

Georeferencing and water management in the agricultural sector: the development of the SIMPLE-G model in Italy.

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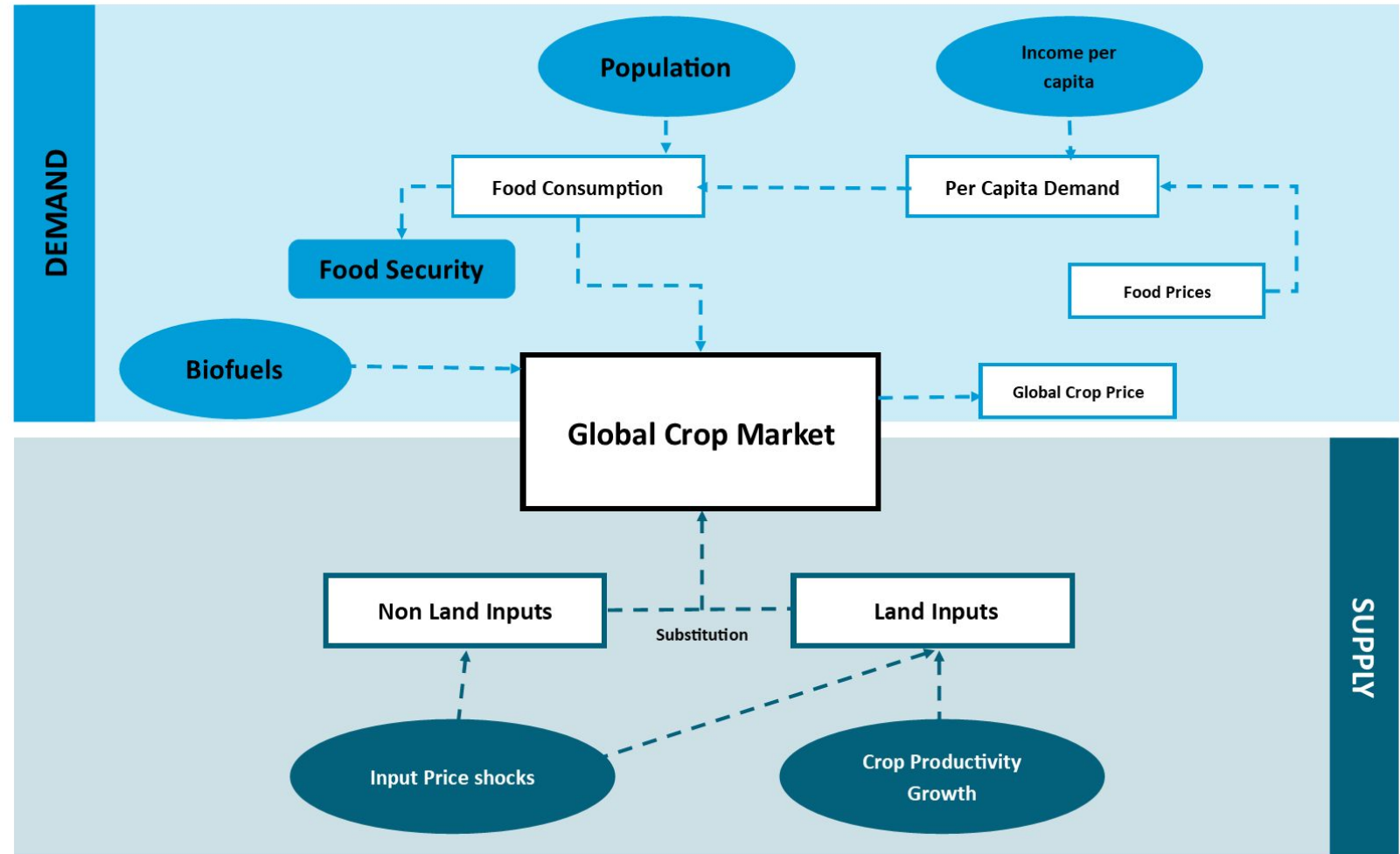
Motivation

- Unpredictable changes in temperature and rainfall threaten agricultural sustainability and food security
- Italy's Struggles:
 - **Droughts:** Increasing frequency over the past two decades, reducing crop yields.
 - **2022 Crisis:** Northern Italy faced extreme heat and severe water shortages.
 - **Recent Extremes:** Severe floods in the north and unusual heatwaves in the south.
- This changing and heterogeneous climatic events have distinct impacts in regional water availability posing location-specific challenges for agricultural production affecting prices and output.
- In this context, the need for a methodological framework that incorporates both **economic and biophysical variables** becomes apparent.

