

Ensuring Food Security in China: The Transformation to Green and Low-Carbon Agrifood Systems

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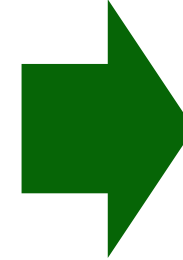
March 20, 2025



Food & nutrition security



Agrifood systems



- Rural Development
- Farmer livelihood

Resources and environmental boundary

Green and Low-carbon Agrifood systems

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Food security status in China **What**

02

Multiple challenges **Why**

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Transformation strategies **How**

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1.1 Food and nutrition status in the World

- The global situation of hunger and various forms of malnutrition remains much higher than before the outbreak of the pandemic
- *The State of Food Security and Nutrition in the World 2024:*
 - People affected by hunger is approximately 713 to 757 million (1/11)
 - 2.33 billion people facing moderate or severe food insecurity (3/11)
 - 2.8 billion people cannot afford healthy diets by 2022 (6.3% high-income vs 71.5% low-income countries)

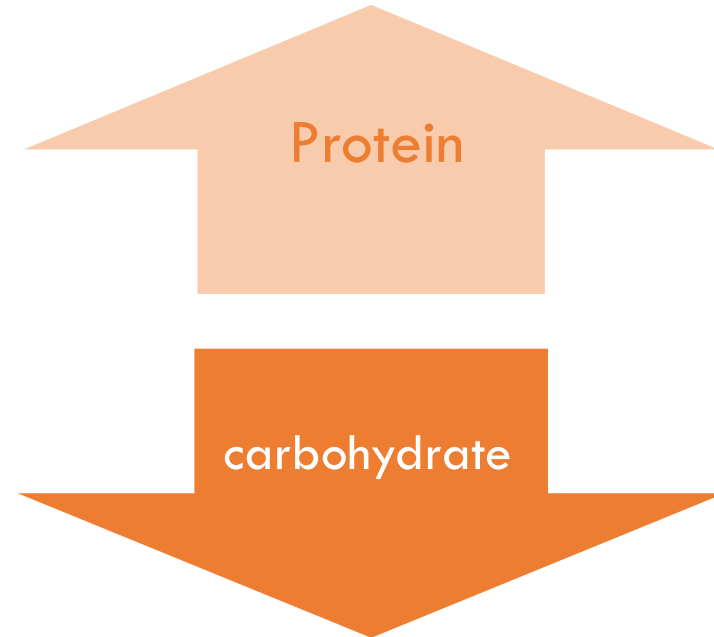


1.2 Food security in China: food demands

1.4 Billion Population
Daily food intake

Trends of food needs

700K ton Grain	100K ton Oil
2M ton Veg	200K ton Meat



Quantity

Structure

1.3 Food security in China: food supply

- Remarkable progress in poverty reduction and social development was achieved through rapid and substantial economic transformations over the past decades.
- China’s grain output reached 650 billion kilograms in 2015 and has maintained a stable level. Per capita grain output is more than 20% higher than the FAO’s food security standard of 400 kg.
- Notable progress in the quality and composition of the diets (AGFEP, 2021).

