THE AGRI-FOOD SYSTEM AND CARBON NEUTRALITY

An Analysis of Agriculture and Food-Related Greenhouse Gas Emissions Mitigation Pathways in China

WORKING PAPER

OCTOBER 2022

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This working paper summarizes the findings of a forthcoming larger analysis of China's agri-food system. It describes a systematic approach to mapping out GHG emissions from China's agri-food system, examines existing mitigation actions in terms of emissions sources, assesses the mitigation potential of these actions, and performs a scenario analysis to identify decarbonization pathways for the system. The goal is to illuminate the contribution that agri-food system policies can make in China's march toward long-term carbon neutrality.

It is based on preliminary research and is circulated to stimulate discussion. A full report will be published in expanded form and the content may be revised.

Suggested citation: Chen, M., Hu, M., Yang, L., & Ma, Z. (2022). The Agri-Food System and Carbon Neutrality: An Analysis of Agriculture and Food-Related Greenhouse Gas Emissions Mitigation Pathways in China. Working Paper. Beijing, China: Innovative Green Development Program.

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BACKGROUND

Climate change and the agri-food system

Food production and climate change are closely linked. Agricultural production and livestock management are exposed to significant climate change risks. Changes in temperature and precipitation as well as extreme weather due to global warming increase the volatility of agricultural production and damage agricultural production potential (Woetzel et al., 2020). At the same time, activities that are associated with food production and consumption generate greenhouse gas (GHG) emissions (Niles et al., 2017; Vermeulen et al., 2012).

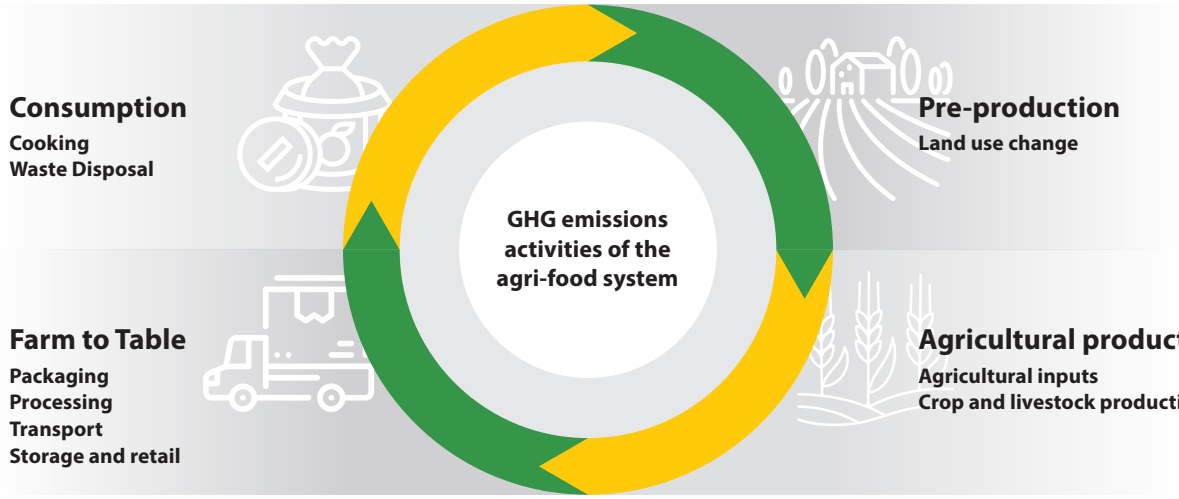
A systematic approach to understanding all activities associated with agricultural production, supply chains, and food consumption is necessary. GHG emissions from different food production-related activities have common drivers, including population growth, economic development, income level, and dietary habits. However, when emissions sources from the agri-food system are segmented into different sectors – such as agriculture, industry, transportation – they appear insignificant. This has led to the agri-food system receiving insufficient research and policy attention.