Simplified International Model of agricultural Prices, Land Use and Environment(SIMPLE)



- **SIMPLE** is a **partial equilibrium model** which comprehensively captures the key socioeconomic factors influencing cropland use and production for 16 regions of the world
- It was first developed by Hertel and Baldos (2013)



Applications for SIMPLE

Baldos & Hertel (2013)

Validation from 1961-2006 assessed model performance on crop production, yields, land use, and prices.

Lobell et al. (2013) & Hertel et al. (2014)

GHG emissions integrated using fixed factors tied to agricultural activities.

Fuglie et al. (2022)

R&D policies focused on achieving global GHG reductions by 2050

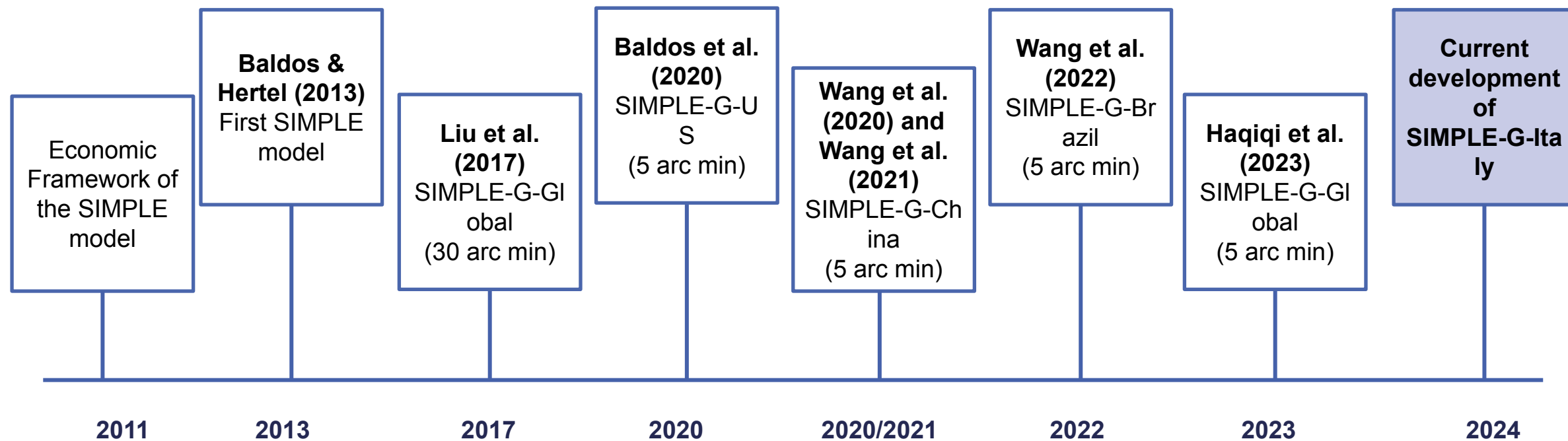
Baldos & Hertel (2014)