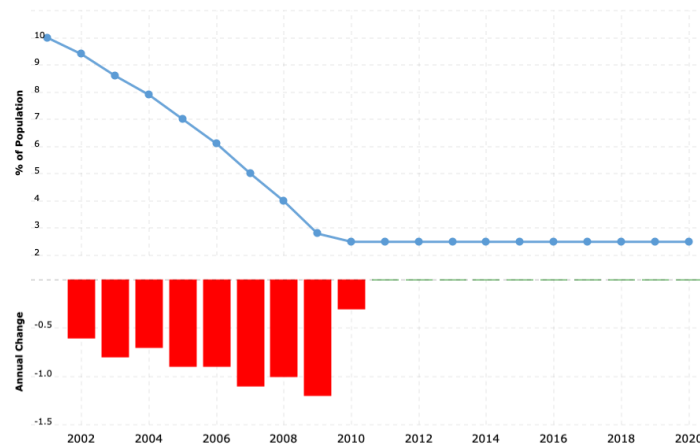


Fig. China Hunger Statistics
Source: Macrotrends

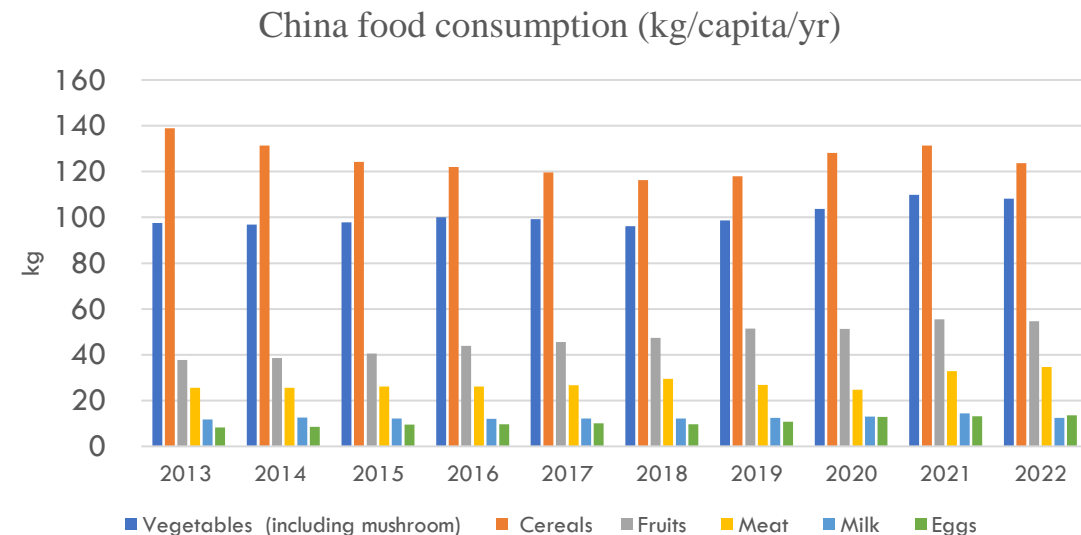
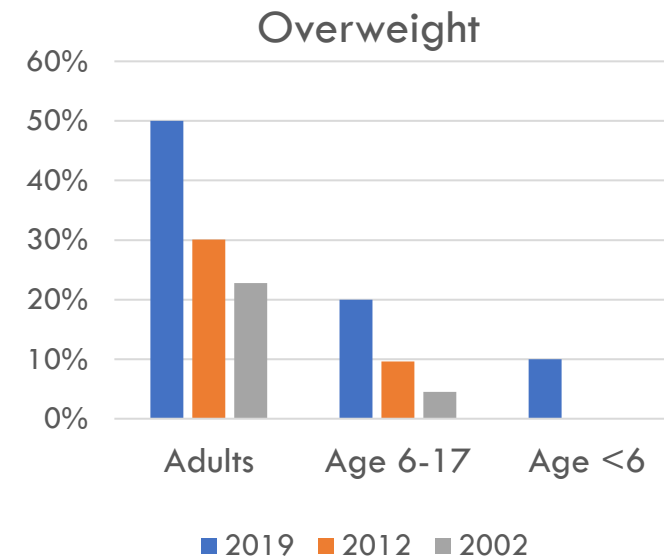
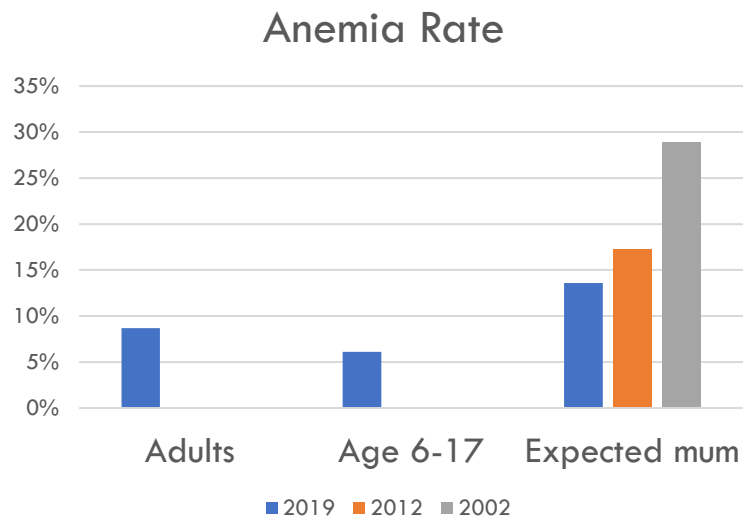


Fig. Food consumption per capita in China
Source: National Bureau of Statistics of China

- China is suffering from the double burden of malnutrition (Meng & Fan, 2023).
 - Micronutrient deficiency, including vitamin A, calcium, and omega-3 fatty acids (Chinese Nutrition Society, 2021).
 - More than half of Chinese adults in 2020 were overweight or obese, as well as 10% and 19% of children and teenagers, respectively (China CDC, 2020).



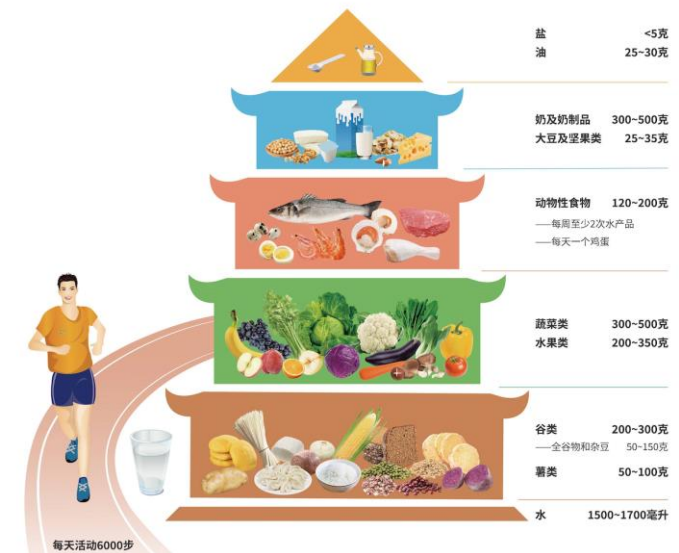
Source: National Health Commission Bureau of Disease Control and Prevention.

Demand side: demographic change and diets

- **Population:** is projected to peak in 2030
- **Structure:** the share over the age of 65 is expected to increase to more than 30% by 2050
- **GDP per capita:** \$21482.6
- **Urbanization:** 64% in China
- **Diets:** transitioning from staple foods, to vegetable- and animal-based fats, and energy-dense, highly processed foods



中国居民平衡膳食宝塔 (2022)



Supply side: land, water, labor and tech

	Feature
Water resources	<ul style="list-style-type: none"> • 2,100 m³ per capita • 28% of the world average
Arable land	0.08 Ha per capita
Cropping seasons	Single or double cropping seasons
In general	<ul style="list-style-type: none"> • 6 % of water resources • 7% of arable land • 18% of population

✓ Labor

Smallholder farmers account for 90% and cultivate over 70 percent of arable land (the third agricultural census, 2020)

✓ Productivity

From 2001 to 2015, China's TFP grew at an average rate of 3.5 percent per year, twice the global average.

