

# Towards sustainable food system in China: transformation options and their connections to the food-land-water-climate nexus

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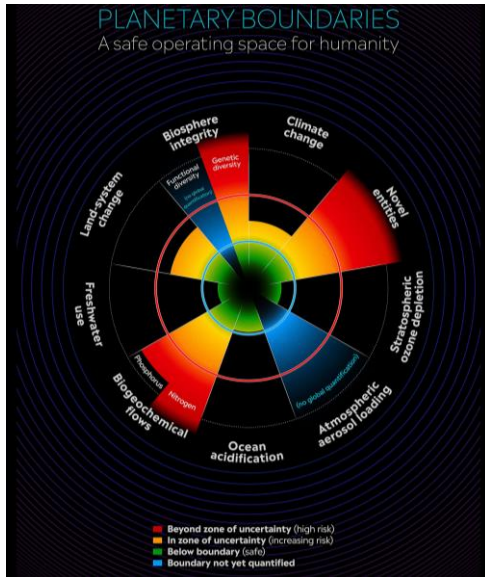
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# Food system transformation is critical for respecting PBs and achieving SDGs

## Planetary boundaries (PBs)



## Sustainable Development Goals (SDGs)

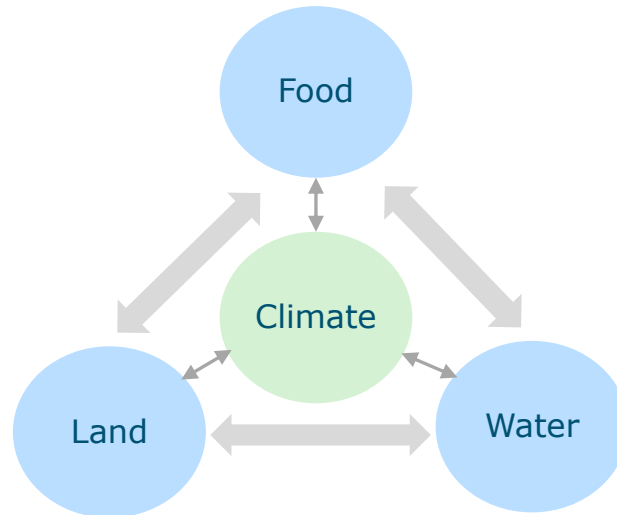


# Problem statement

- Food, land, water, and climate have, in the past, often been treated as individual and disconnected sectors (Johnson et al., 2019).
- Pathways and measures to achieve one or more specific PBs/SDGs may cause trade-offs or unexpected changes for other PBs/SDGs and/or for other sectors/regions in our society.
- It remains unclear how solutions to one PB/SDG affect other PBs/SDGs in the food-land-water-climate nexus.

# Central research questions

- What are the environmental and economic impacts of food transformation options?
- How will these options cause trade-offs and synergies in the food-land-water-climate nexus?



# An integrated environmental-economic framework based on applied general equilibrium (AGE) models

- **Database:**

- 1) GTAP version 10 database (2014 as the base year)
- 2) Region- and sector-specific environmental impact database



Global Trade Analysis Project

- **Regions:** China and its main food and feed trading partners (MTP, including Brazil, the United States, and Canada)
- **Sectors:** Detailed food-related sectors and aggregated non-food sector

# PhD research outline



- Dietary structure change
- Cleaner cereals production
- Emission restriction policy