Food Security Module

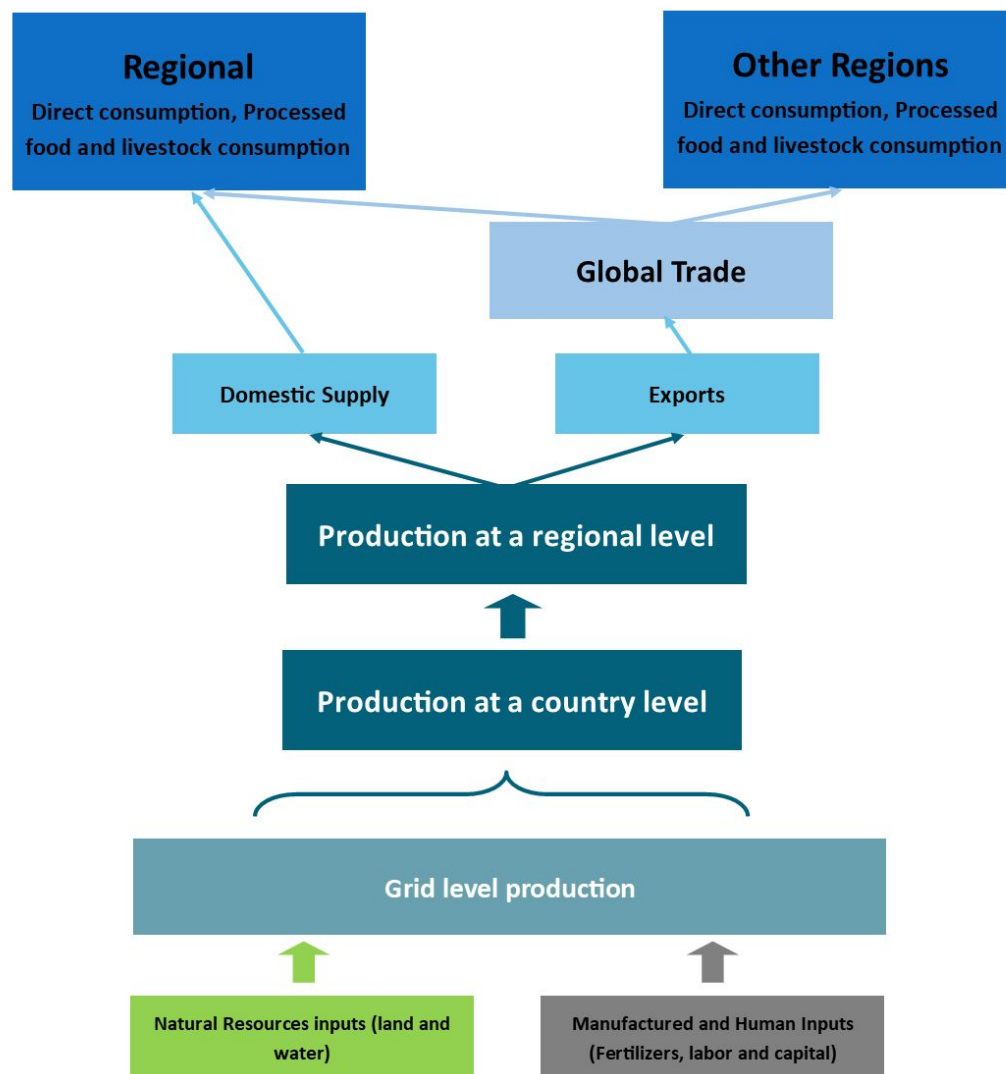
Baldos & Hertel (2015)

