SIMPLE-W

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IAM Water Challenges

- Water variability and uncertainty

- Water quality and in-stream services

- Significant small scale heterogeneity of supply, demand, policies and institutions

- Imperfect and missing markets

Where to go?

- Choose key water IAM question and pursue it by developing a model that:
  - is not overly complex at the outset (thus allowing us to explore benefits and costs of complexity and informing research needs); and
  - Builds on/contributes to the community modeling portfolio
- The IAM water question: adequacy of water supplies to meet future agricultural water demands
- The platform: Add water and corresponding allocation mechanism in the Hertel & Baldos SIMPLE model

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

- A global static partial equilibrium model of agricultural supply, demand, prices, and land use

- Initially developed to test (like many other models) whether the agricultural resource base (land) could meet future demands given climate change, environmental constraint, plausible technological change, etc.

SIMPLE

- SIMPLE is intended to be complex enough to be useful (capture key socio-economic, technological, and policy drivers of cropland)
- But...SIMPLE is simple enough to be validated against stylized historical facts and to perform interesting experiments
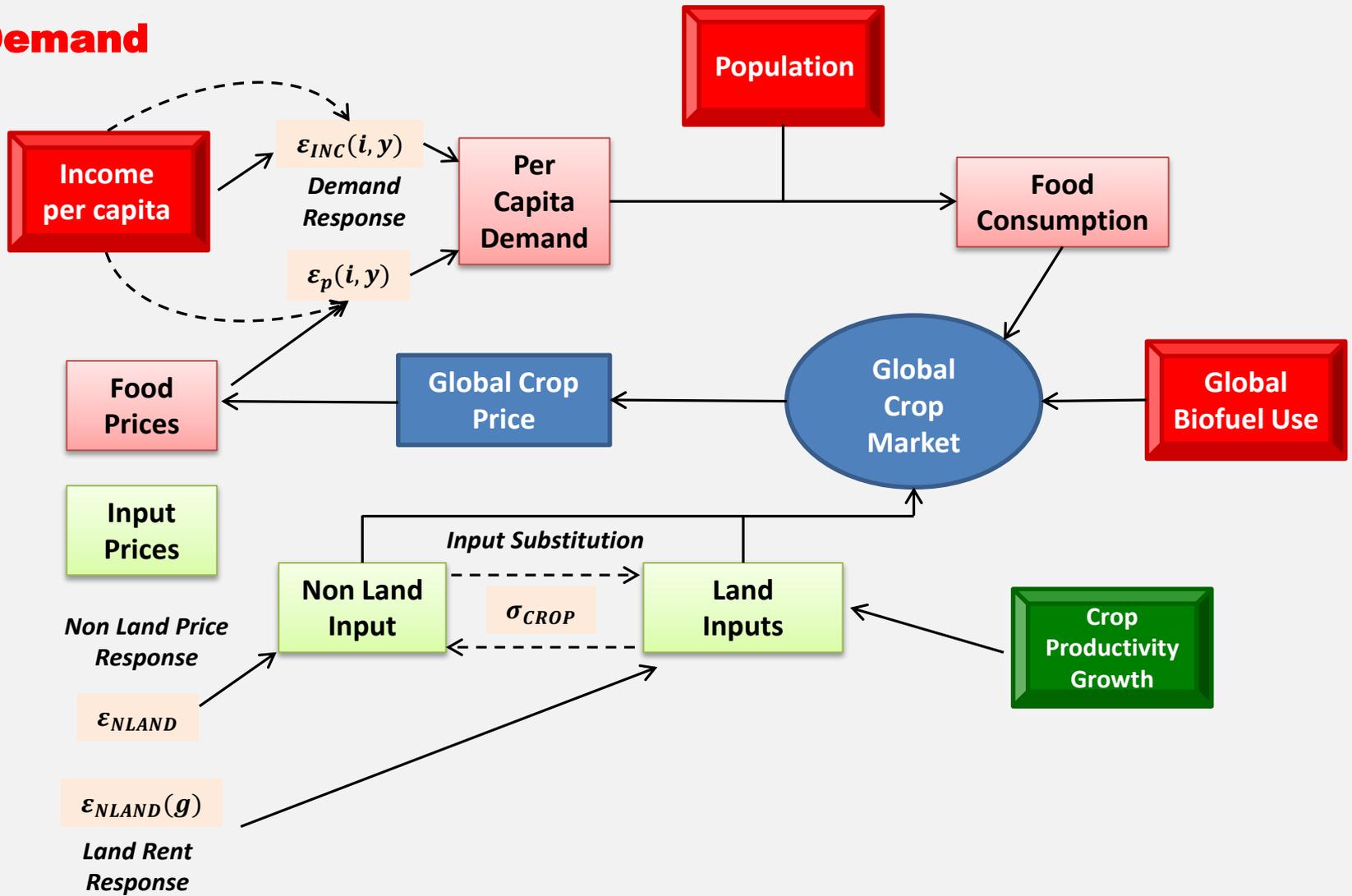
SIMPLE