According to the IPCC's Sixth Assessment Report, global GHG emissions from the agricultural sector, including land use, accounted for between 13% and 21% of total global emissions from 2010 to 2019 (IPCC, 2022). However, when considering the agri-food system as a whole, including GHG emissions from food processing, packaging, transport, retail, and consumption, these food-related GHG emissions account for one-third of global GHG emissions (Crippa et al., 2021), meaning the system is pivotal to global climate safety.

Several studies have described the role of agri-food system emissions in climate change (Crippa et al., 2021; Niles et al., 2017; Poore & Nemecek, 2018; Rosenzweig et al., 2020; Tubiello et al., 2021; Vermeulen et al., 2012). In these studies, the agri-food system is conceptualized to include agricultural pre-production, production, and post-production, as well as food consumption, with each stage having multiple sources of GHG emissions. Specifically, the components of the system include pre-production land use changes, food processing, packaging, transportation, retail, cooking and food waste disposal.

The green and low-carbon transition of the agri-food system can make a substantial contribution to GHG reduction, sustainable development, biodiversity conservation, social equity, and public health. For example, reducing the overuse of fertilizers and pesticides in agricultural production, as well as changing production methods such as monoculture

FIGURE 1. GHG emitting activities in the agri-food system by stage



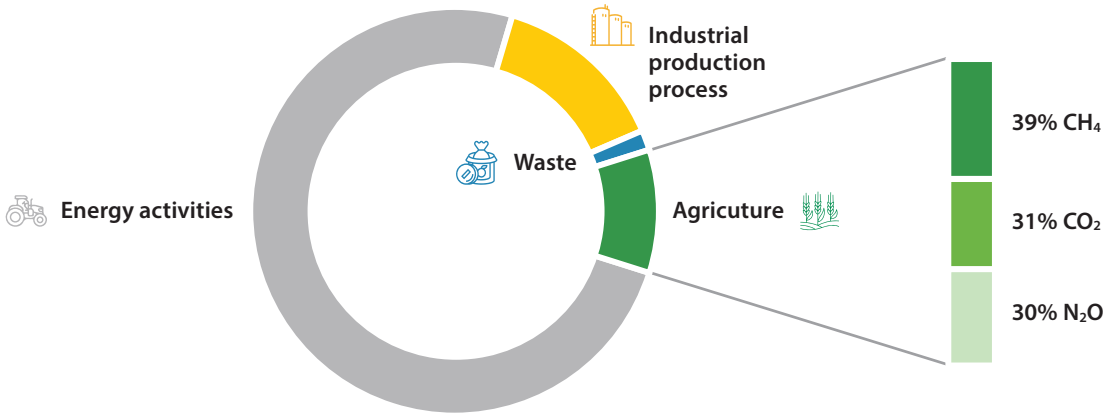
and intensive farming, can reduce damage to the ecosystem (Benton et al., 2021). Another example is the development of community supported agriculture, which directly connects consumers with farmers, and enhances food security and social equity. In addition, the promotion of low-sugar and low-fat diet guidelines benefits public health and mitigates GHG emissions by reducing animal based food consumption (Tilman & Clark, 2014; Zang et al., 2018).

Challenges for GHG emissions mitigation in China's agri-food system

China is a large agricultural country, with the production, consumption, import and export of agricultural food products among the highest in the world. According to the Food and Agriculture Organization of the United Nations, China is the world's largest food producer, meat consumer and soybean importer. Its aquaculture production and export value both rank first in the world. As a country with a large population, agriculture and food security are top priorities. China's No. 1 Central Document (the first policy statement released by the central government every year) has made agriculture and rural development a top priority for the last 17 years; in the wake of industrialization and urbanization, the country maintains a strict red line on minimum arable land area. China's 2035 Vision Plan emphasizes the fundamental role agriculture plays in food supply, food safety and rural revitalization. Finally, GHG mitigation in the agri-food system plays an important role in China's carbon peaking and carbon neutrality strategy. For example, China's updated NDC (*China's Achievements, New Goals and New Measures for Nationally Determined Contributions*) proposes many GHG mitigation measures for the agri-food system, including fertilizer use reduction, ecosystem carbon sinks, and waste resource utilization.