## 1. Theoretical framework & application

## 2. Supply-side option

- Upcycling food waste as feed in monogastric livestock

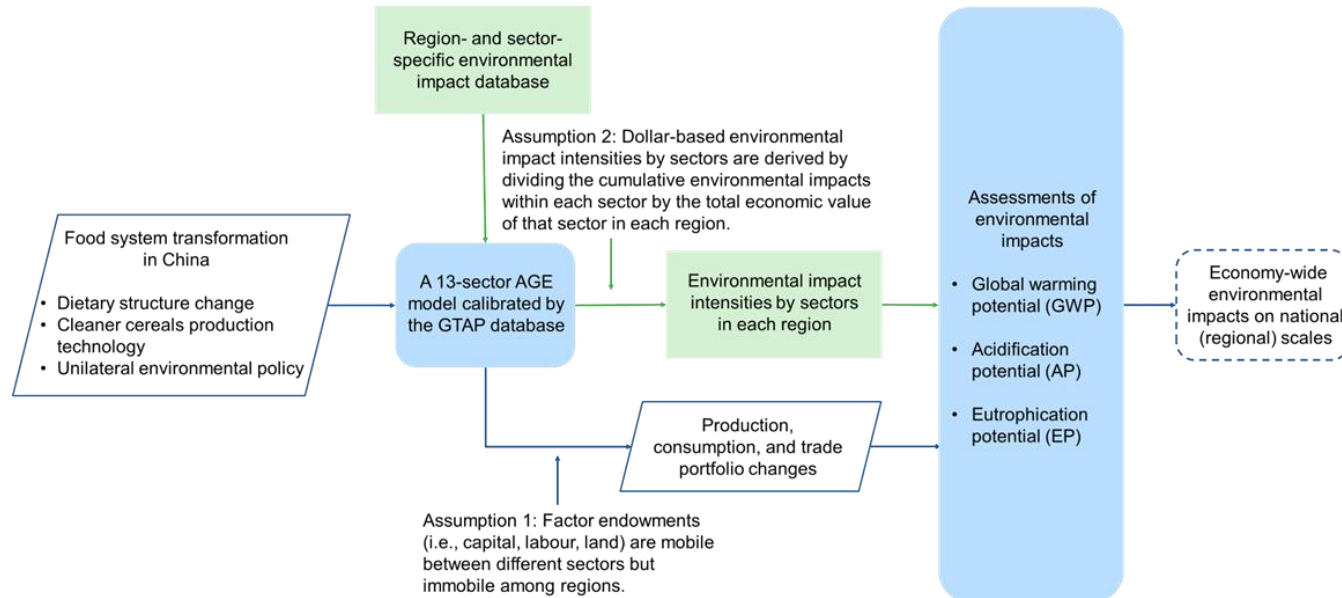
