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Bridging the Gap between Land and Food: Leveraging Food Balance Sheets to Enhance Food System Modeling

August 8, 2024

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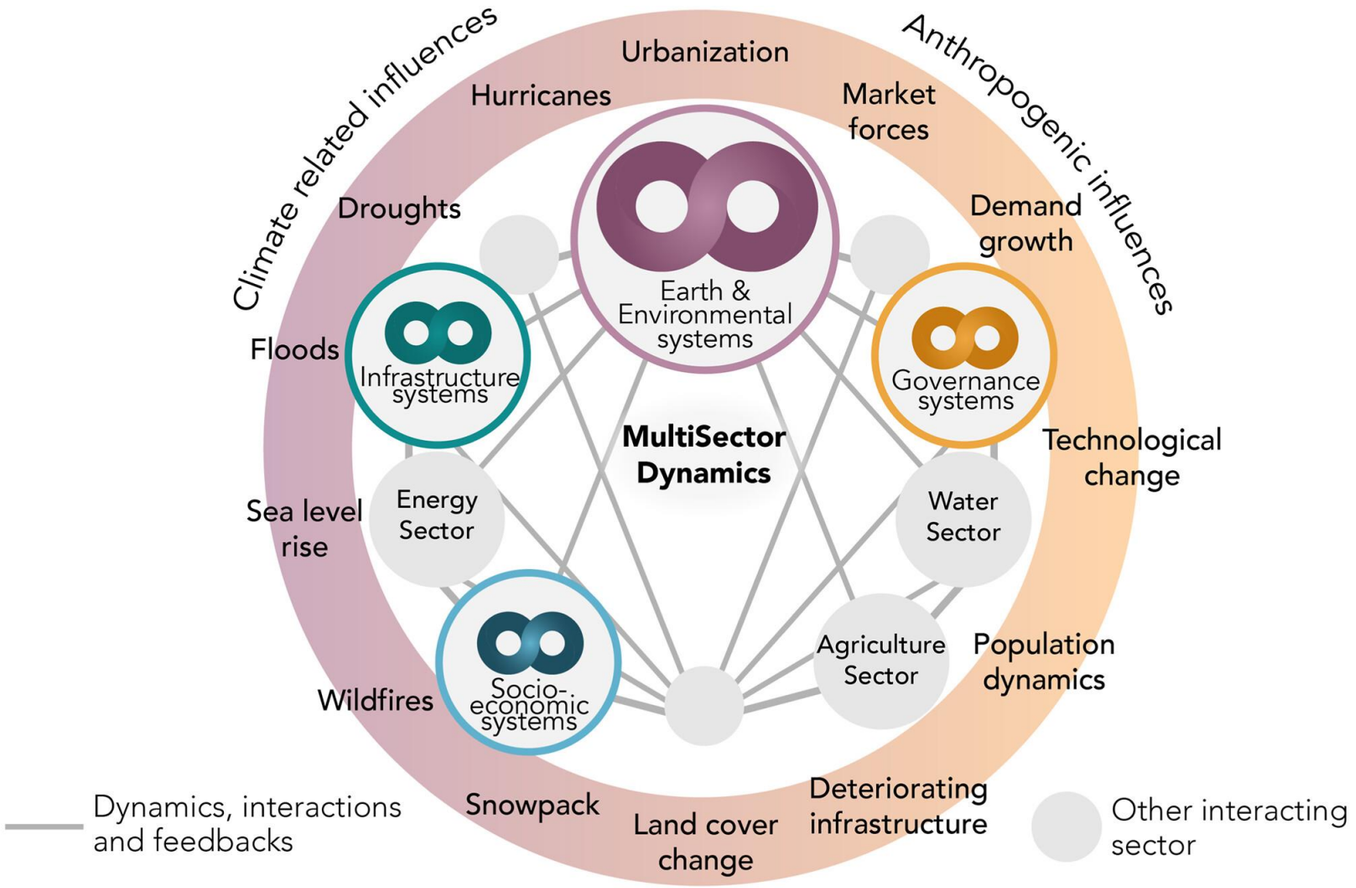
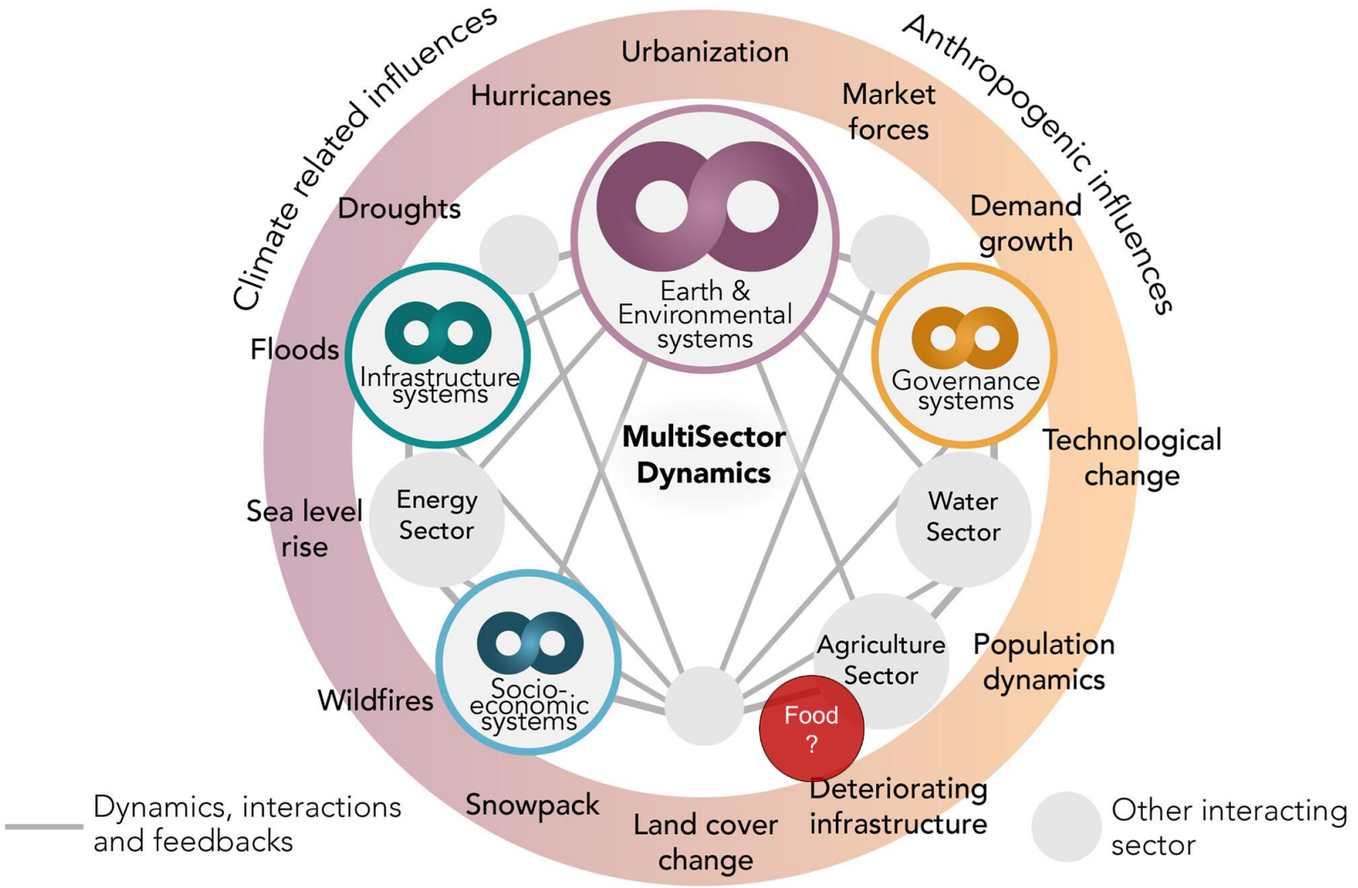
Agriculture and food systems in MSD