Introduction of market barriers

From SIMPLE to SIMPLE-G

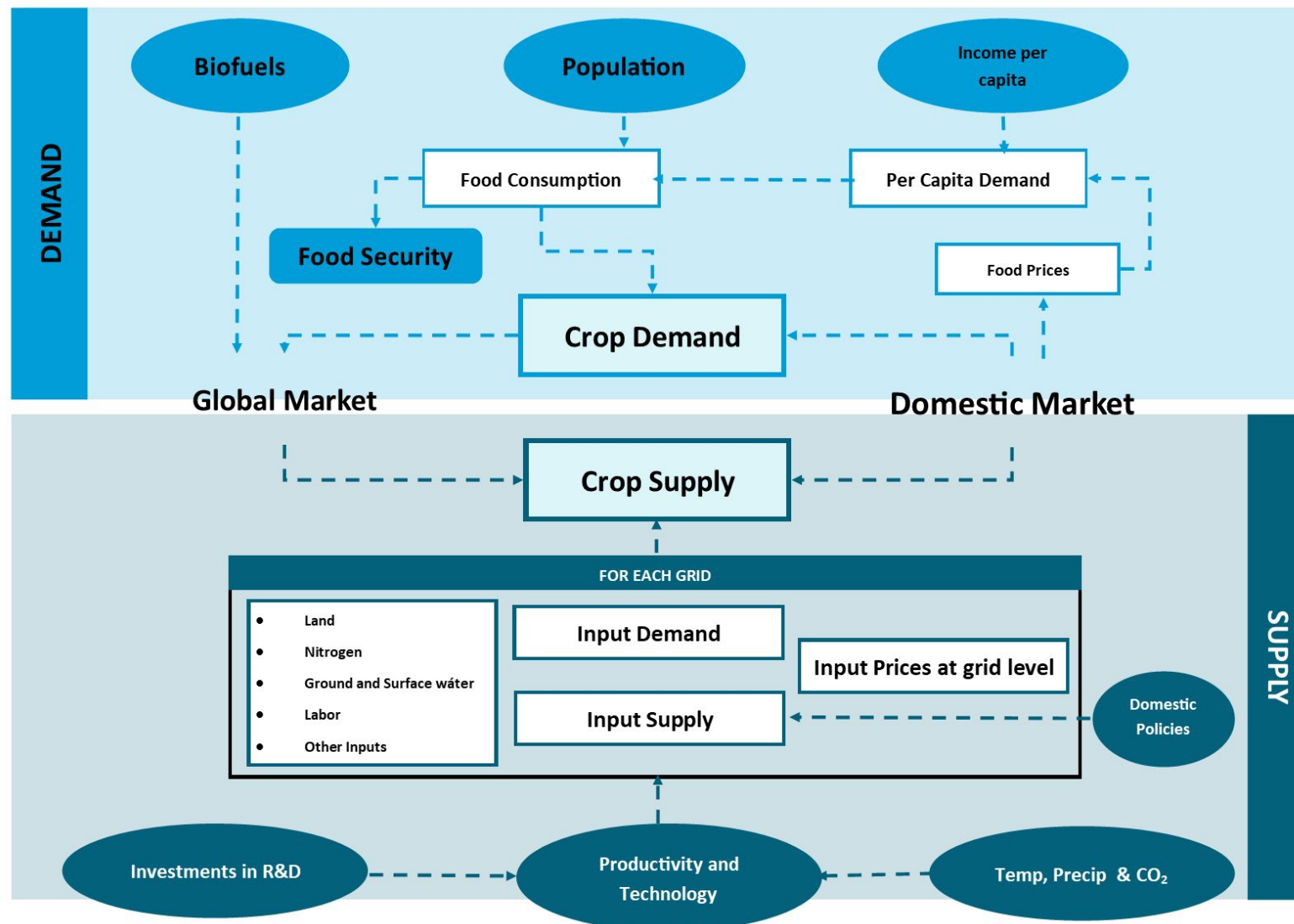


SIMPLE-G philosophy

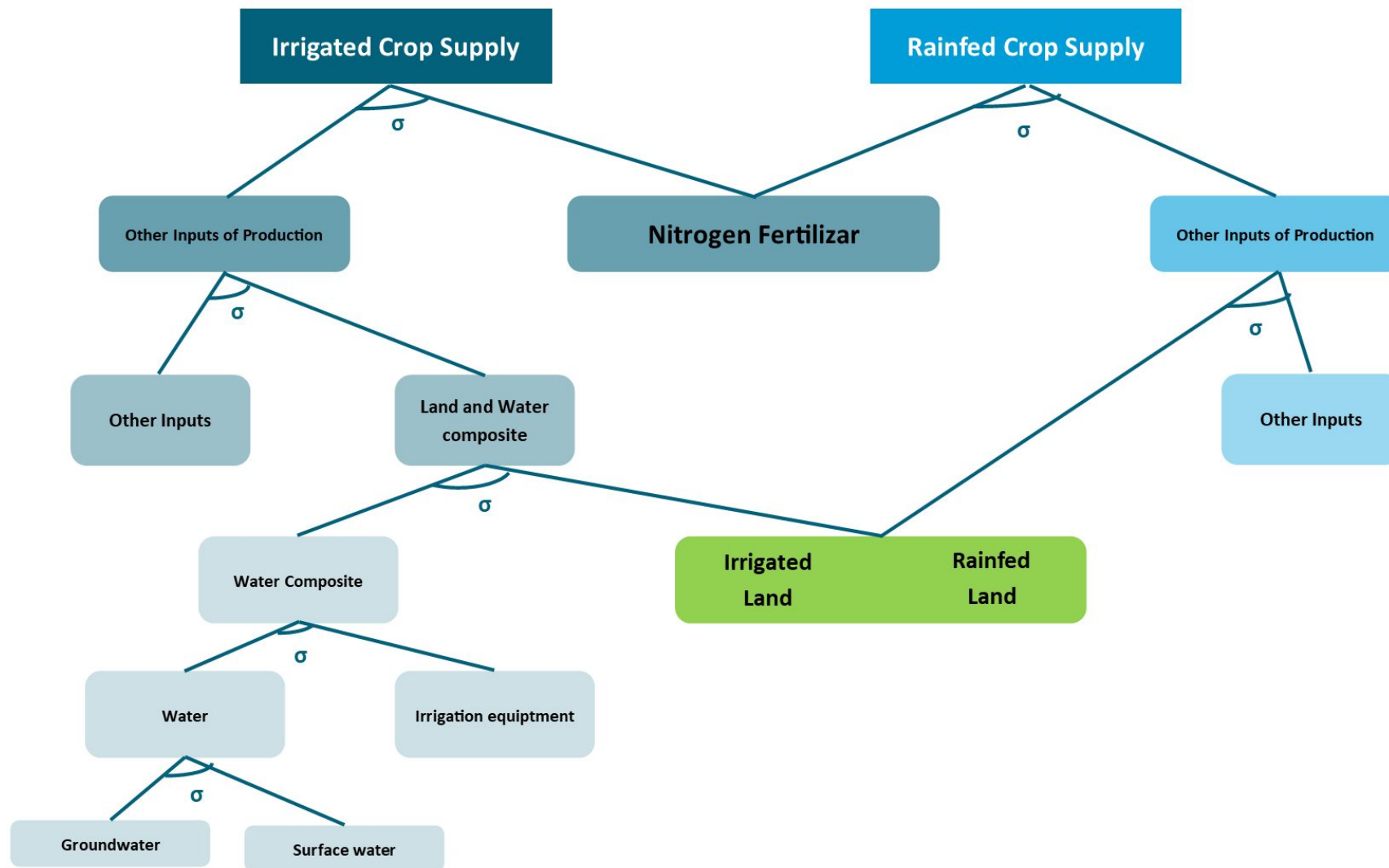


- Recognizes that global forces are driving local sustainability stresses
- Yet the character of these stresses and solutions vary by locality
- **Local responses can have global consequences**
- Georeferenced analysis that incorporates local heterogeneities is key
- Additionally, the economic analysis should be complimented with biophysical estimates such as cropland use, yields, water usage and fertilizers applications, among others

SIMPLE-G structure



SIMPLE-G production function at a grid level



Applications of SIMPLE-G

Liu et al. (2022)

Introduced SIMPLE-G-US-CS to analyze nitrogen loss management policies in the US Corn Belt.

Haqiqi et al. (2023)

Studied future population growth and groundwater policies' effects on local crop production and demand.

Ray et al. (2023)

SIMPLE-G-US-CZ incorporates a labor mobility module to analyze agricultural labor markets at the gridded level.

