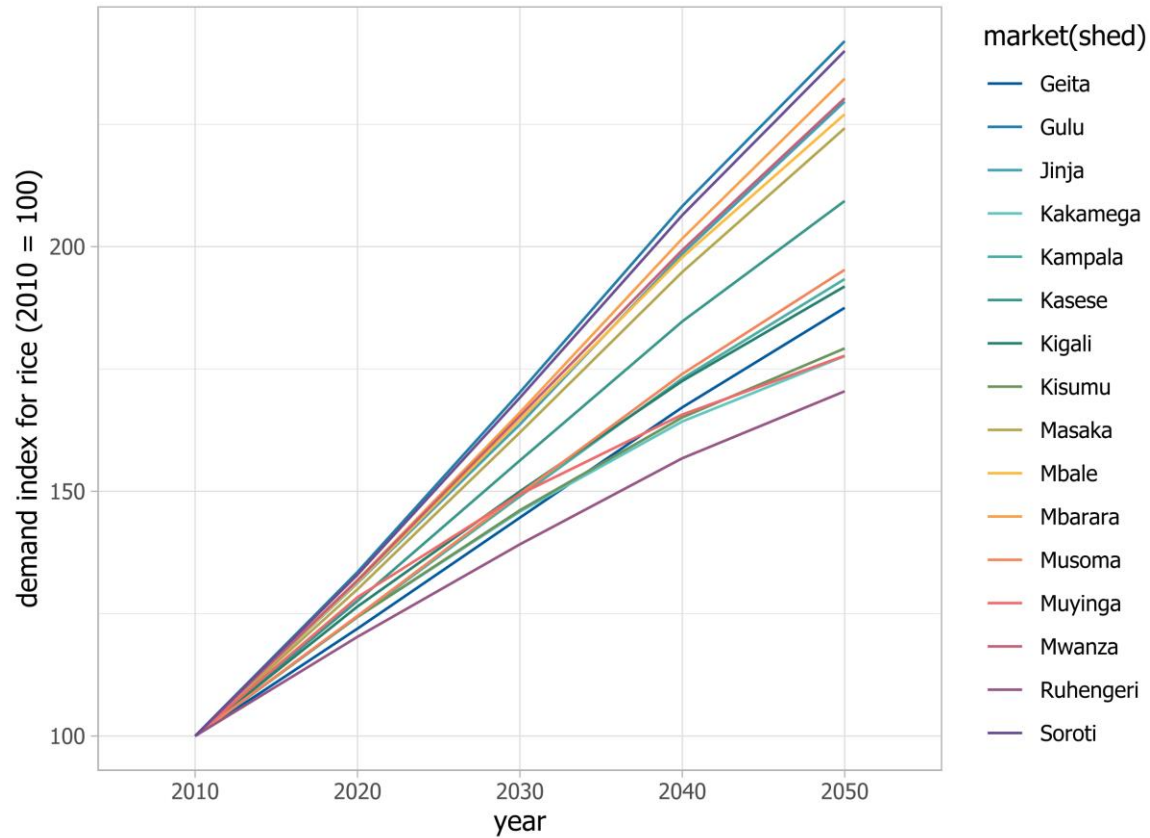
Basemap source: Esri, HERE, Garmin, USGS, Esri, HERE, Garmin, Esri, HERE, Garmin, FAO, NOAA, USGS