## 3. Supply- & demand-side options

## 4. Supply- & demand-side options

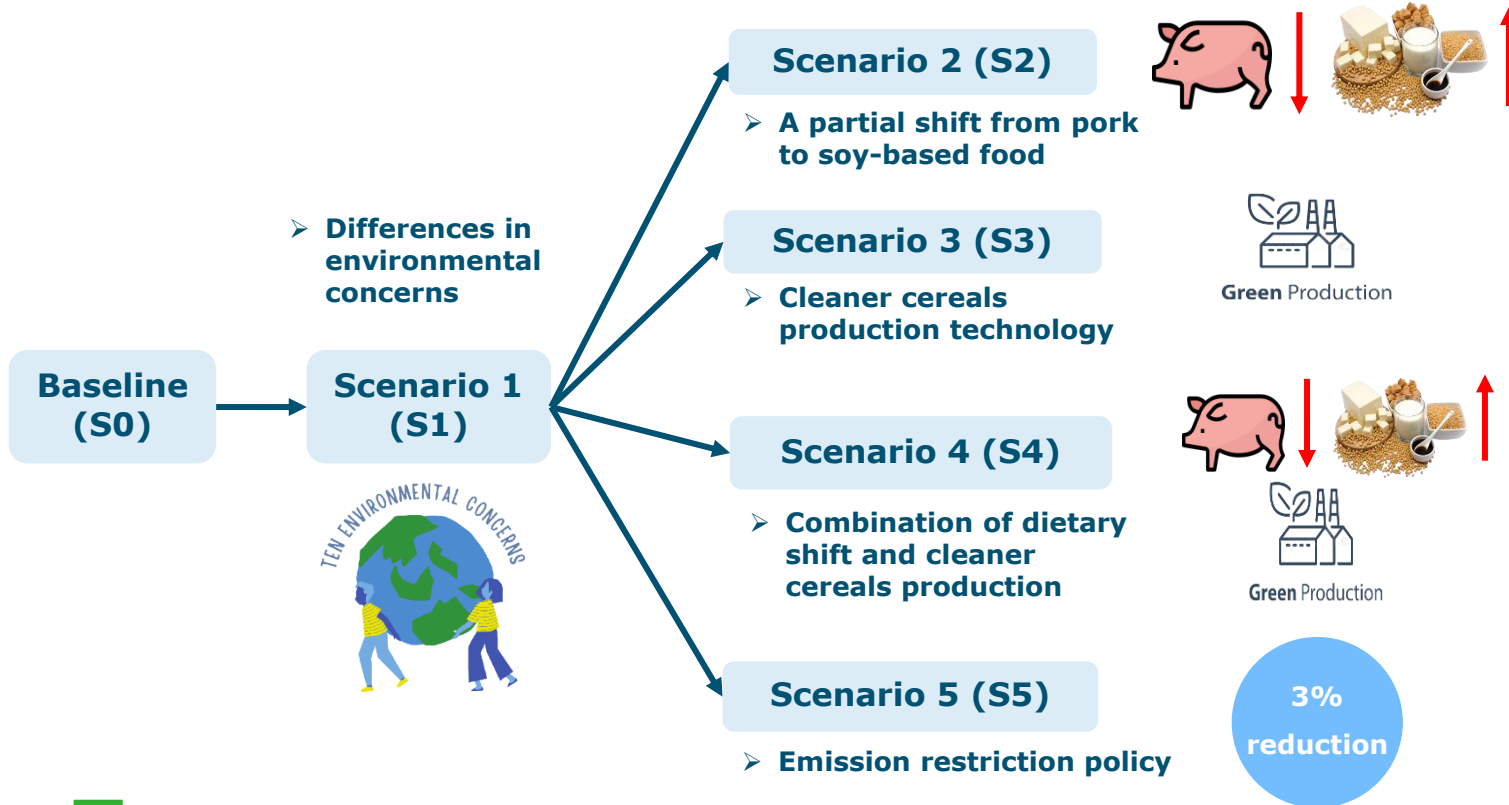
- Combing crop and livestock supply-side as well as demand-side measures