- Integrated Human and physical Earth system modeling
  - Spatial & temporal resolution
  - Processes

Key concepts for MSD. Reed et al. (2022)

Agriculture and food systems in MSD



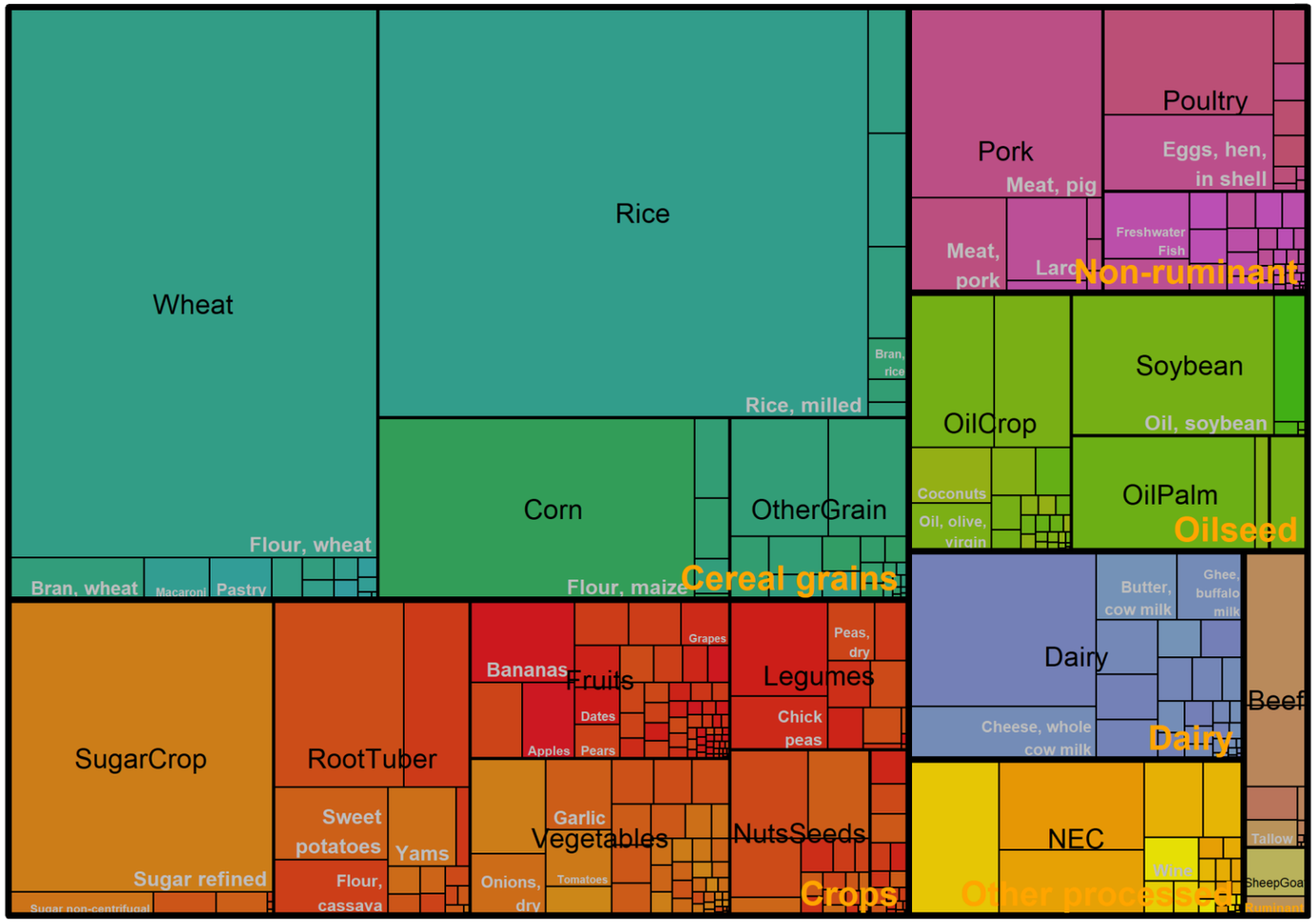
Key concepts for MSD. Reed et al. (2022)

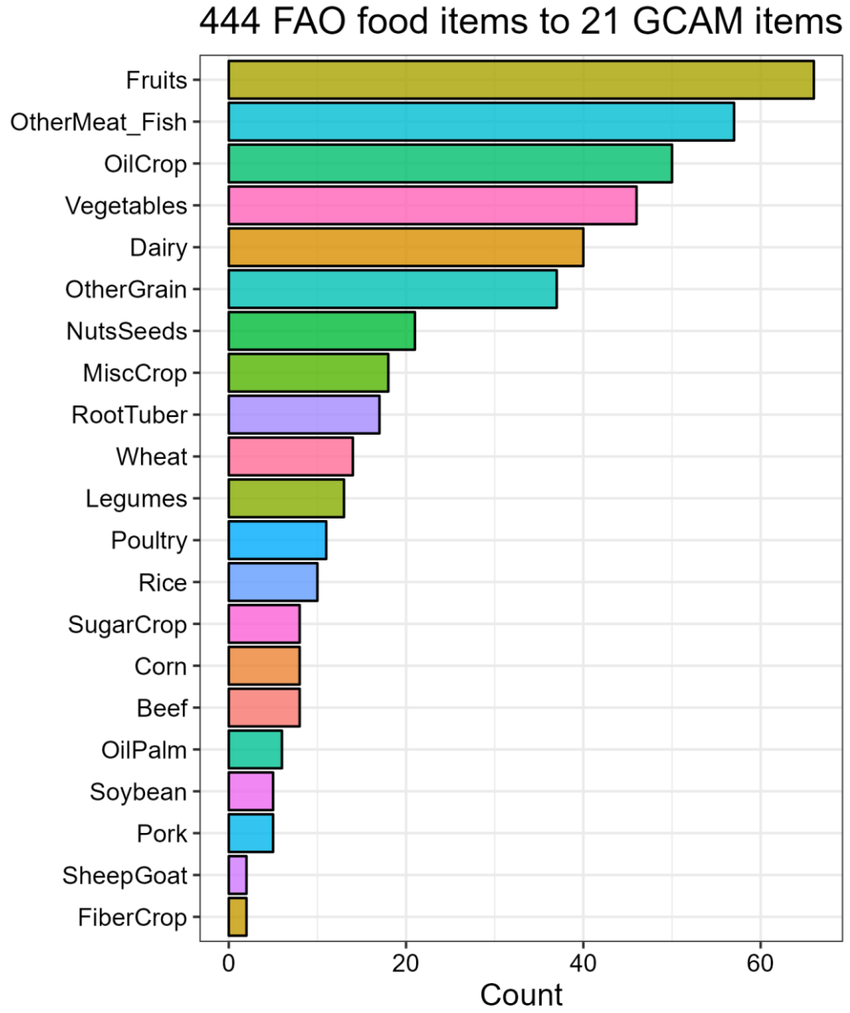
- Integrated Human and physical Earth system modeling
  - Spatial & temporal resolution
  - Processes
- Agriculture and **food** systems
  - Sectors along the supply chain (primary and processing sectors)
  - Market supply and demand (production, storage, trade, bioenergy, feed, food, etc.)