- 4 crops, livestock, processed food and non-food
- 7 continental scale production regions
- Crops produced using land and non-land inputs
  - Water is embedded in land
- Land and non-land inputs inelastic in supply to agriculture
- Livestock (Processed food) produced using crop as feed input (food input) and non-crop inputs
- Final demand in 5 income classes
- Consumers' demand function of own price and consumer's income level

Production Regions

- East Asia and Pacific
- Europe and Central Asia
- Latin America and Caribbean
- Middle East and North Africa
- North America
- South Asia
- Sub-Saharan Africa

SIMPLE Validation and Illustrative Applications

- Baldos & Hertel (2013) validated the model on 1961-2006

- Baldos and Hertel (2014), Lobell, Baldos & Hertel (2013) explore impacts of climate change, adaptation investments, urbanization, agricultural GHG emissions

- Value of SIMPLE is not prediction but

  – Demonstrating role of economic responses in commodity and input demands

 – Understanding and evaluating the effects parameters

We like SIMPLE but…

- Water might pose an even stronger challenge to global agriculture and food availability as compared to land use

- Agriculture accounts for around 70% of global freshwater withdrawals

- Water demand is from competing sources is increasing rapidly 2000 and 2050.
  - Manufacturing (+400%),
  - Electricity (+140%)
  - Domestic use (+130%)

- Number of people living in river basins under severe water stress projected to reach 3.9 billion by 2050, totaling over 40% of the world's population

Adding Water to SIMPLE: "Easy Parts"