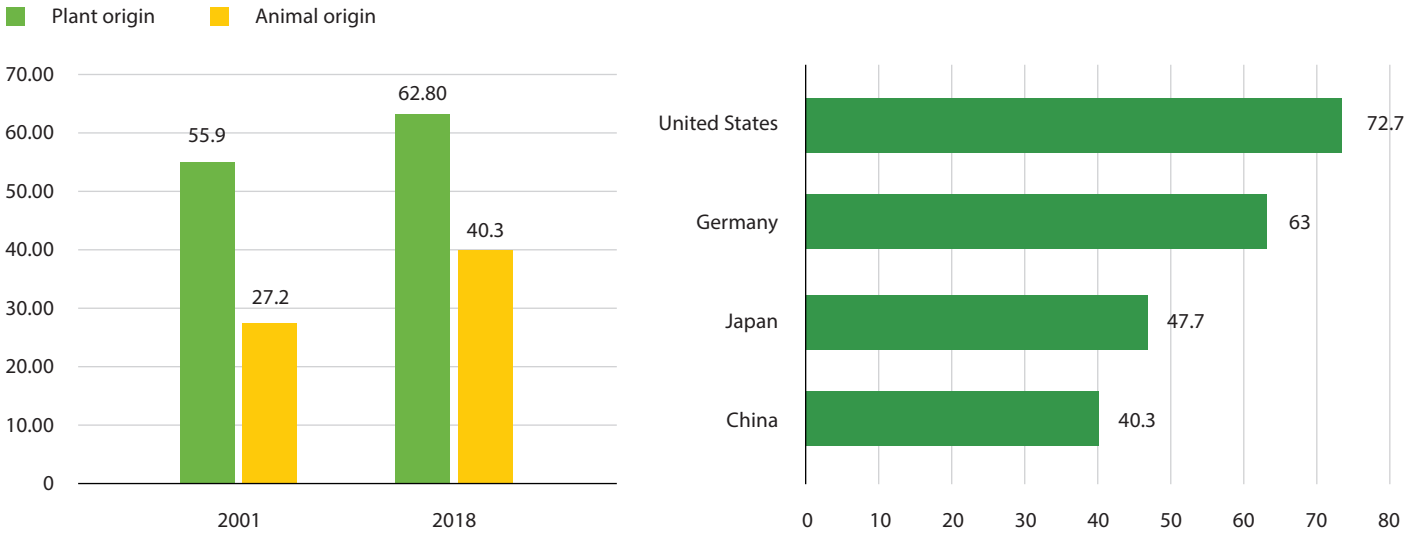
Estimates based on The People's Republic of China Second Biennial Update on Climate Change show that GHG emissions from agricultural production in China reached 1.2 billion tons of CO_2e in 2014, accounting for about 11% of national GHG emissions in the same year (Figure 2). Of these, 31% were CO_2, 39% were methane (CH_4), and 30% were nitrous oxide (N_2O) (Cheng & Pan, 2021). Numerous studies have shown that near-zero emissions in the agricultural sector will not be reached until after the energy, transportation, and building sectors have done so, and even with extensive mitigation measures, the agricultural sector is likely to become the second largest emitter after industry in 2050, posing a challenge to China's carbon neutrality (Lin et al., 2021; Teng et al., 2019).