- Human: food demand and behaviors around the supply chain
- Earth: physical inputs in agricultural production, e.g., land, water, nitrogen, etc.
- Why challenging?

Food: 444 FAO food items by calories

World food consumption (2010 – 2019):
7770 Peta-Kcal per year or ~2900 Kcal/ca./day

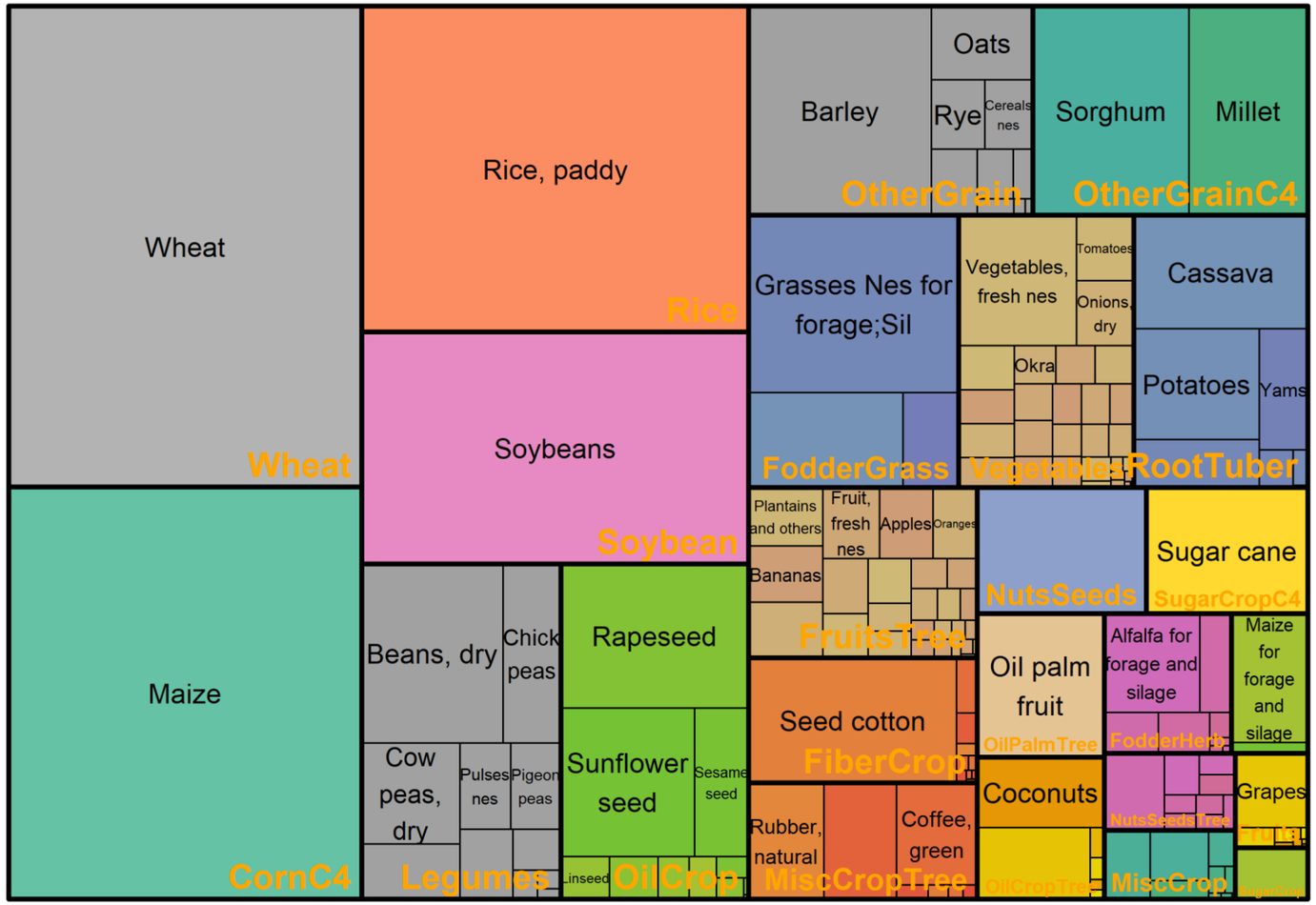


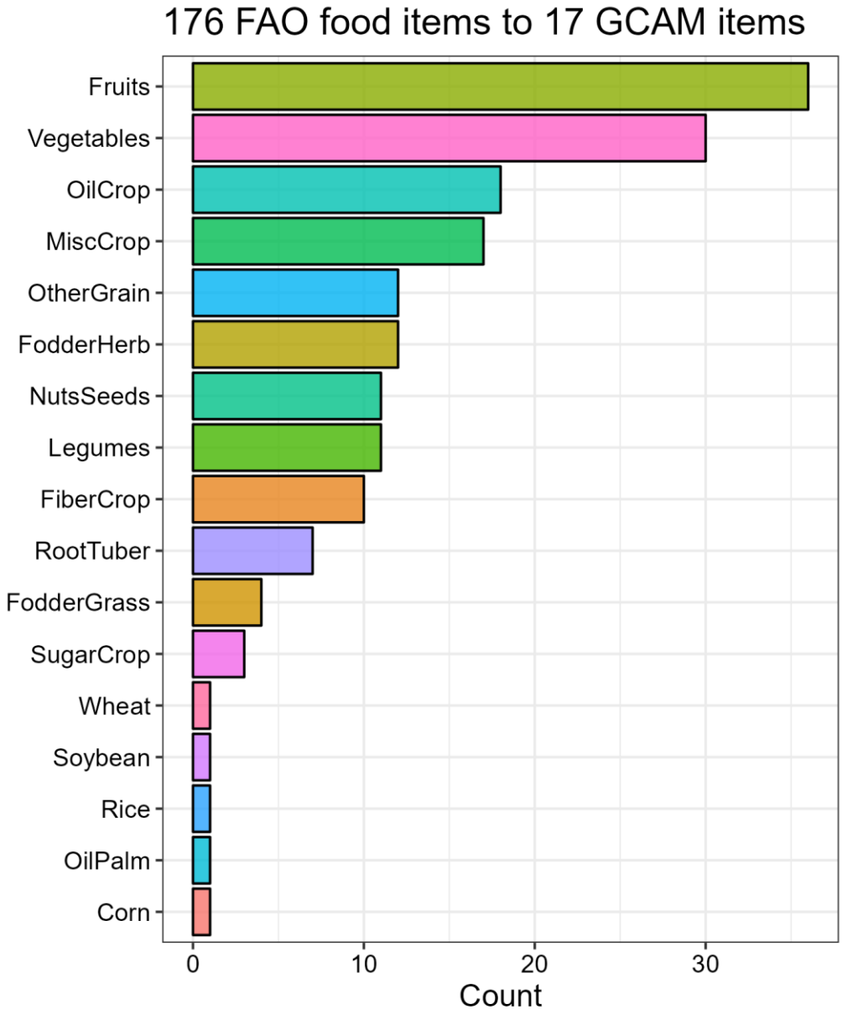


Source: FAOSTAT and *gcamfaostat*

Land (harvested area): 176 FAO crops by hectares

World harvested area (2010 – 2019):
Mean = 1570 million hectares





Source: FAOSTAT and *gcamfaostat*

Challenges in connecting land to food

- Primary land-based output is usually further processed
- Models do not include the full processing chain

- Supply utilization accounting (food balance sheet):