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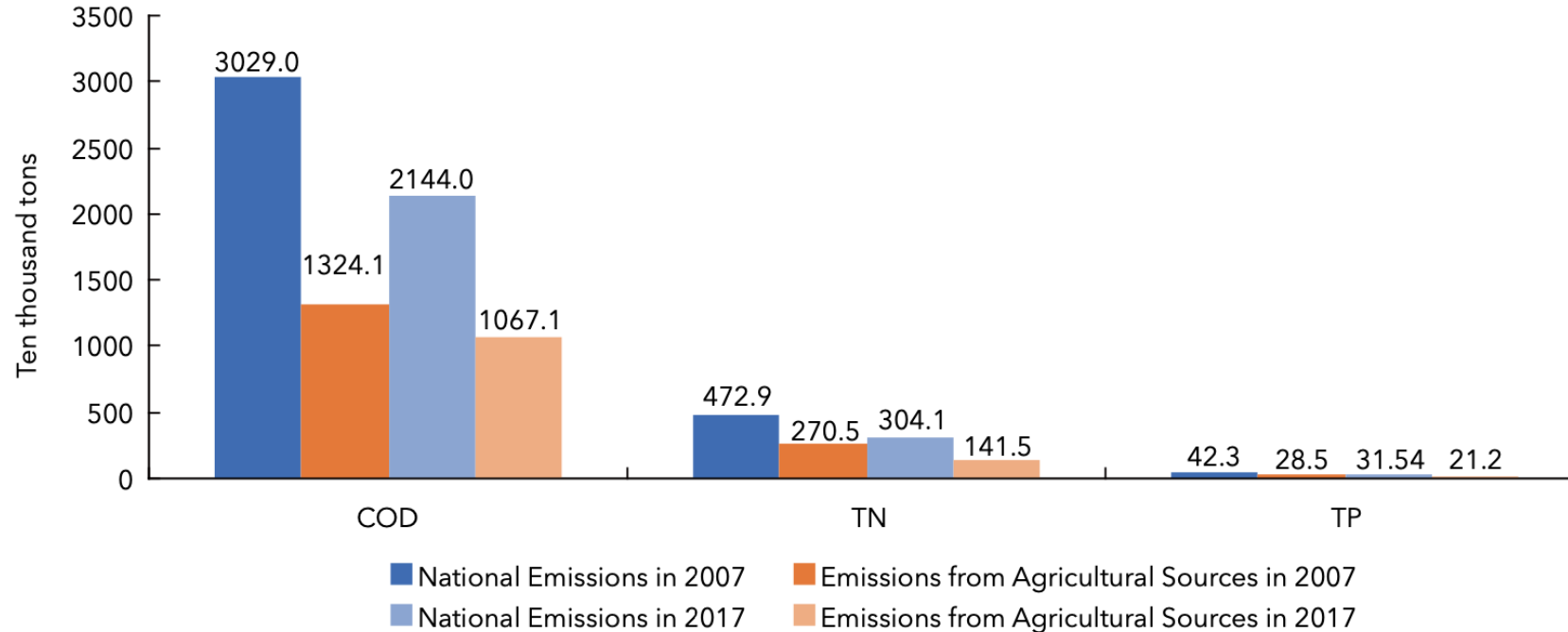


(Fan et al., 2021)

Global promotion of transformation

- **Health** : improving the availability of healthy and nutritious foods
- **Sustainability** : enhancing future food supply capacity
- **Efficiency** : improving food accessibility
- **Resilience** : ensuring a stable supply
- **Inclusiveness** : achieving nutritious food for all

Figure 4.1 Total water pollutant discharge and agricultural-source discharge, 2007 and 2017



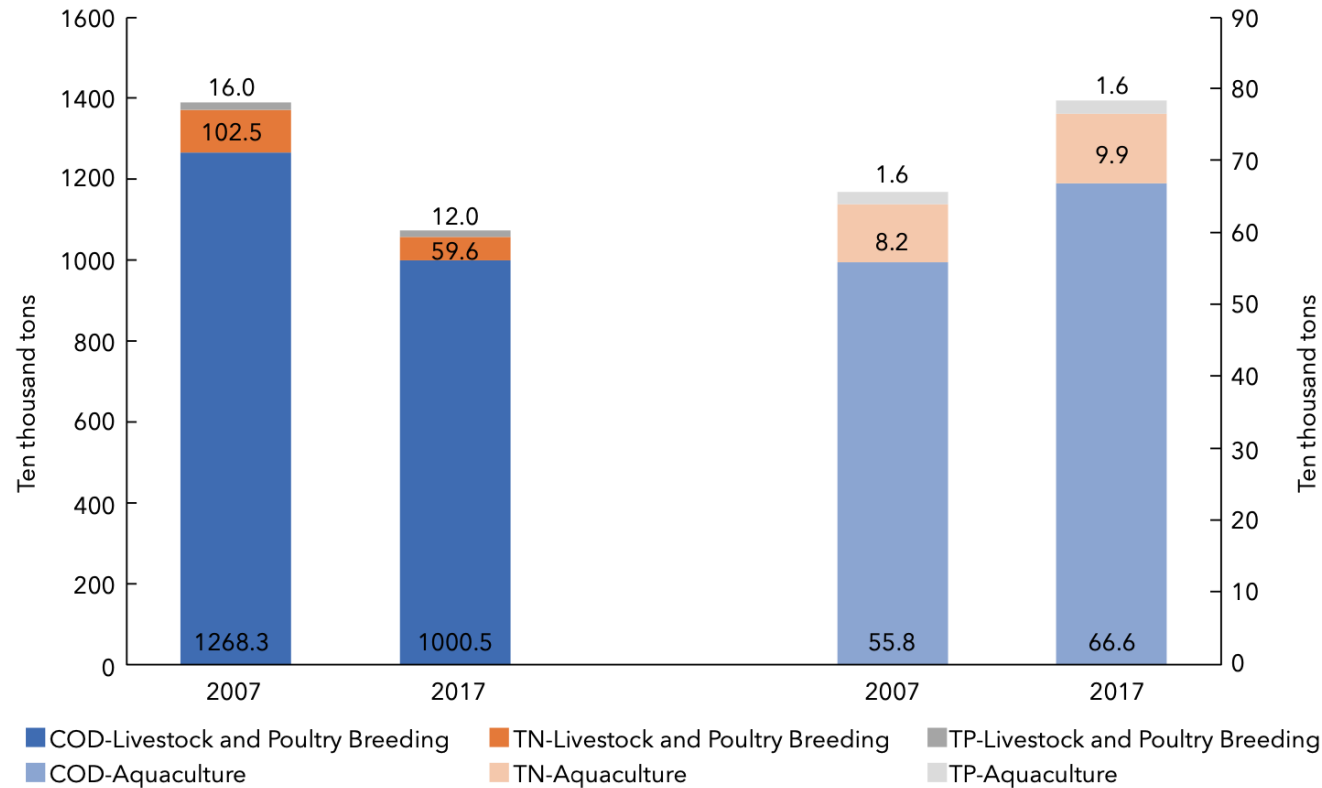
Land degradation:
Two-thirds of farmland in China are considered as low or medium quality.