Location of the extended Lake Victoria Basin in East Africa

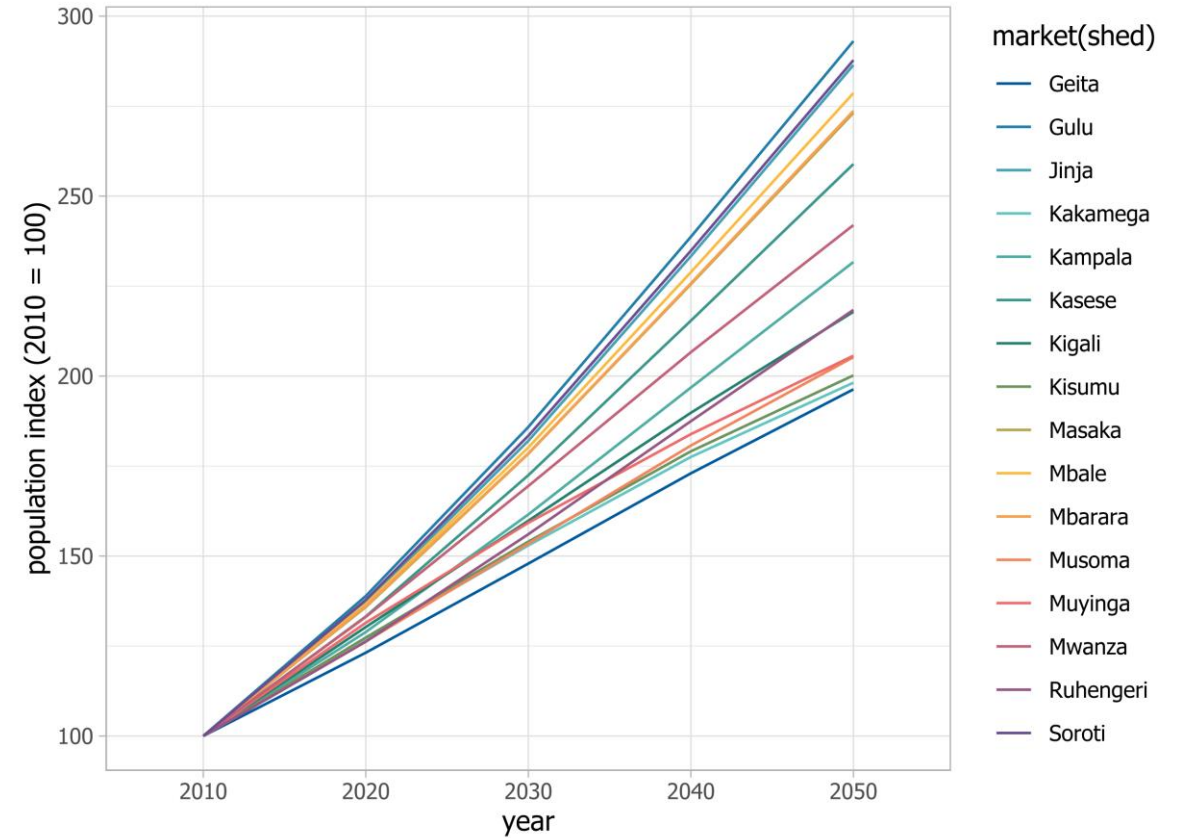


Increasing demand for food

Rice demand doubles in East Africa

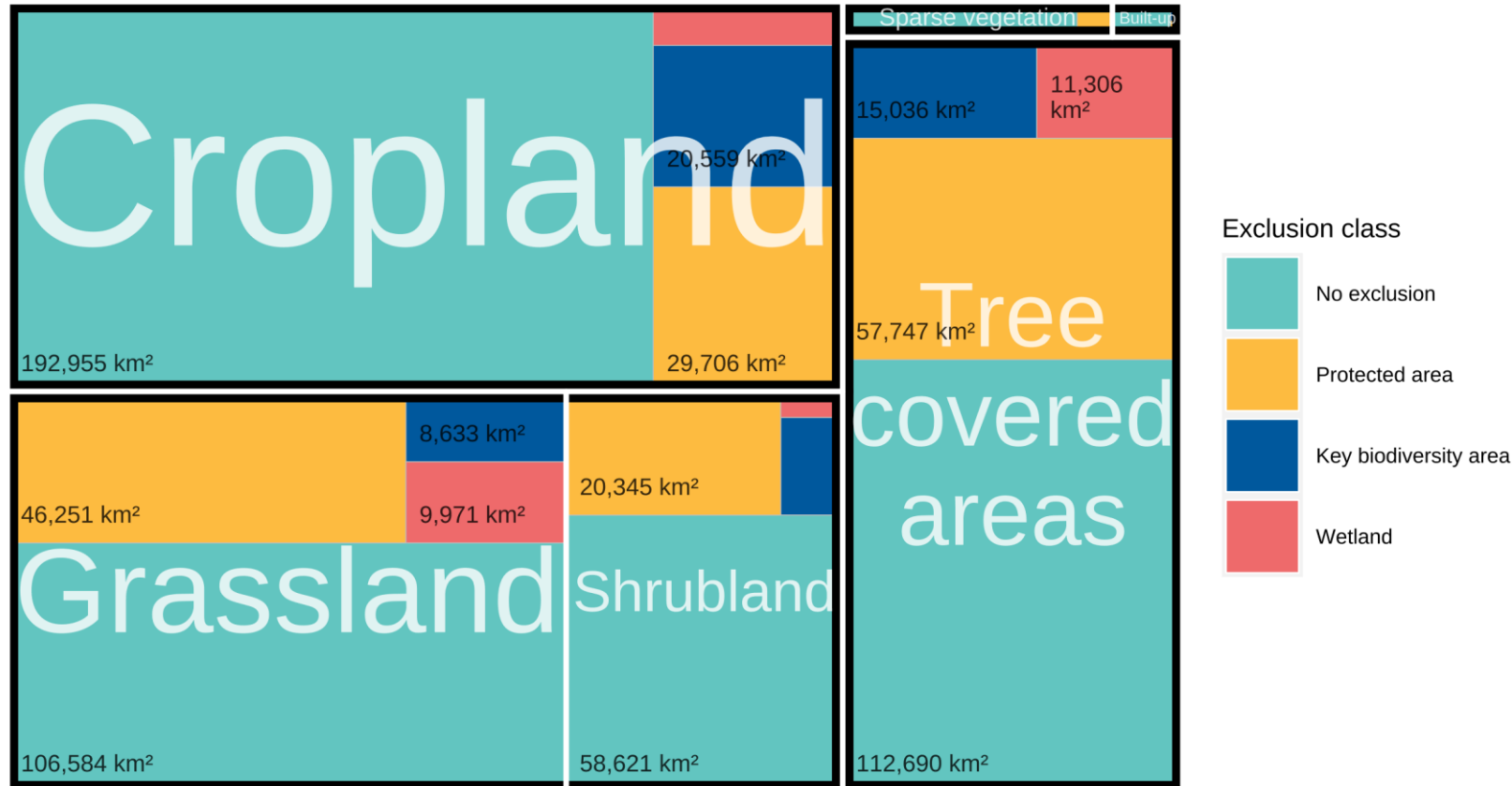


Population more than doubles in East Africa

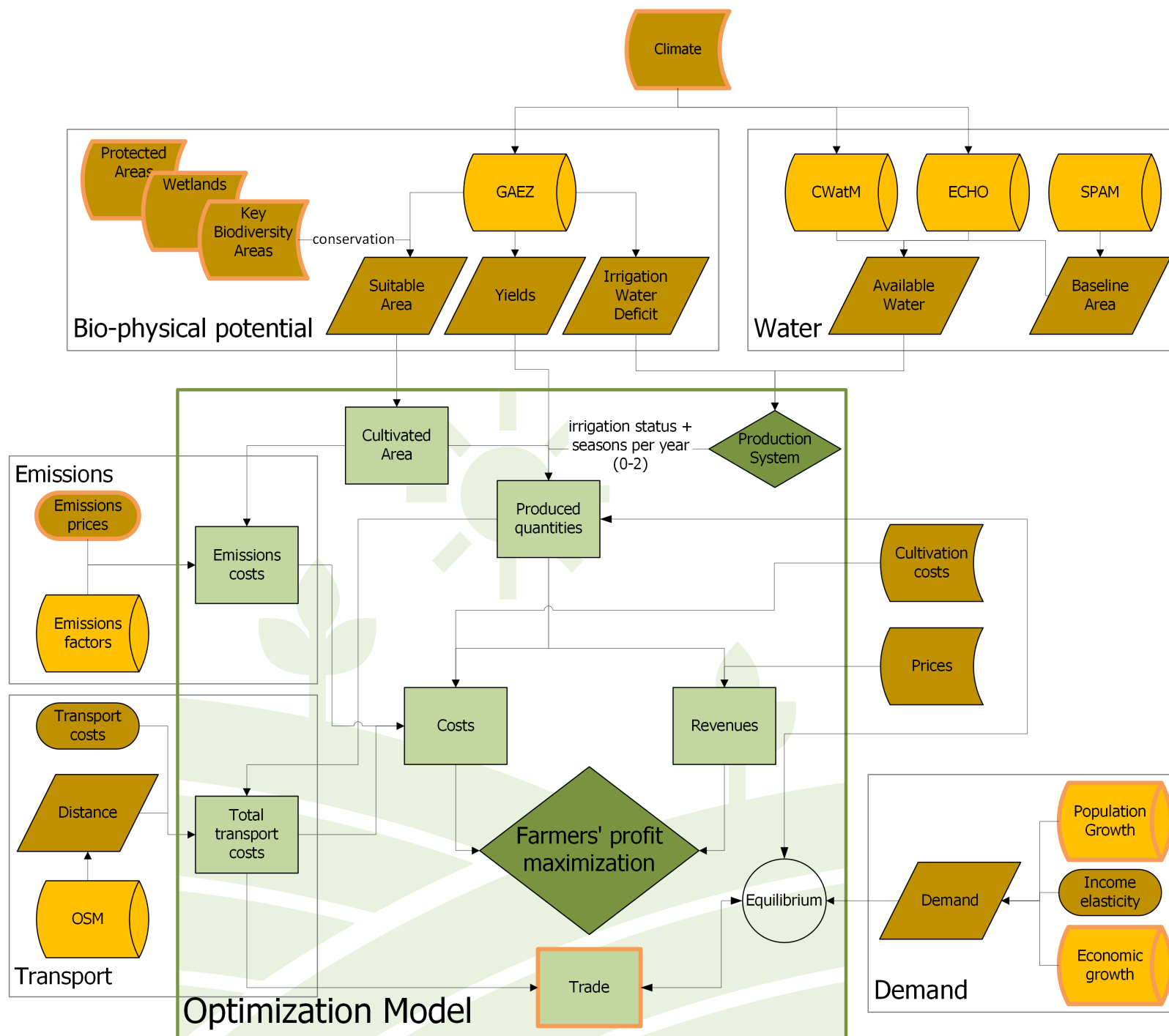


Limited space for **sustainable** expansion of crop production

Total land area in the study area



Optimization Model for Sustainable Intensification of Crop Production



Variable Types

Exogeneous Data

- Model:** External models and resulting data
- Parameter:** Parameters from data or assumptions
- Input Data:** Model input data
- Data:** External model output data, used as input in optimization

Endogeneous variables

- Variable:** Variables determined in optimization model
- Decision:** Optimization objective/choice