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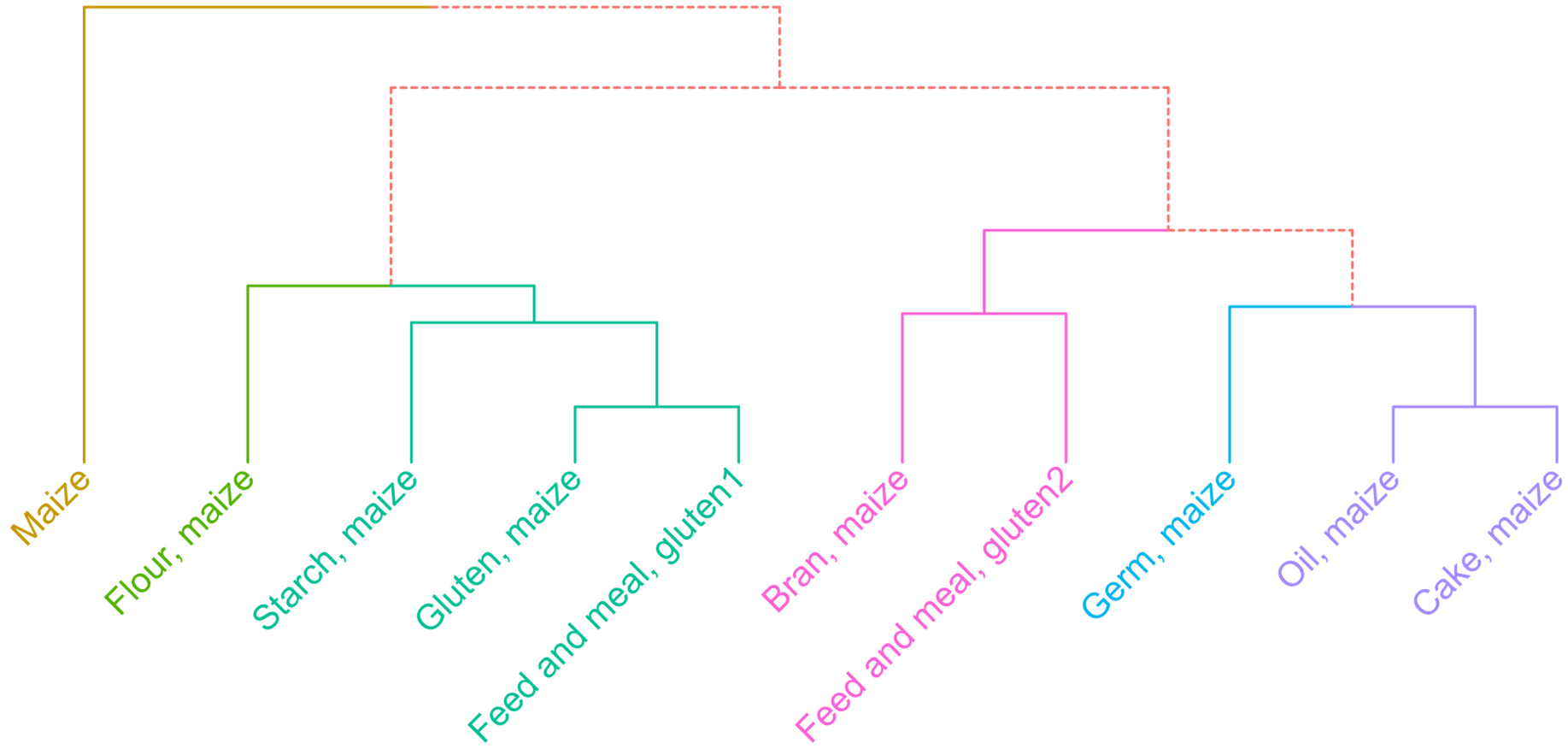
- Supply utilization accounting (food balance sheet):

Maize example:
Showing the depth of agri-food sectors



- Supply utilization account (SUA) balances for all commodities

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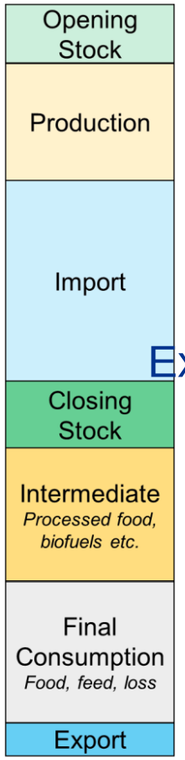
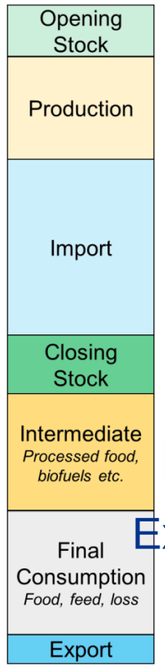
Vertical aggregation: Primary Commodity Equivalent

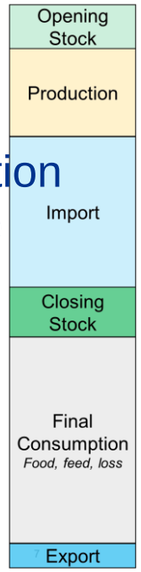


Extraction rate



Maize

Extraction rate



Starch
Gluten
Etc.