Source: China, Ministry of Agriculture and Rural Affairs, Ministry of Ecology and Environment, and National Bureau of Statistics (2020); China, Ministry of Environmental Protection, State Statistics Bureau, and Ministry of Agriculture (2010).

Note: COD = chemical oxygen demand; TN = total nitrogen; TP = total phosphorus.

(1) Animal farming pollution

Figure 4.2 Pollutant discharge from livestock, poultry, and aquaculture, 2007 and 2017

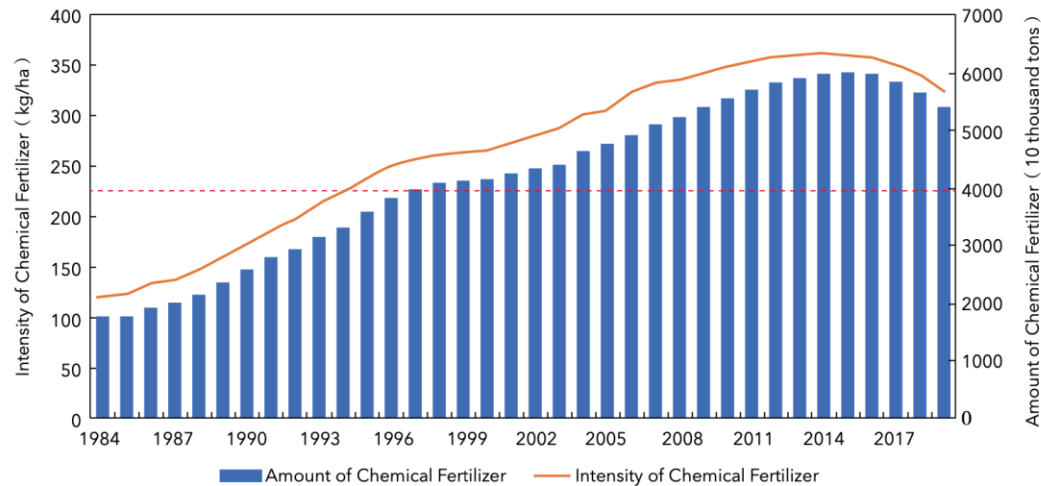


Animal farming sectors take a large share of pollution

Source: China, Ministry of Agriculture and Rural Affairs, Ministry of Ecology and Environment, and National Bureau of Statistics (2020); China, Ministry of Environmental Protection, State Statistics Bureau, and Ministry of Agriculture (2010).

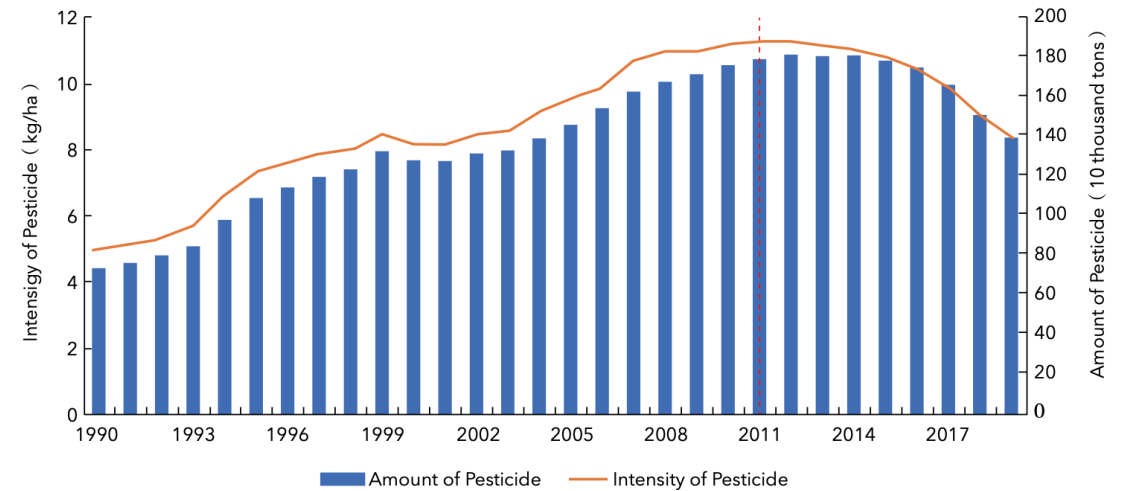
Note: COD = chemical oxygen demand; TN = total nitrogen; TP = total phosphorus.