- Add explicit water inputs in agriculture, and water demands from non-agricultural sources
- Crop production function
  - 2 level nested-CES production function for crops
  - Land and water are inputs in production of a composite LW
  - LW and non-LW inputs used to produce final crop output
- Water excluded as an input from processed food and livestock sector, just like land was excluded.
- Land market remains the same
- Residential, manufacturing and hydropower demand aggregated as non-crop water demand
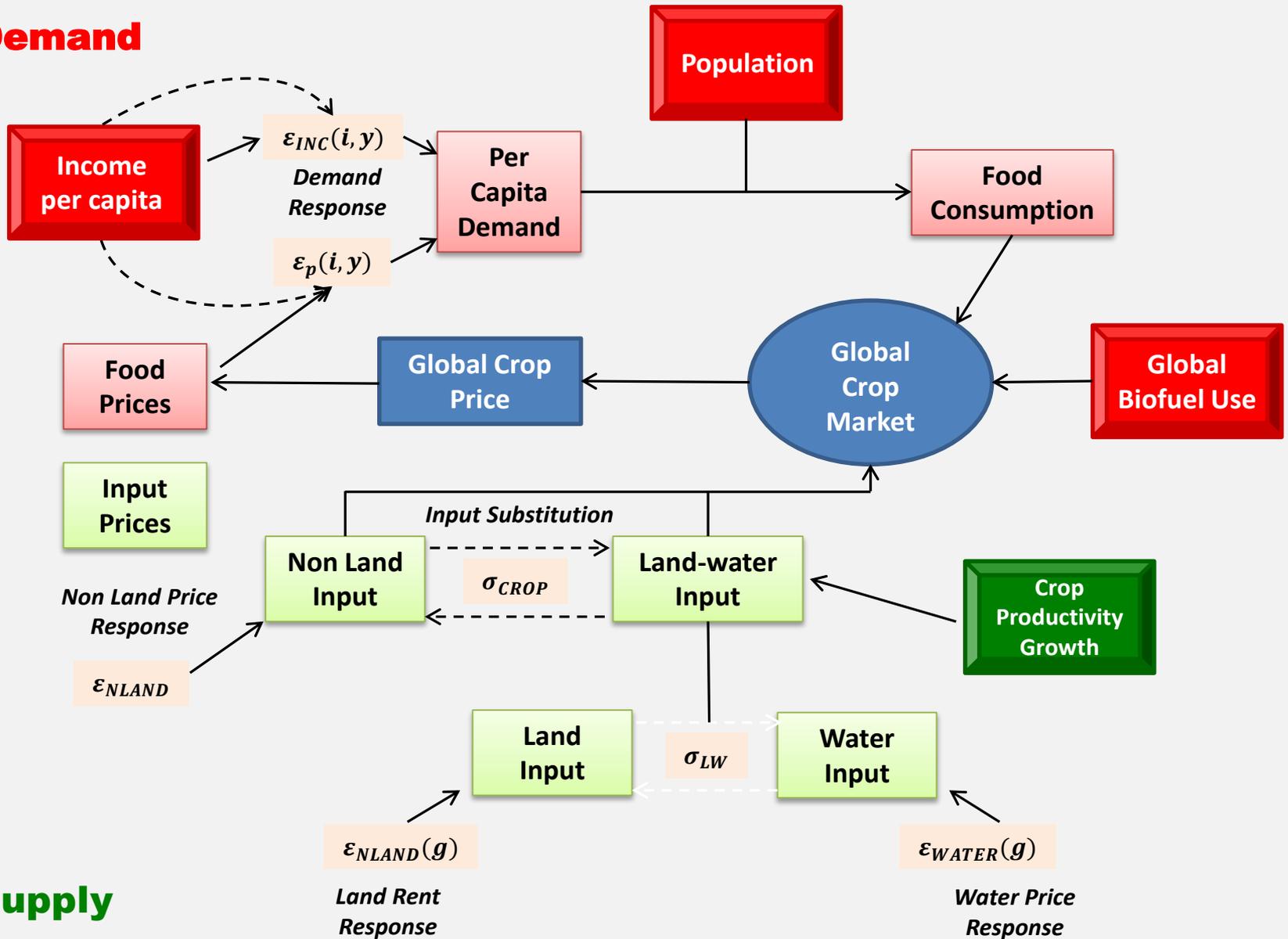
Adding to Simple: "Harder Parts"

- Water Supply, Allocation Mechanisms, and Institutional Adaptation

- Aggregate water supply
  - natural and managed elements

- Water allocation
  - Institutions vary within and across regions and by water types
  - Perfectly competitive markets is not a good assumption

Adding to Simple: "Harder Parts"

- Options
  - Perfectly competitive markets with tax/subsidy distortions
  - Administrative allocation (quotas)
  - Open access
  - Mixtures (e.g. variations between sectors and types ground/surface water)
- Institutional Adaptation in response to increasing scarcity