Flour
Germ
Bran

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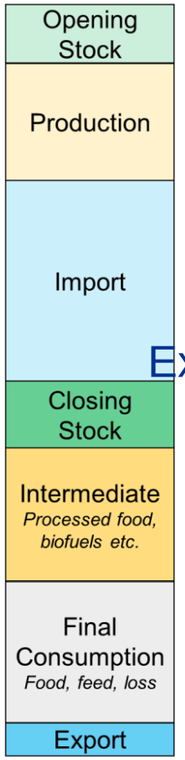
Vertical aggregation: Primary Commodity Equivalent

- Consistency:
  - Space
  - Time
  - Supply - Utilization
- Preserve:
  - Yield
  - Macronutrients



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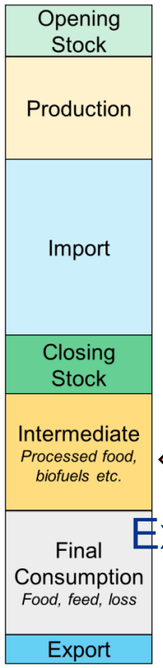

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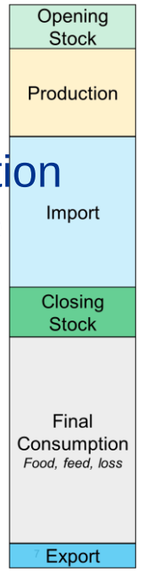
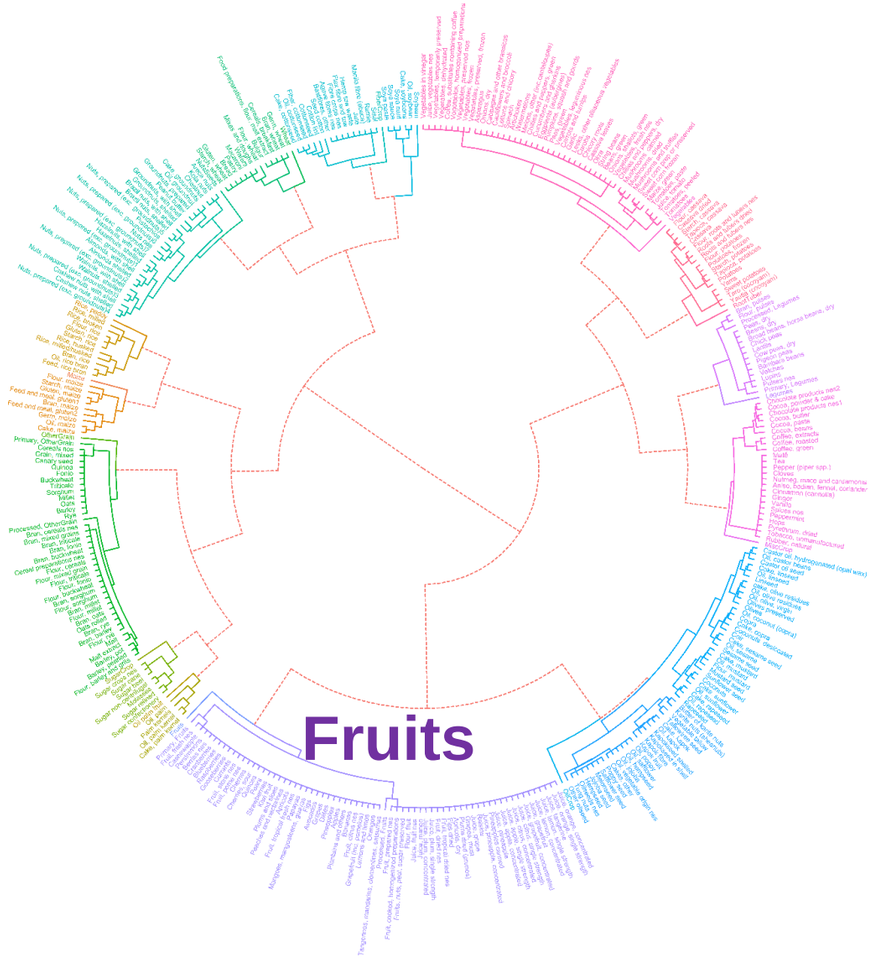
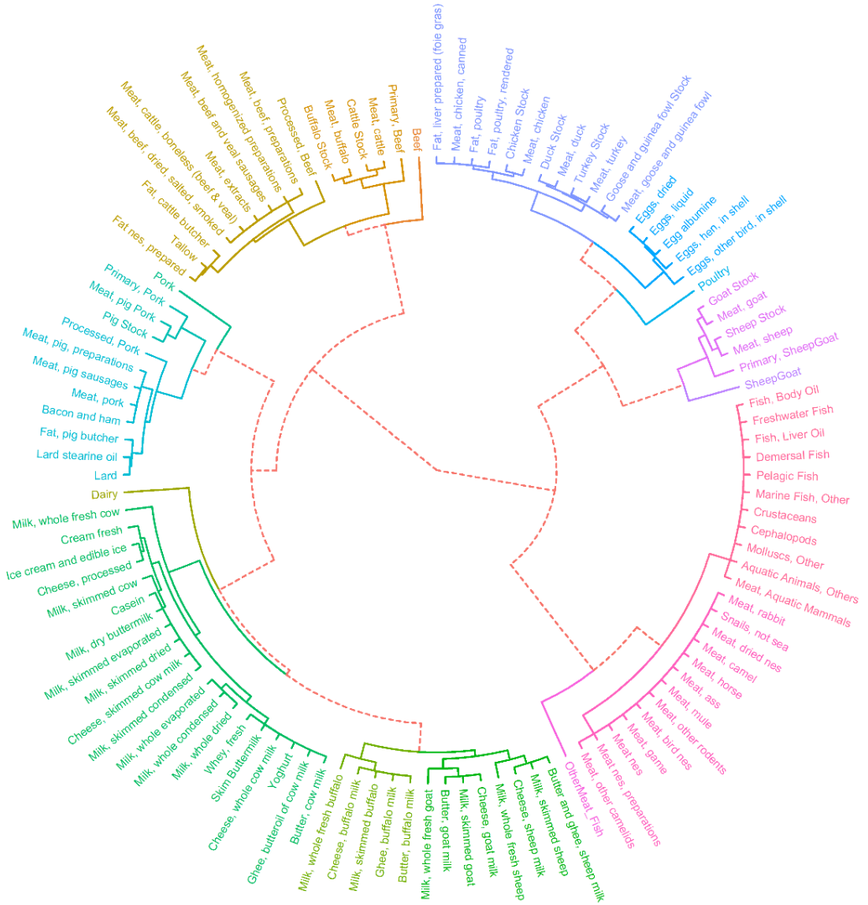