Figure 4.3 Application amount and intensity of chemical fertilizers in China, 1984-2019



Source: China Statistics Press (various years).

Figure 4.4 Pesticide use and intensity in China, 1990-2019



Source: China Statistics Press (various years).

- Chemical fertilizers and pesticides have been reduced since 2015
- However, the levels are still higher than the world average.

2.3 Climate change



Climate patterns



- **Precipitation:** northern less rainfall, southern and southwestern more (OECD, 2018).
- **Warming:** the regional mean over China will exceed the global average, about 1.63 °C and 2.24 °C in 1.5 °C and 2.0 °C warmer futures (Zhang et al., 2020).

Impact



- **Yield and TFP:** wheat yield is projected to decline by 9.4% by 2050 (Xie et al., 2020). Extreme hot weather has decreased agricultural TFP by 2.6% (Chen and Gong, 2021).
- **Drought:** 8 percent by 2030 in rice, wheat and corn yields losses.
- **Livestock:** increase in temperature will decrease both net revenue and net revenue per livestock, while the precipitation increment will increase livestock production (Feng et al., 2021).
- **Marine:** half of the marine species will have at least one-fourth of their habitats no longer suitable in the 2050s (Ma et al., 2023).



- The red and blue lines represent the mean values of crop production changes under RCP 8.5 and 2.6, respectively
- The red and blue shaded areas represent the uncertainty of crop production changes under RCP 8.5 and 2.6, respectively

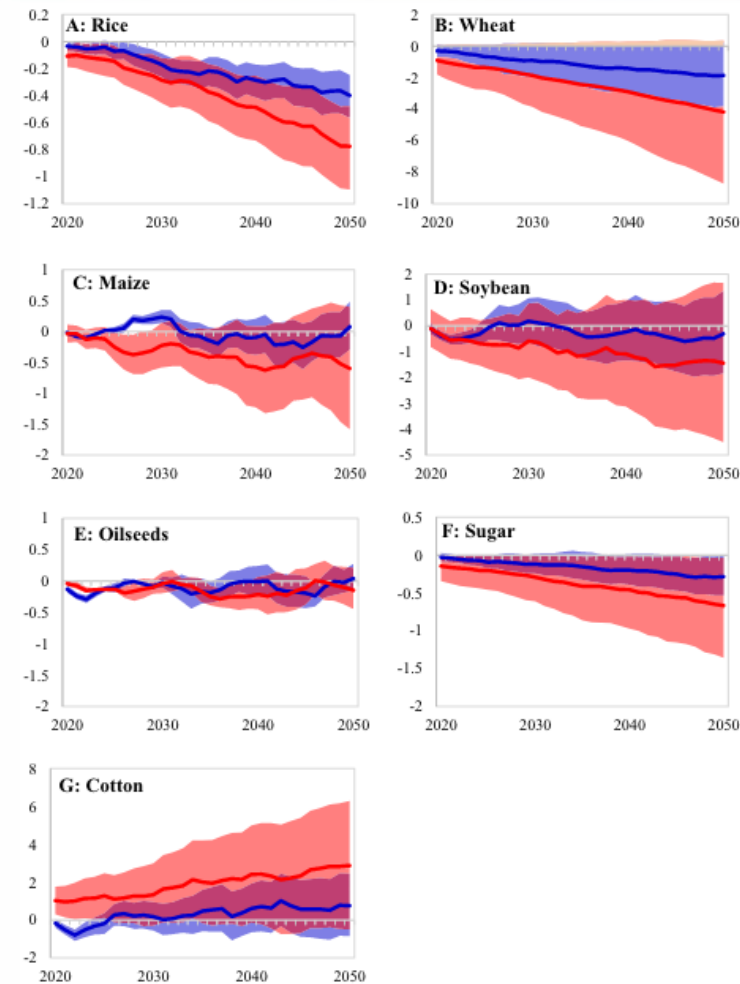
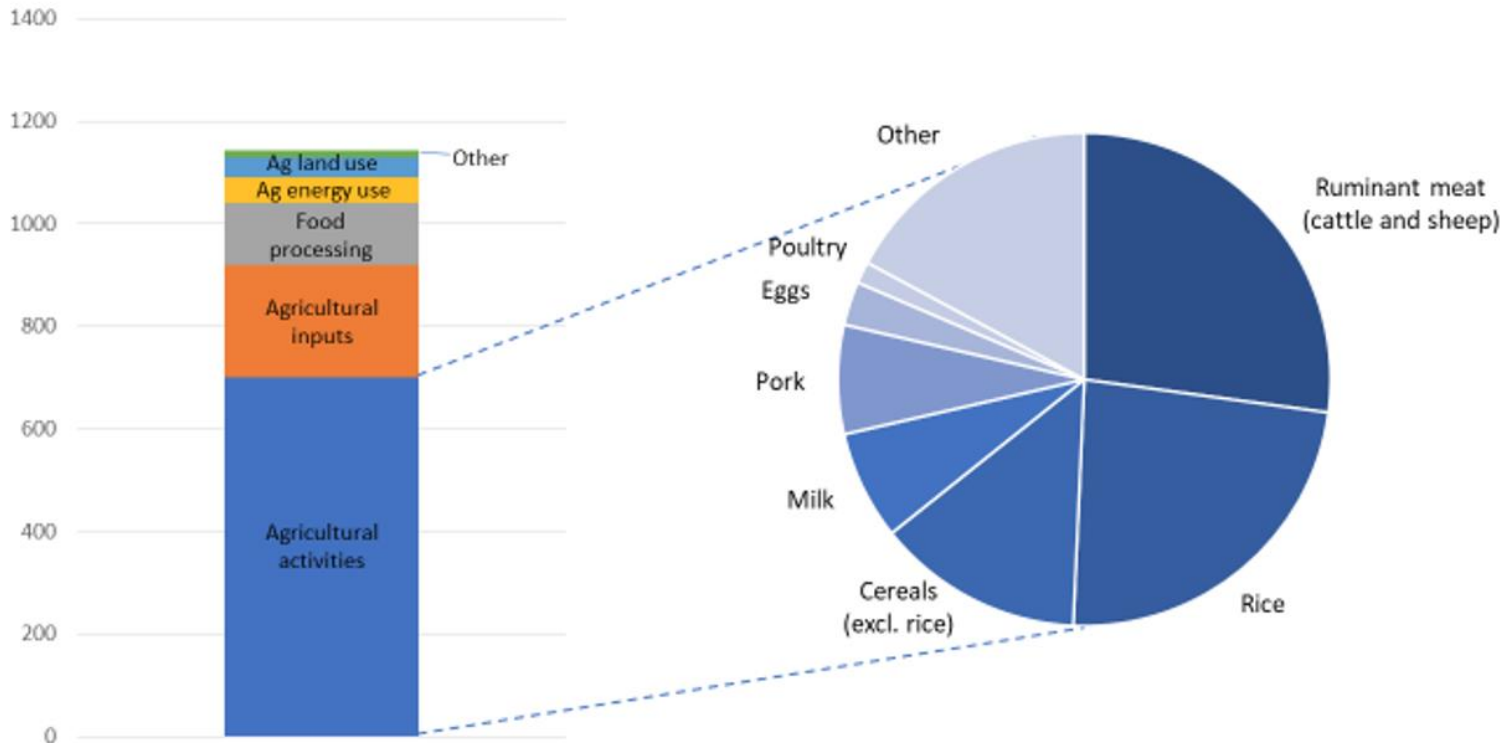