Water pricing

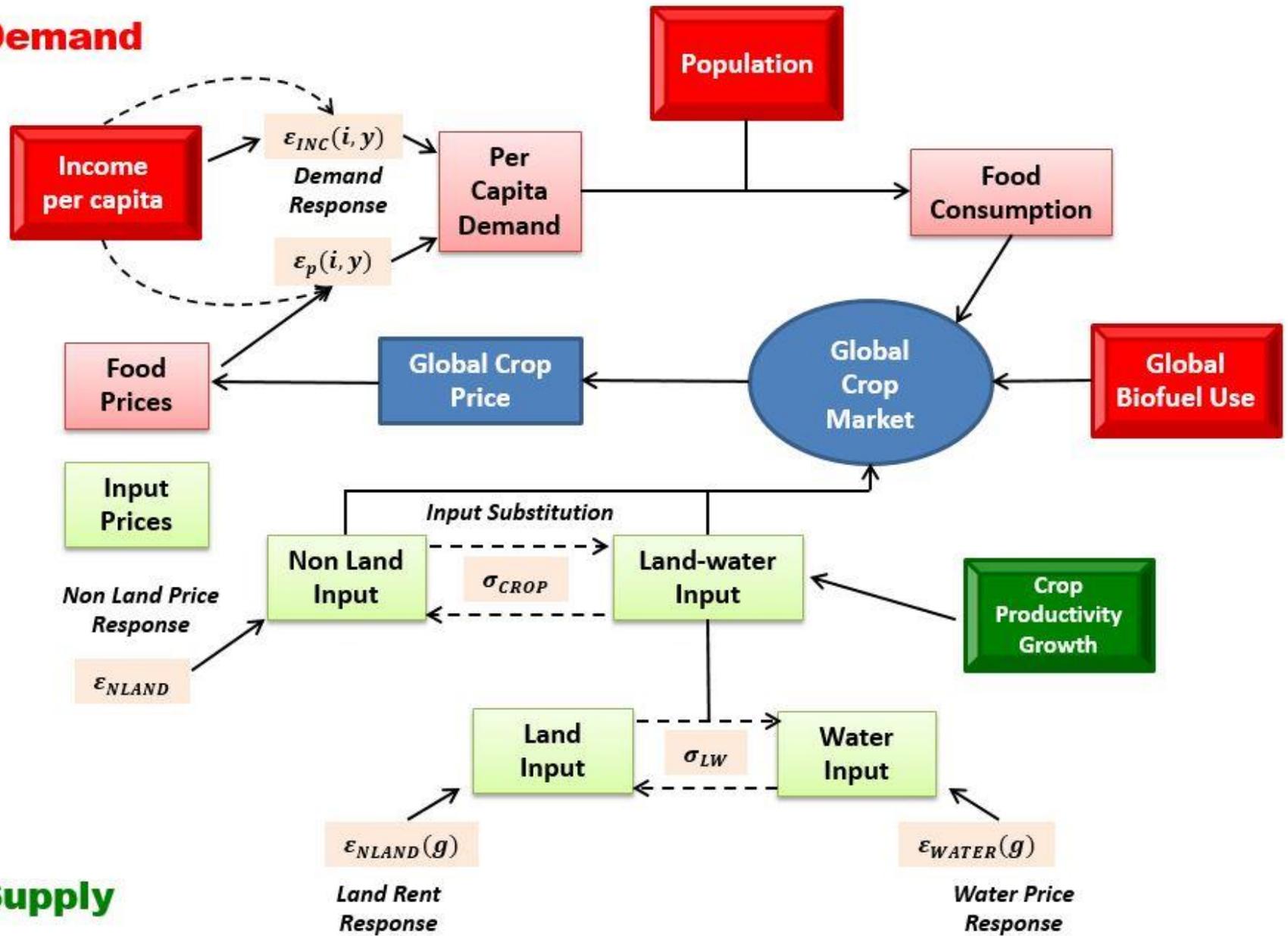## OECD estimates of prices for water by broad sector usage

OECD nation	Household water supply	Industrial and commercial	Irrigation and agriculture	Average price of water supply
Netherlands	3.16	1.08	1.44	1.89
France	3.11	0.95	0.08	1.38
Greece	1.14	1.14	0.05	0.78
Spain	1.07	1.08	0.05	0.73
USA	1.25	0.51	0.05	0.6
United Kingdom	2.28	1.68	0.02	1.33
Australia	1.64	1.64	0.02	1.1
Portugal	1	1.26	0.02	0.76
Turkey	1.51	1.68	0.01	1.07
Canada	0.7	1.59	0.01	0.77