Scenarios

- Variables introducing scenarios

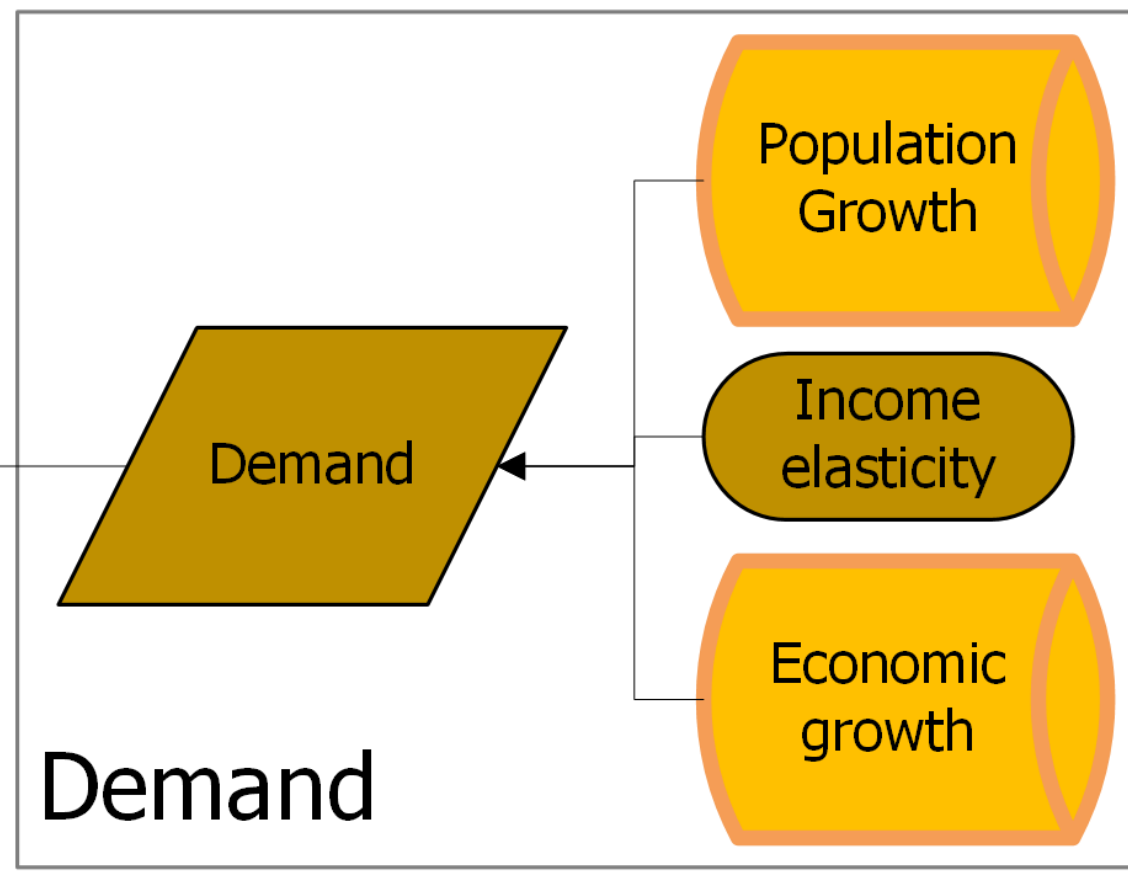
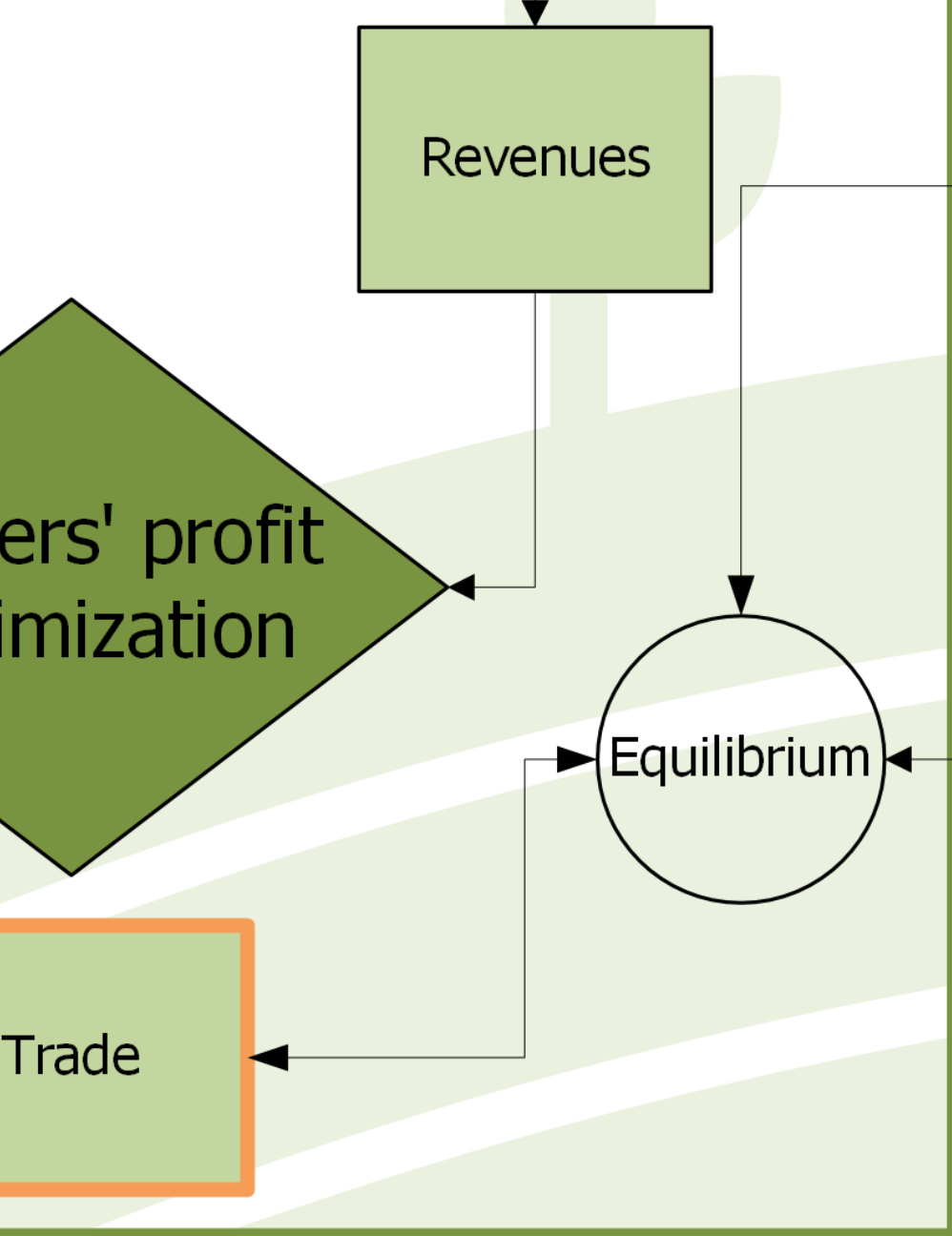
Models and tools used for inputs

Run specifically for this model application:

- GAEZ** Global Agro-Ecological Zones
- CWatM** Community Water Model
- ECHO** Global Hydro-Economic Model
- OSM** OpenStreetMap routing