Fig. The uncertainty of climate change impacts on China's crop production (%)
(Cui et al., 2022)

2.4 Greenhouse gas emissions

Figure 1. Greenhouse gas emissions from China’s agrifood system (2017)

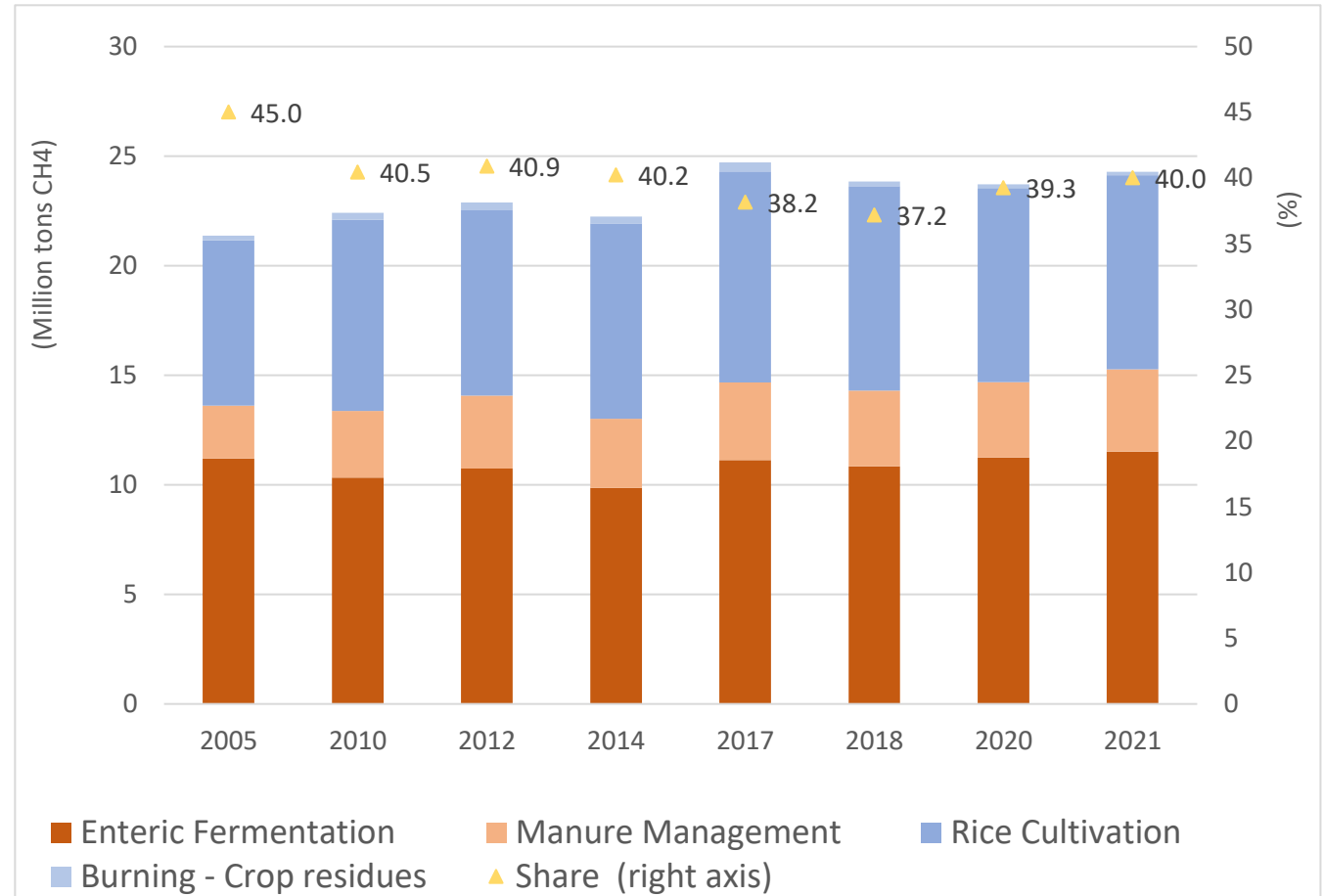
Million metric tons of CO₂e



- In 2021, China’s GHG emissions reached 14.3 billion tons
- Agrifood systems’ share in nationwide total GHG emissions **continuously declined**, from 17.5% to 12.2%, during 2005–2021
- GHG emissions from agrifood systems increased from 1.24 billion tons in 2005 to 1.59 billion tons in 2021

Source: AGFEP, CARD, CIFA, IAED, and IFPRI. 2021. *2021 China and Global Food Policy Report*, Beijing: China.

- China accounts for 1/5 of global methane emissions (Khanna et al., 2024)
- Methane is the most important component of agricultural greenhouse gases (accounting for nearly 3/4)
 - Rice cultivation (36.5%) and enteric fermentation (47.4%)



Methane emissions from agricultural activities in China, 2005–2021

2.5 Relevant Policies

- ***GHG emissions from the global agrifood systems are 31% of the total GHG emissions.***
- ***Emissions from agrifood systems are already enough to increase the global temperature by 1.5 °C***
- **GHG emission reduction in agrifood systems has been placed on the international agenda**
 - **COP28** first time highlighted the role of agrifood systems in addressing climate change. China also signed the on Sustainable Agriculture, Resilient Food Systems, and Climate Action.