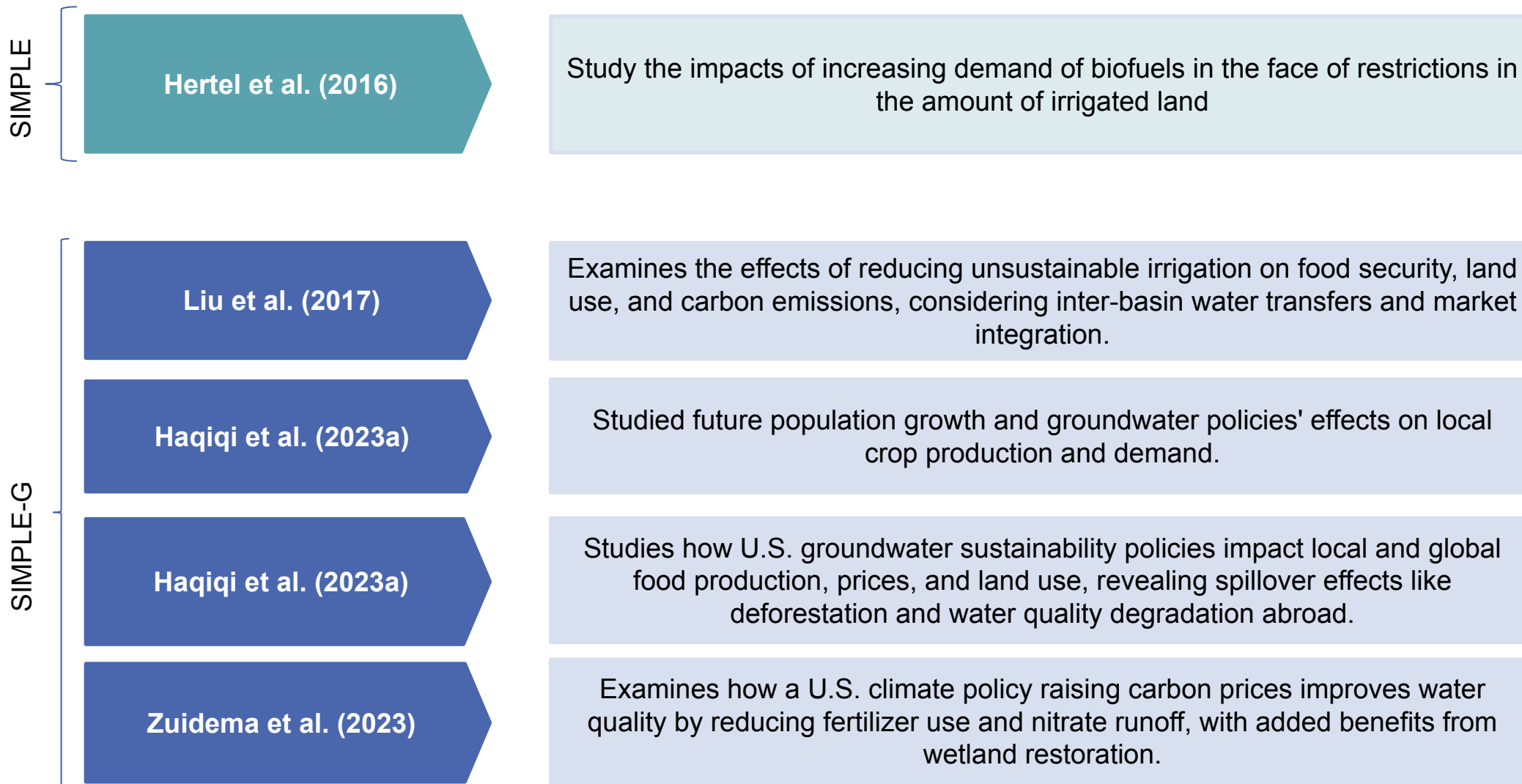
Wang et al. (2022)

SIMPLE-G-Brazil integrated with a transportation module to examine how reduced transport costs affect agricultural production and cropland expansion.

Haqiqi et al. (2023)

Used the global model to analyze the impacts of COVID-19 and climate shocks on global crop production.

Applications of SIMPLE and SIMPLE-G about WATER



Data construction for SIMPLE-G-IT

Global Datasets

Dataset	Year	Geographical Dimension
FAOSTAT	1961-2023	Country level
Earthstat	2000	10km x10 km
ISIMIP	1861-2017	50 km x 50 km
AQUASTAT	2005	10 km x 10 km
GCWM	1998-2002	10 km x 10 km

Italian Datasets

Dataset	Year	Geographical Dimension
ISMEA	Up to 2024	Regional level
RICA	2017	Provincial level
CREA	Up to 2022	Regional level

Data assumptions for SIMPLE-G-IT

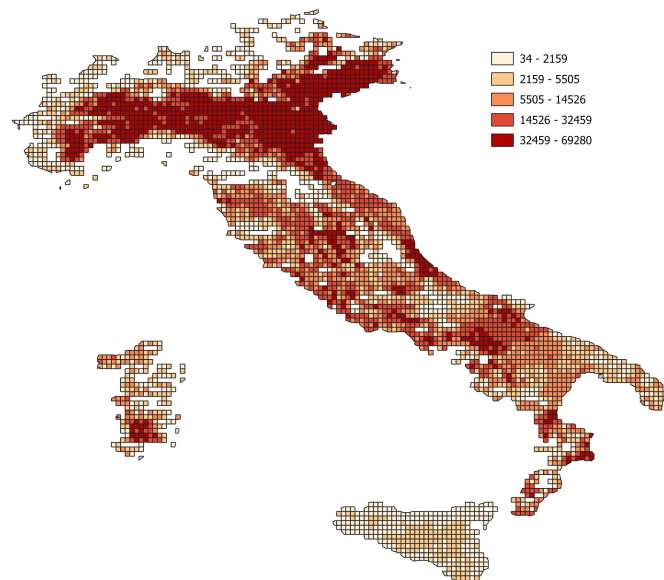
A preliminary dataset for the year 2017 using the following sources:

1. **Earthstat:** to extract data on total cropland, crop production and total nitrogen application
 2. **GCWM:** to determine the percentage of rainfed and irrigated cropland
 3. **Aquastat:** to distinguish between groundwater and surface water irrigation
 4. **RICA:** to extract data on
Crop and Fertilizer prices per province
Water Price per province
Non-crop input values for livestock and processed food
 5. **CREA:** to establish cropland values at a regional level
- All of the data provided by this data sources were contrasted with the aggregate estimates provided by FAO

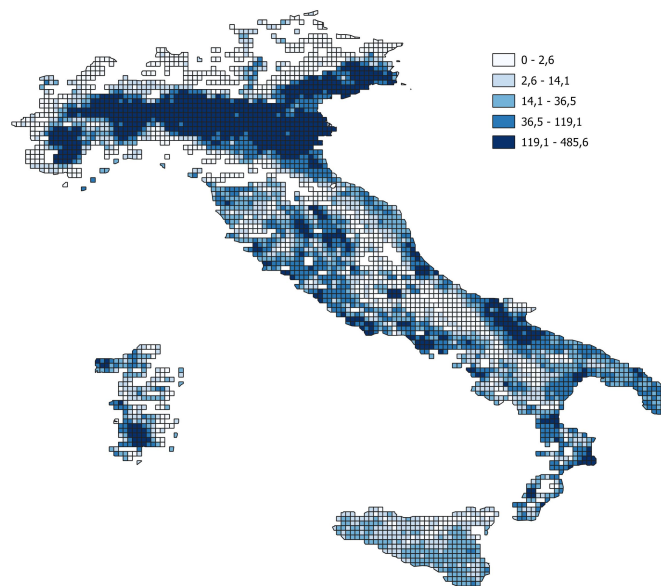


**Total number
of grids for
Italy: 3745**

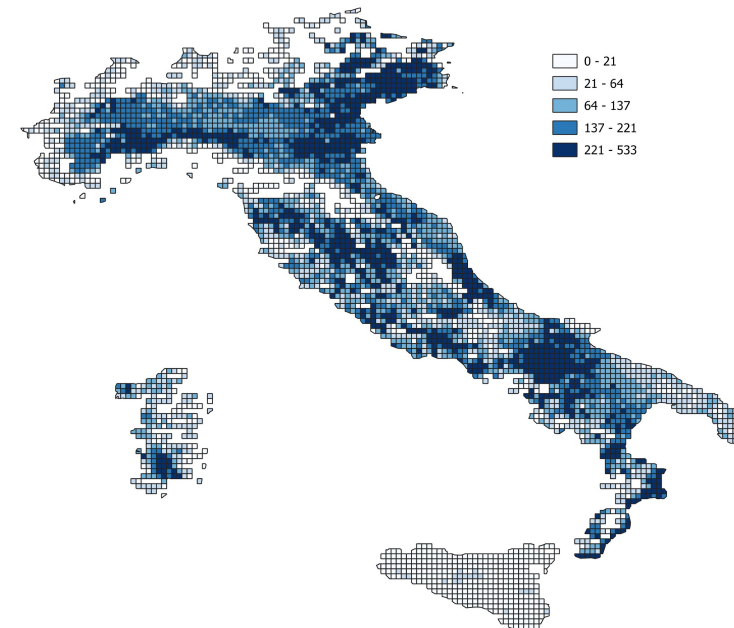
Crop Production



Irrigated Hectares



Rainfed Hectares



Future Steps

□ SIMPLE-IT MODEL

- A preliminary version of the model has been calibrated for 2017 with Italy as a distinct region..
- The model will be used to examine the implications of the 2023-2027 CAP Strategic Plan implemented in Italy.
- From a technical standpoint, we extended the existing framework to allow crop differentiation: *organic vs non-organic*.
- The model will be used to investigate the effect of **25% organic goal**

□ SIMPLE-G-IT MODEL

- A preliminary database for 2017 has been built to serve as the calibration for the model.
- We are currently working on improving the quality of the data used.
- The model will be used as a base to simulate different policies oriented in restricting water use for agriculture.

Thank you for your attention

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Debate



1. Priorità Politiche:

- Quali tipi di valutazioni sulle risorse idriche sono più rilevanti per le attuali esigenze politiche?
- In che modo i nostri modelli possono supportare il processo decisionale sulla governance e l'efficienza dell'uso dell'acqua?

2. Scala e Governance:

- A quale scala spaziale (nazionale vs locale) dovrebbero essere valutate le politiche idriche per dare indirizzi di policy?