Source: The United Nations World Water Development Report 2014, pp. 73.
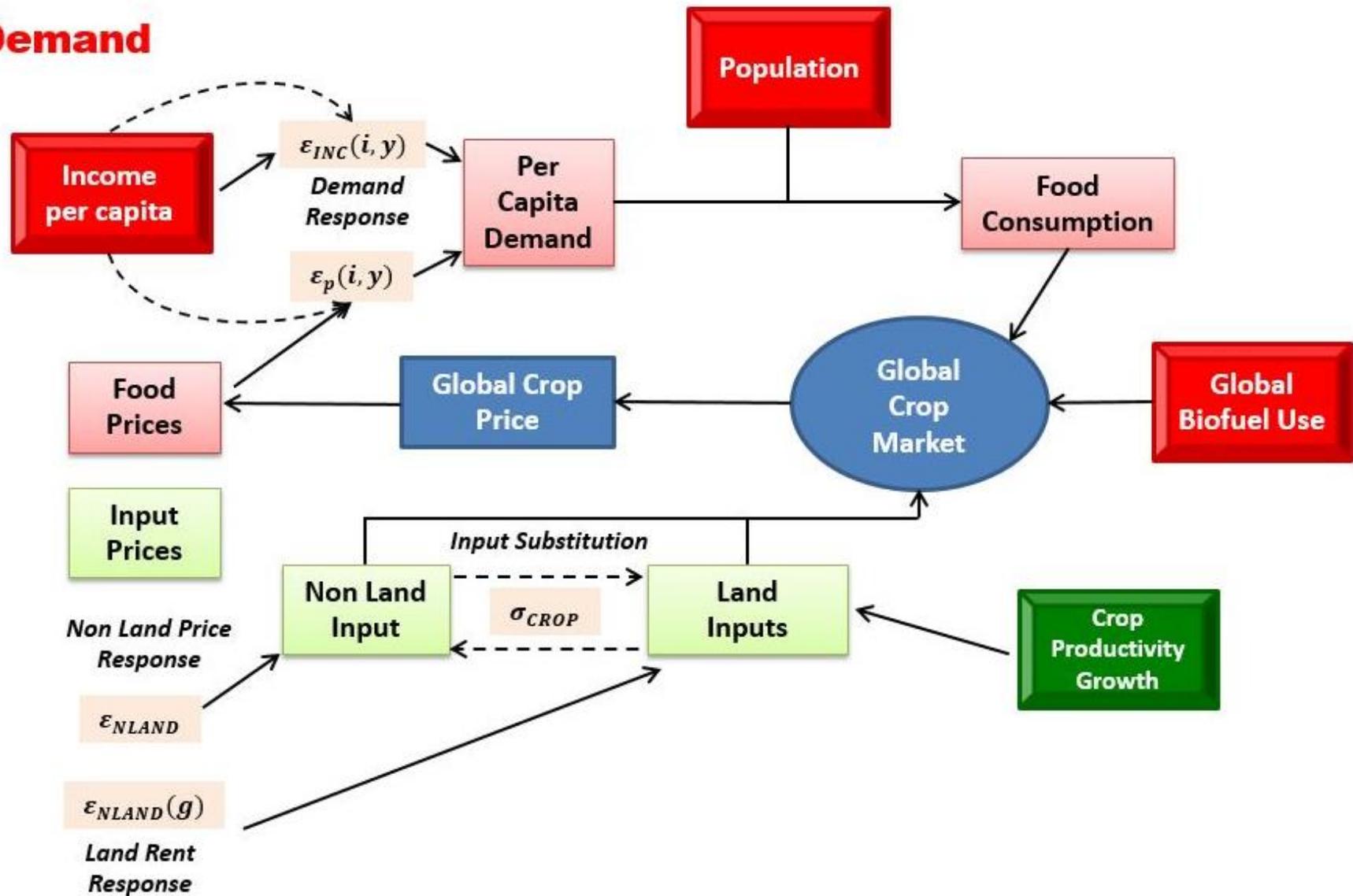
Adding Water to Simple: Harder Parts

- Data
  - GTAP-BIO-W uses the same regions as SIMPLE and have a water database

- Validation
  - What stylized facts?