 - FAO has developed a Global Roadmap to reduce the carbon emissions of the agri-food system by 25% compared to 2020 levels by 2030, achieve carbon neutrality in the agrifood systems by 2035, and transform the agri-food sector into a net carbon sink by 2050 (FAO, 2023).
- **Chinese government has taken actions for carbon emission reduction and sequestration in agriculture and rural area**
 - The government has made Action Plan for Peak Carbon by 2030 and carbon neutrality by 2060
 - The Ministry of Agriculture and Rural Affairs (MARA) and the National Development and Reform Commission (NDRC) have made the action Plan for carbon emission reduction and sequestration in agriculture and rural areas.

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3.1 Huge Potential of Reduction in China

➤ GHG emissions from China's agrifood systems will increase by 7.7% in 2030 compared to 2020 under the baseline scenario

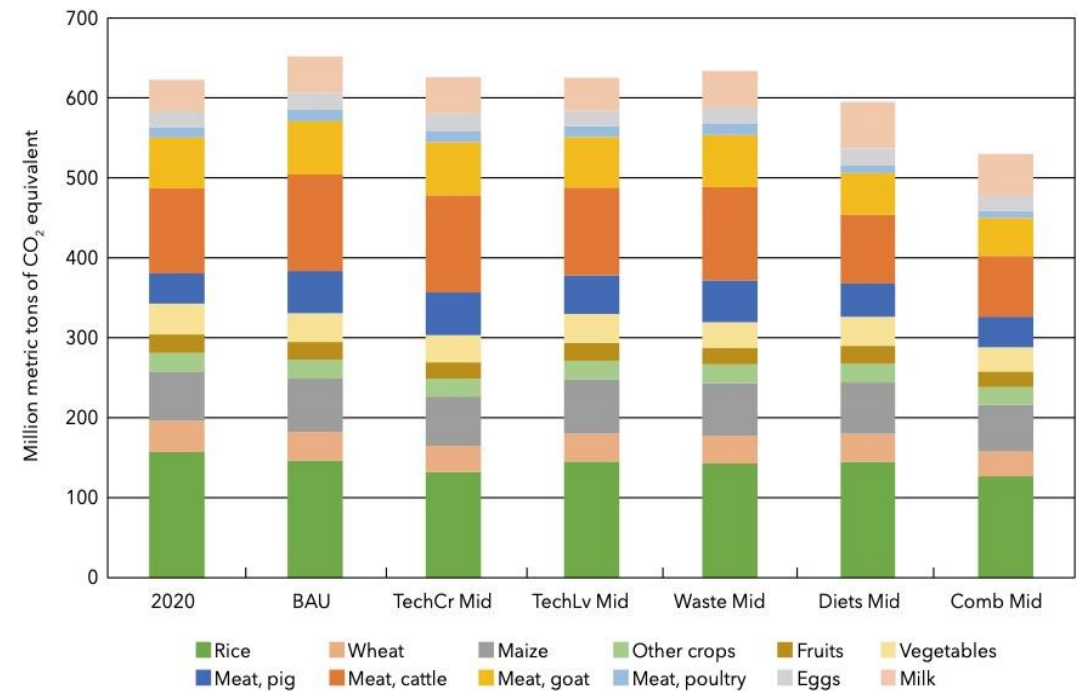
- **Five scenarios:**

- Improvement of crop technology
- Animal husbandry technology improvement
- Reduce food loss and waste
- Adjust diet structure
- Combined scenario

➤ By 2060, each scenario would reduce carbon emissions by 17% to 63% compared to the base scenario

Source: AGFEP

Figure 2.7 Greenhouse gas emissions of agricultural activities in China in 2060 under different scenarios, by commodity



Source: Results of China Agricultural Sector Model.