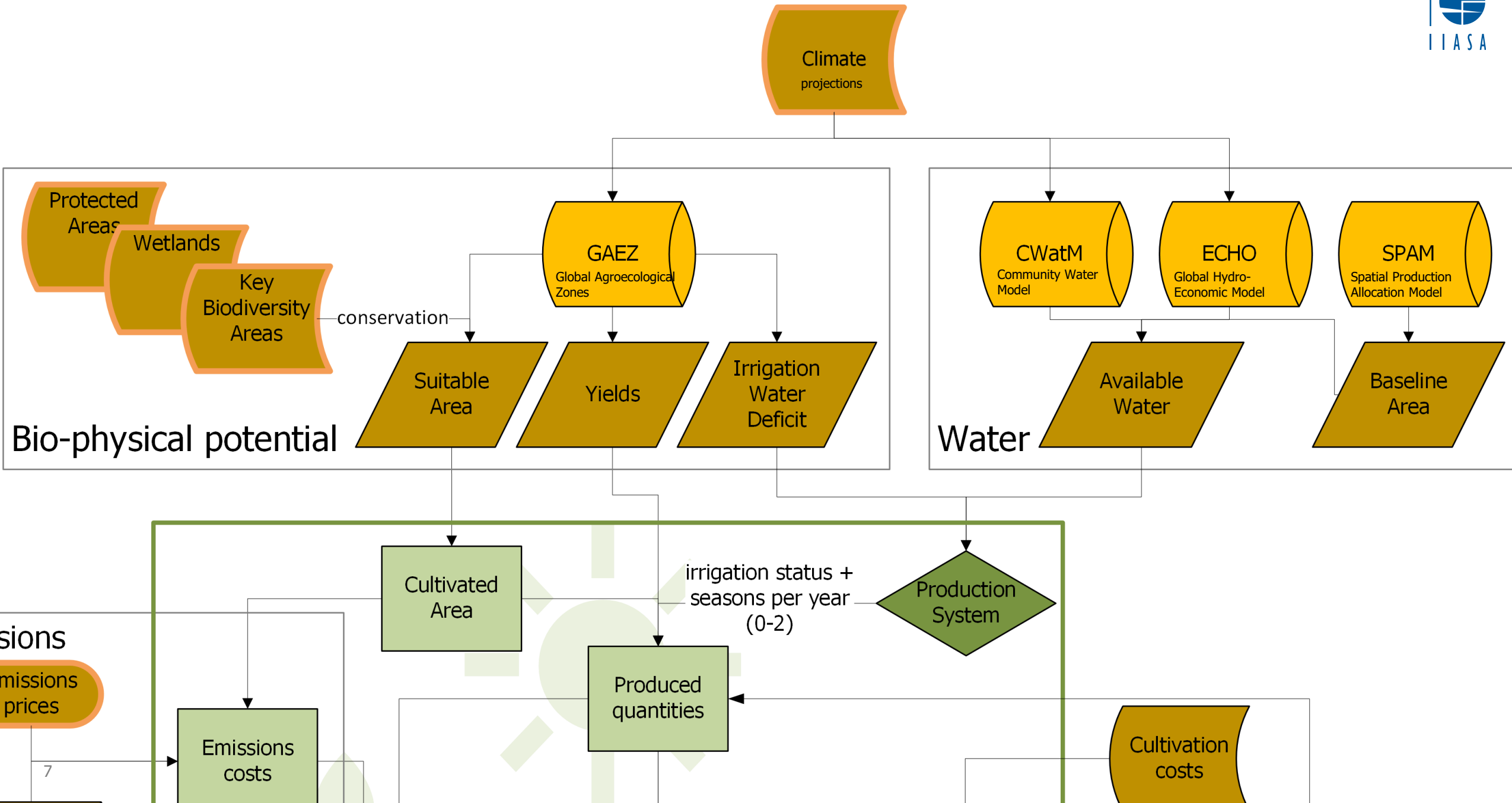
Using global/regional results:

- SPAM** Spatial Production Allocation Model



Using Shared Socioeconomic Pathways (SSP) projections

- Mode
- Run s
- GAEZ G**
- CWatM**
- ECHO**
- OSM**
- Using
- SPAM S**



Emissions

Emissions prices

Emissions factors

Emissions costs

Transport costs

Distance

OSM

Total transport costs

Area

Produced quantities

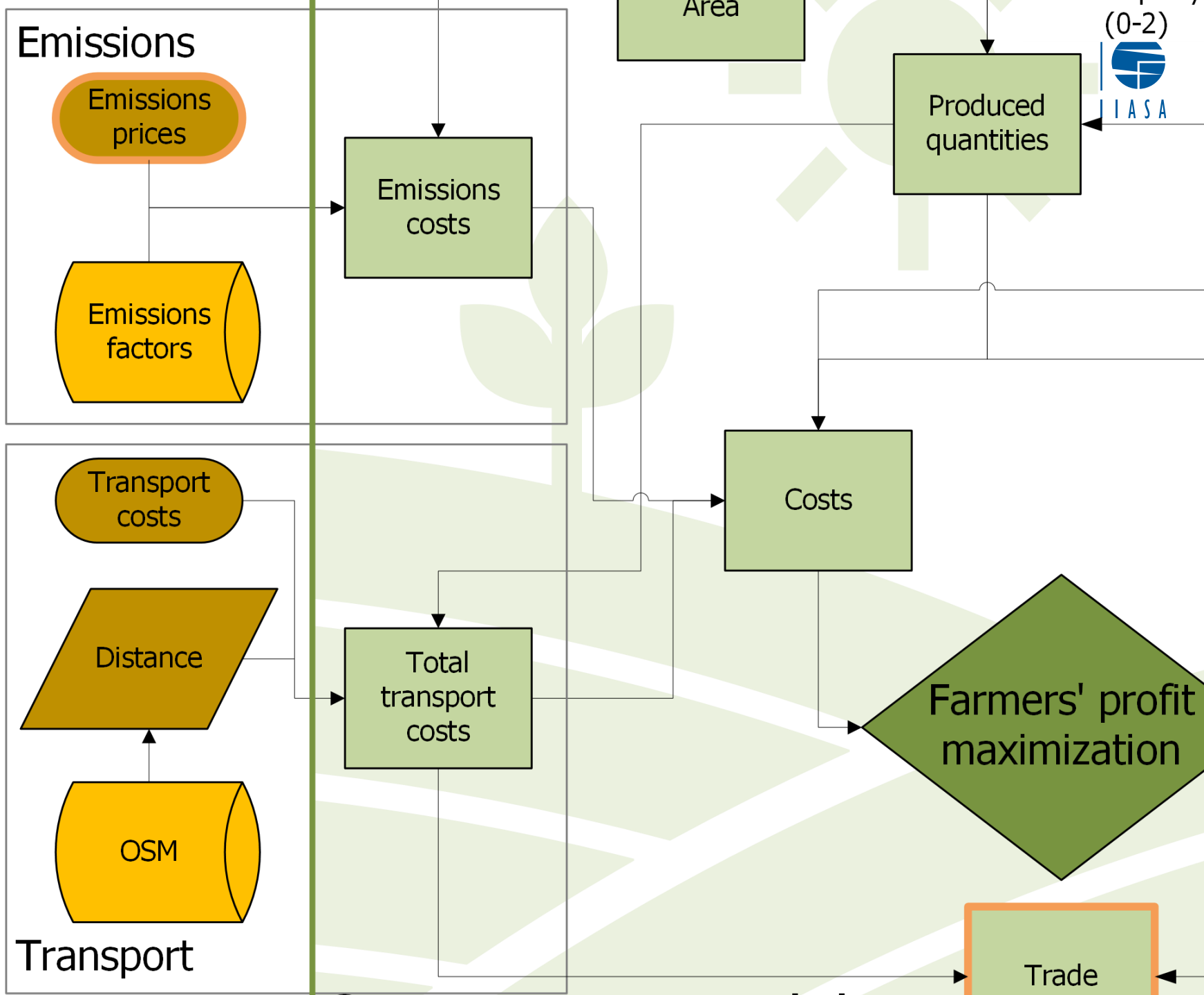


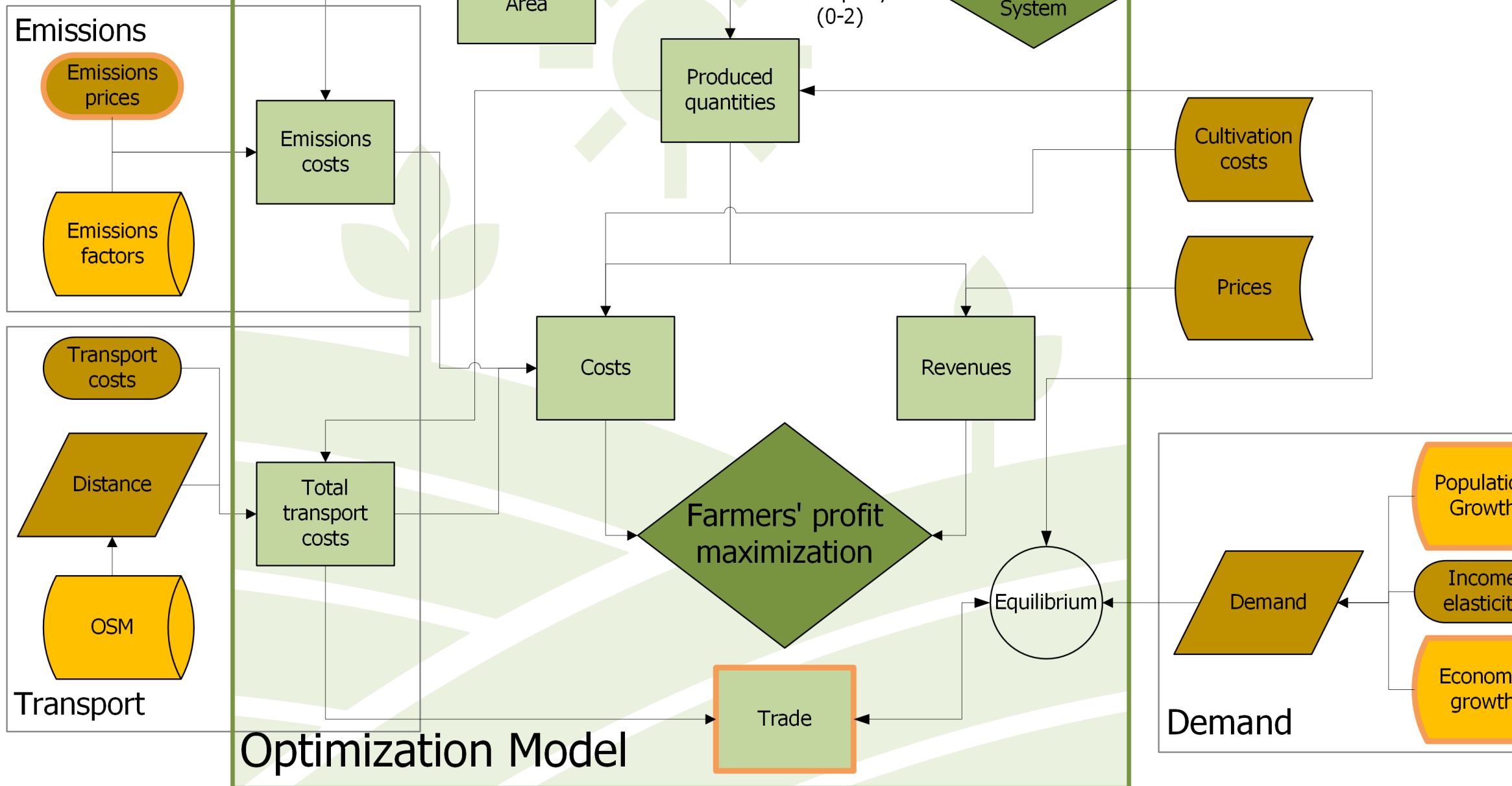
Costs

Farmers' profit maximization