Food balance sheets: Nested mapping structure

17 GCAM crop commodities



6 GCAM livestock commodities



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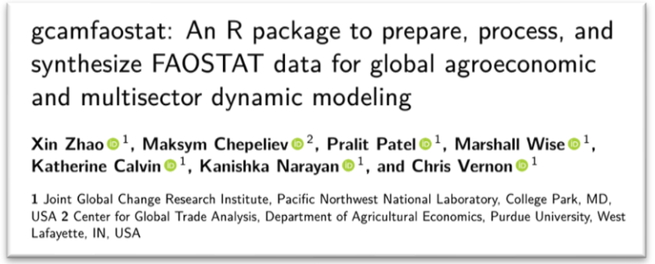
Summary

- Representing food systems is important and data talk!
- We developed a primary commodity equivalent approach that allows aggregating agriculture and food commodities along the supply chain
  - Transparent, reproducible, consistent, and flexible


gcamfaostat: An R package to prepare, process, and synthesize FAOSTAT data for global agroeconomic and multisector dynamic modeling

Xin Zhao [1], Maksym Chepeliev [2], Pralit Patel [1], Marshall Wise [1], Katherine Calvin [1], Kanishka Narayan [1], and Chris Vernon [1]

1 Joint Global Change Research Institute, Pacific Northwest National Laboratory, College Park, MD, USA 2 Center for Global Trade Analysis, Department of Agricultural Economics, Purdue University, West Lafayette, IN, USA

- Bridges the gap between agricultural inputs (e.g., land) and final consumptions (e.g., food)
  - Enhances data quality and scientific robustness in multisector global economic modeling
  - Enables further disaggregation of additional commodities and processing sectors
  - Accounts for **storage** and trade in secondary products
- Food is more than calories
  - Macronutrients (protein and fat) & micronutrients
- Improves the tracing of monetary and physical flows along supply chains
  - Value-added (labor & capital)
  - Energy, water, nutrients, waste, emissions, etc.

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We acknowledge the support from the U.S. Department of Energy, Office of Science, as part of research in the Multi-Sector Dynamics, Earth and Environmental System Modeling Program

Thank you

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