- Combining food, land, water, and climate scenarios

# Paper 1: Exploring sustainable food system transformation options in China: An integrated environmental-economic modelling approach based on the applied general equilibrium framework

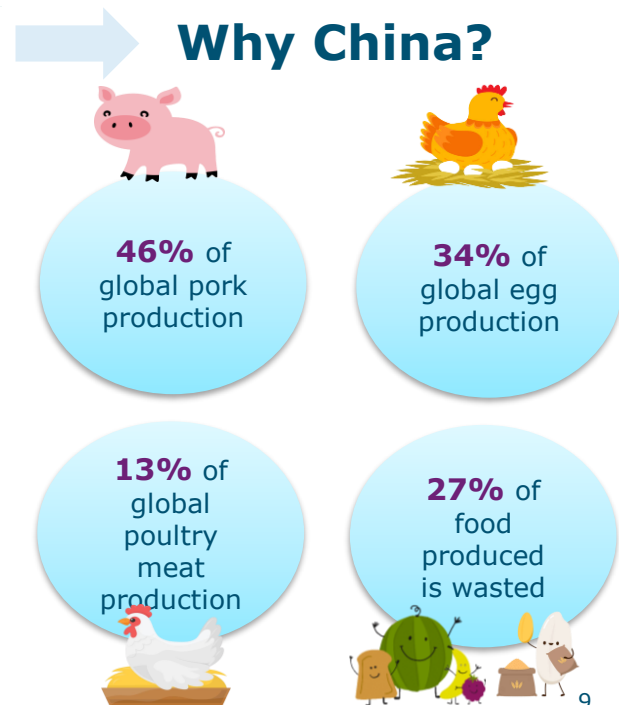
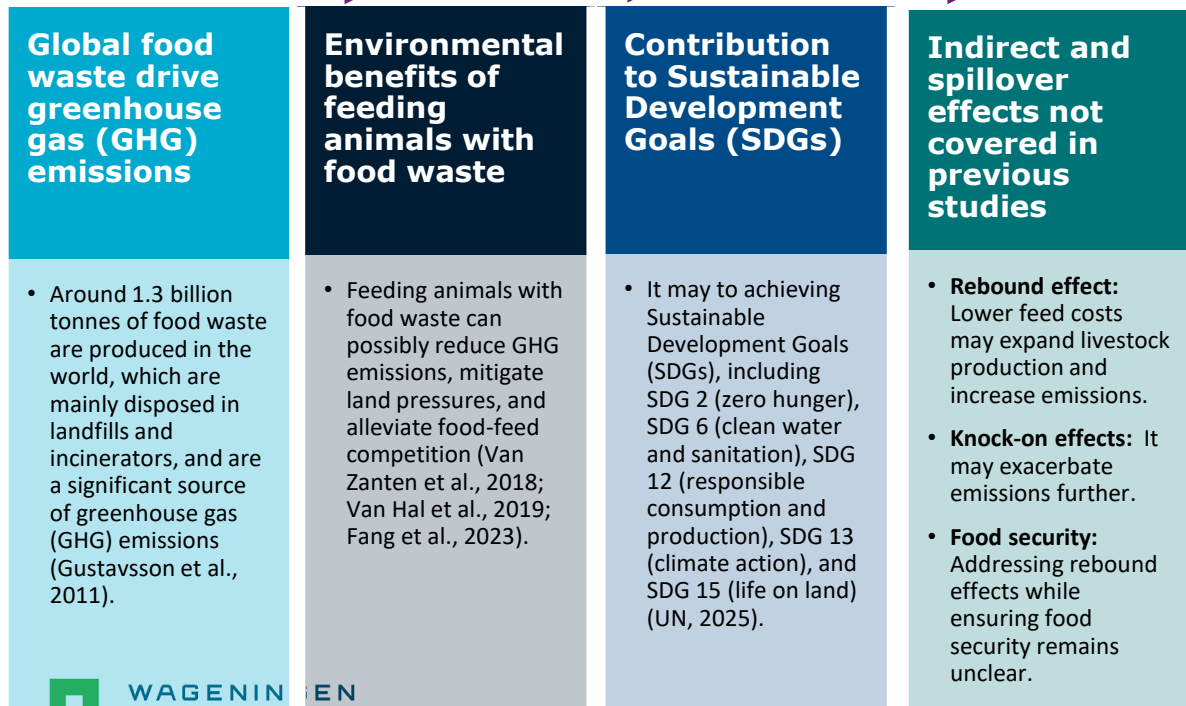