Transport

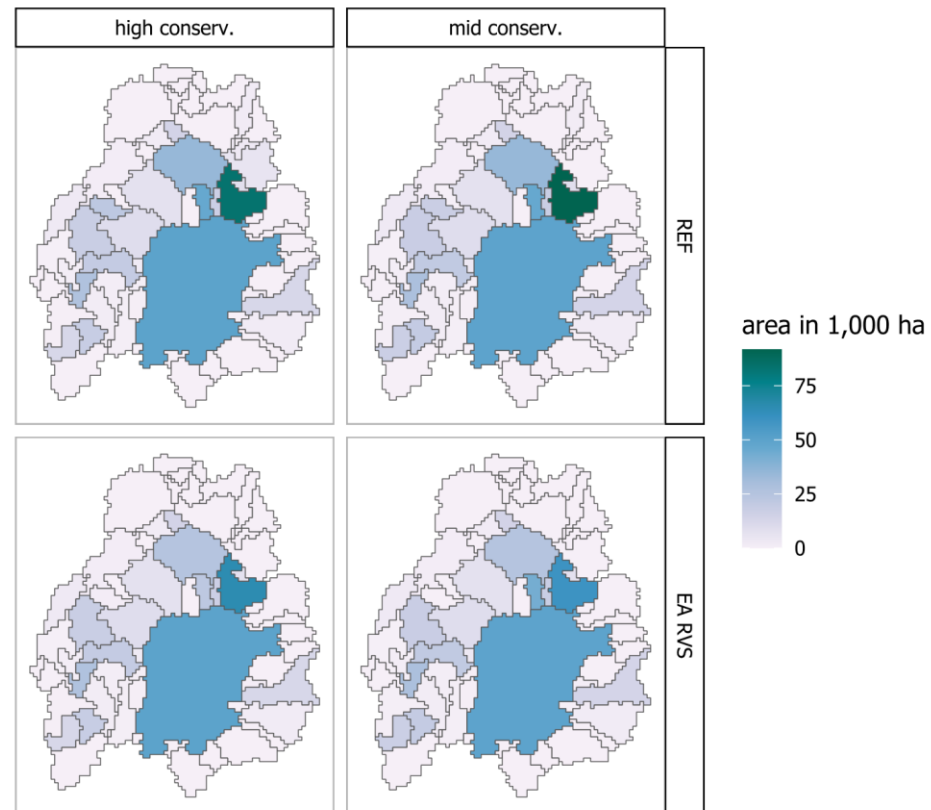
Trade





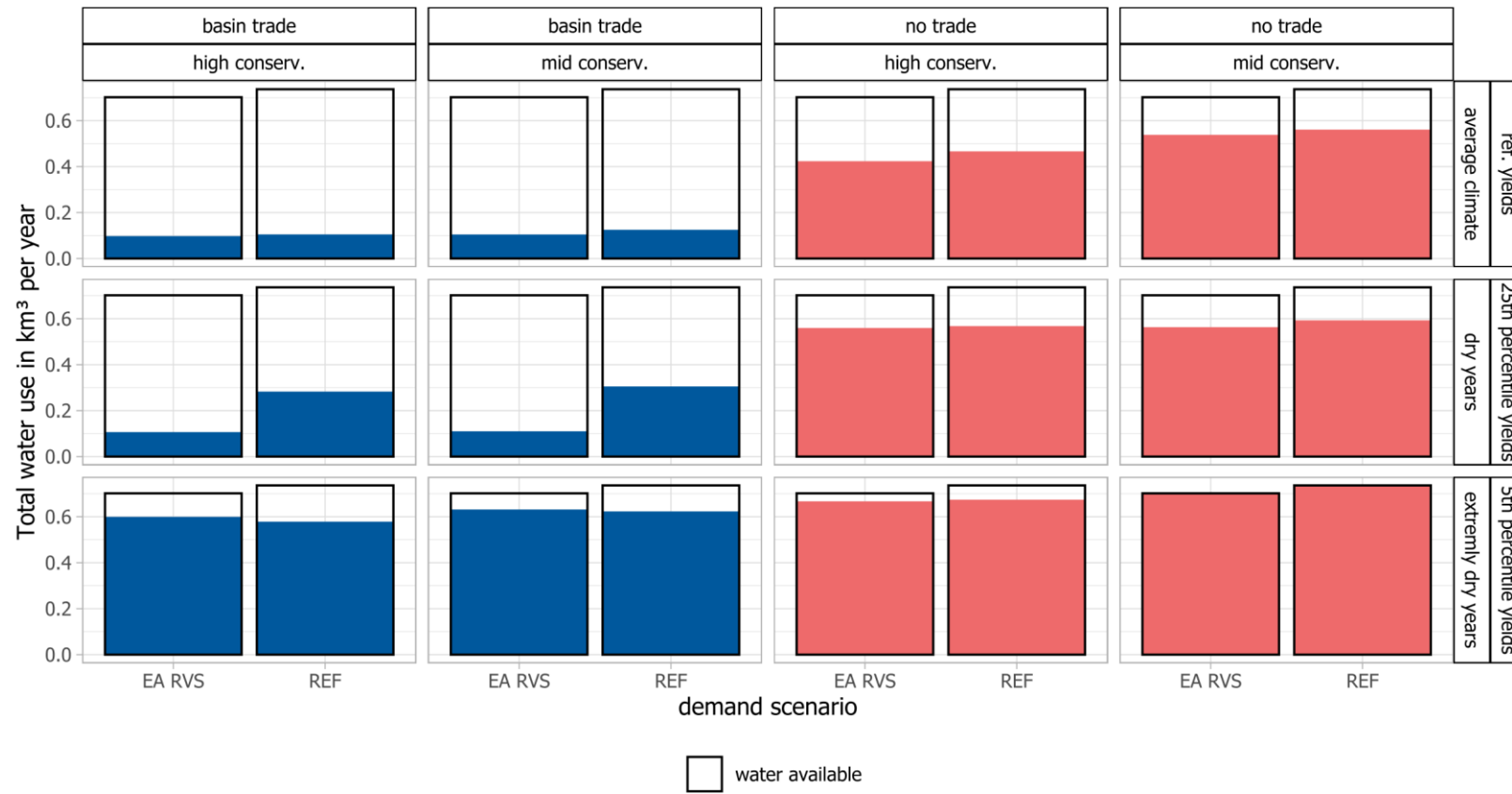
Allocation of production to subbasins

Area of production in subbasins
with free trade in basin

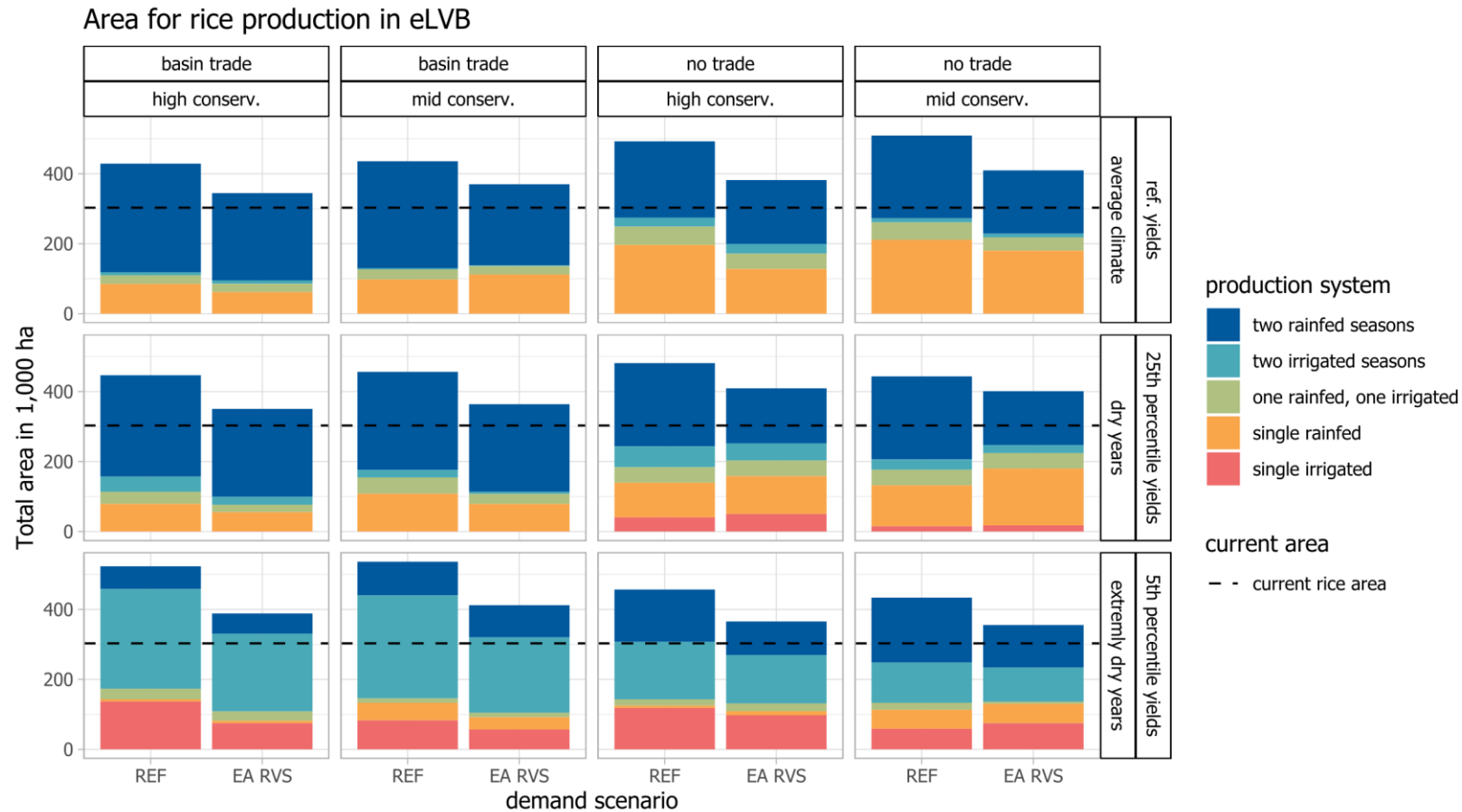


Water use

Water use scenarios for rice production in eLVB



Rainfed and irrigated areas for rice production



Key messages



We develop an optimization model for sustainable intensification of agricultural production that can be adapted to any basin, including the Lake Victoria and Nile basins.



Regional international trade can help reduce environmental impacts and water use of food production, especially rice.



Sustainable local rice production to meet future demand is possible.



Majorly rainfed rice production is only insufficient when extreme drought shocks occur.

Thank you for your time.

Questions.