Note: BAU = business as usual; Tech-CR = crop technology improvement; Tech-LV = livestock technology improvement.

Fertilizer

Technical Guidelines for Green Agricultural Development (2018-2030)

- Promote fertilizer saving and other technologies
- Use new fertilizers such as slow-release fertilizers

Control of livestock pollution

- In 2024, the “Special Measures for the Management of Central Budget Investment in Ecological Protection and Restoration” was issued, which supported the infrastructure construction of the collection, storage, treatment, and utilization of livestock manures.



3.3 Energy Transition

➤ Implementation Plan

- Reduce energy consumption per unit of output value
- Increase the proportion of renewable energy in the agricultural sector by 2025
- Support uses of **biogas, solar energy and biomass energy** in rural areas



Clean Energy

- By 2022, clean energy accounted for 30% of agricultural energy consumption, and carbon emissions will be reduced by about 1 million tons per year

Agricultural electric machine

- By 2022, China's electric agricultural machinery accounted for 15%, reduce diesel consumption by about 1 million tons per year, and reduce carbon emissions by about **3 million tons** (Ministry of Agriculture and Rural Affairs, 2023)

3.3 Reduce Food Loss and Waste

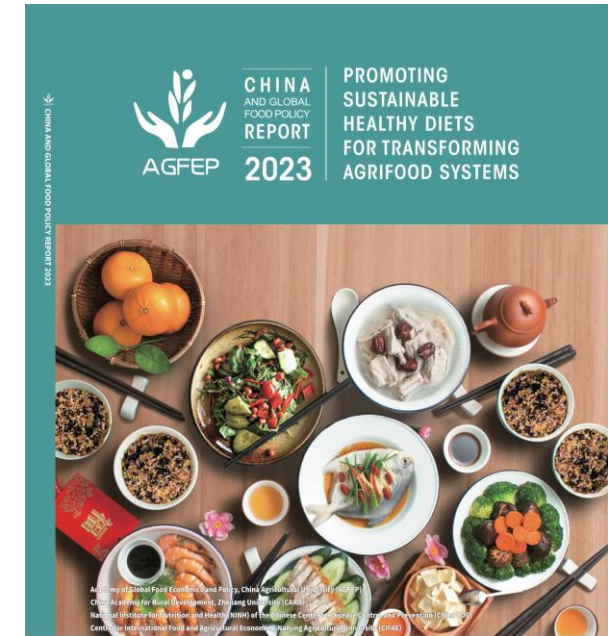
In China, the FLW-associated GHG emissions along the food supply chain accounted for approximately 4% of China's national total GHG emissions.

- In 2013, “*clean plate campaign*”
- In 2016
 - The national plan for the implementation of the Sustainable Development Agenda
- Since the "14th Five-Year Plan"
 - Laws such as **the Anti-Food Waste Law** of the People's Republic of China have been promulgated
 - The Food Conservation Action Plan has been issued, and the Ministry of Agriculture and Rural Affairs has issued a number of documents to promote the work of food reduction in various links



Dietary structure transformation

- In 2014
 - The Outline of China's Food and Nutrition Development (2014-2020) was issued
- In 2016
 - The Outline of the Healthy China 2030 Plan was released
- In 2019
 - The Healthy China Action (2019-2030) listed the "Reasonable Diet Action" as a major action, and the dietary guidelines were revised several times.



AFOLU increase

- ***The Master Plan for Major Projects for the Protection and Restoration of National Important Ecosystems (2021-2035)***
 - Through the Natural Forest Protection Project and the Conversion of Farmland to Forest Project, the forest stock volume reached 19.4 billion cubic meters in 2022, with an average **annual increase in carbon sink of approximately 180 million tons**. (National Forestry and Grassland Administration)

Government

- Reorient **agricultural subsidy** policies and **investment** in green agricultural
- Establish and improve the **distribution mechanism** of carbon emission reduction benefits, and **share the benefits** of emission reduction
- Increase **support for agricultural infrastructure** and public services, and strengthen the construction of land carbon emission reduction monitoring system

Research Institution

- Promote interdisciplinary research and produce **research results**
- Build strong scientific and policy **links between government and academia**
- **Independent monitoring** of progress towards food and climate policy-related goals

Private Sector

- Make emission reduction **commitments**
- **Monitor** and disclose progress on environmental commitments
- **Invest in building the capacity** of the whole society to reduce emissions
- Optimize daily business
- **Transform business model** and encourage to adopt green and low-carbon production and lifestyle

Public Participation

- Integrate low carbon awareness into school teaching
- Empower **consumers** to be active participants in carbon neutrality
 - learn relevant knowledge
 - Purchase green agricultural products
- Encourage residents to actively participate in **carbon market** trading
 - Reduce carbon emissions
 - Increase income

Summary

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It will be released in 2025, with the title "**Green and Low Carbon Transformation of China's Agrifood Systems**".

Progress and challenges in the low-carbon transition of global and Chinese agrifood systems

Low-carbon transition path and comprehensive effect evaluation of **rice** in China

Low-carbon transformation path and comprehensive effect evaluation of **animal farming** in China

The **energy** transformation of China's agrifood systems

Analysis of **food loss and waste reduction** path and carbon emission reduction effect in China

Simulating policy changes to promote low-carbon transformation of China and global agrifood systems