# Scenarios of paper 1

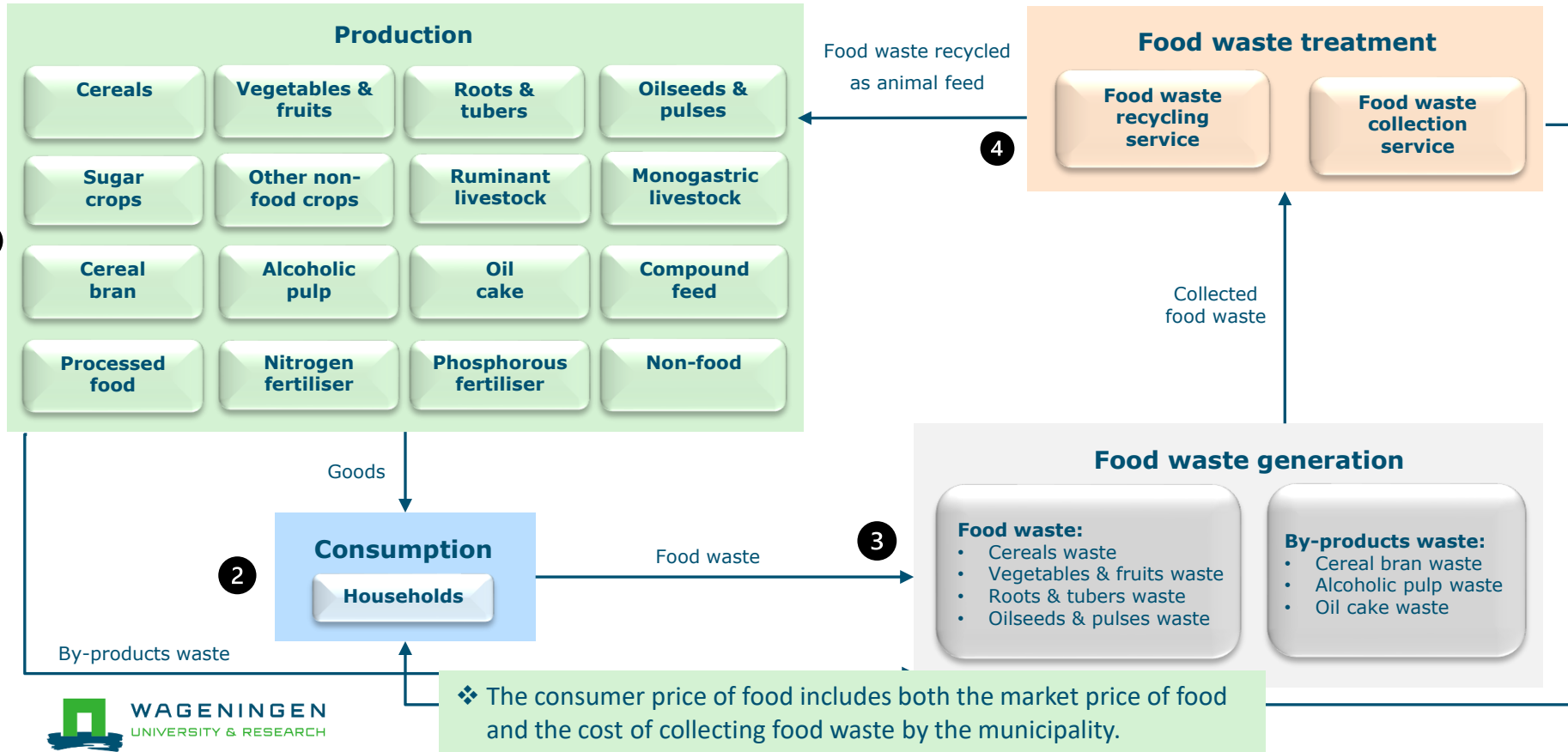




# Paper 2: A modest mitigation target could address rebound effects of upcycling food waste as feed in China while safeguarding global food security



# Applied general equilibrium models with food waste



# Scenarios of paper 2

Scenarios	Food waste as feed	Emission mitigation target
<b>S1: Partial use of food waste as feed</b>	Food waste: 54% By-products: 100%	No
<b>S2: Full use of food waste as feed</b>	Food waste: 100% By-products: 100%	No
<b>S3: S1 + A modest emission mitigation target</b>	Food waste: 54% By-products: 100%	Implementing economy-wide emission taxes to ensure that emissions of greenhouse gases, acidification pollutants, and eutrophication pollutants in both China and its trading partners do not exceed their baseline (S0) levels.
<b>S4: S1 + An ambitious emission mitigation target</b>	Food waste: 54% By-products: 100%	Implementing economy-wide emission taxes to meet their annual mitigation target of the Intended Nationally Determined Contributions (INDC) under the Paris Agreement and the "13th Five-Year Plan".

# Paper 3: Food system transformation is key to achieving food security and environmental sustainability in China

Scenarios	Descriptions
<b>S1: Crop supply-side option</b>	<ul style="list-style-type: none"><li>Improving crop production efficiency through Integrated Soil-crop System Management technology (ISSM).</li></ul>
<b>S2: Livestock supply-side option</b>	<ul style="list-style-type: none"><li>Upcycling food waste as feed in monogastric livestock production.</li></ul>
<b>S3: Demand-side option</b>	<ul style="list-style-type: none"><li>Shifting towards less meat-intensive diets based on the EAT-Lancet diet recommendation.</li></ul>
<b>S4: S1+S2+S3</b>	<ul style="list-style-type: none"><li>Combining crop and livestock supply-side as well as demand-side measures.</li></ul>

# Paper 4: Exploring transformation options in the food-land-water-climate nexus: towards achieving multiple SDGs in China

Scenarios	Descriptions
<b>Food scenario</b>	Shifting towards less meat-intensive diets based on the EAT-Lancet diet recommendation in line with SDG 2 (zero hunger).
<b>Land scenario</b>	An afforestation policy based on China's National Forest Management Plan (2016–2050) in line with SDG 15 (life on land).
<b>Climate scenario</b>	A carbon tax in line with the Paris Agreement as well as the PB on climate change and SDG13 (climate action).
<b>Water scenario</b>	Improving crop production efficiency up to the levels of developed countries in line with SDG 6 (clean water and sanitation).
<b>Combined scenario</b>	Combining food, land, water, and climate scenarios.