FIGURE 2. Agricultural GHG emissions in China, 2014



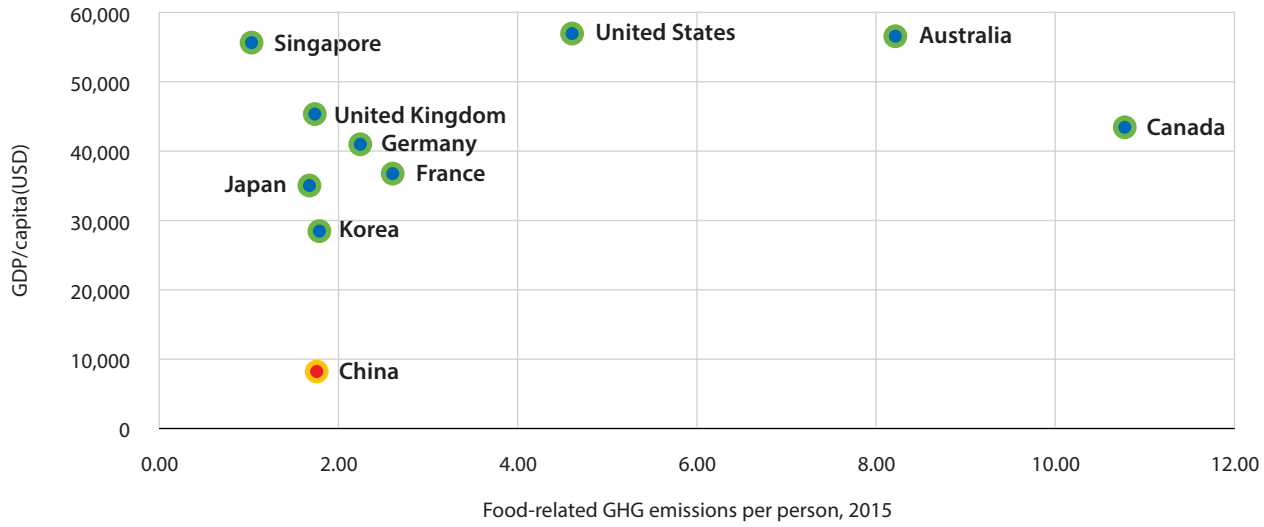
With a growing population and ongoing economic development, GHG emissions from China's agri-food system will continue to increase. As indicated in Figure 3, China's GHG emissions per capita in the agri-food system in 2015 were already close to those of major developed countries such as the UK, Japan and Germany, while GDP per capita remains lower than these countries. Other driving factors such as total food consumption, dietary structure and consumption patterns can also directly influence the scale of agricultural production and food supply, in turn affecting GHG emissions from the agri-food system. For example, protein intake per capita in China remains at a low level compared

FIGURE 3. Daily protein supply in China and comparison of animal protein supply (g/person/day) between China and other countries, 2018



Data source: FAO, 2018

FIGURE 4. China vs. major developed countries, 2015



Data source: EDGAR Food Database and the World Bank

to some developed countries (Figure 4). Notably, if increased protein intake all comes from consumption of animal based products, it would increase GHG emissions and pose a challenge to the carbon neutrality and food security of the agri-food system (Bai et al., 2018; Li et al., 2016; Ma et al., 2019).

AN OVERVIEW OF POLICY ACTIONS LEADING TO GHG EMISSION REDUCTIONS IN CHINA'S AGRI-FOOD SYSTEM

Policy actions to promote GHG mitigation in China's agri-food system

China has made agricultural production and food security top priorities. It has developed and implemented a set of strategies and policies targeting sustainable agricultural and rural development, including actions for green agricultural development, soil conservation, rural revitalization, and food security. In addition, China has issued numerous policy measures in food consumption-related sectors, including industrial energy conservation, green low-carbon transportation, and waste management. The primary goal of these actions is not GHG emissions mitigation, but they can nevertheless bring the co-benefits of emissions reduction in the agri-food system. The table below lists the policies that have an impact on GHG emissions reduction in the agri-food system in terms of emissions sources.

TABLE 1. Major mitigation actions in the agri-food system

	MITIGATION ACTIONS	POLICY DOCUMENTS
Agricultural production	• Promote the use reduction and efficiency enhancement of chemical fertilizers and pesticides along with organic fertilizer substitution. • Build a long-term mechanism for replacing chemical fertilizers with organic fertilizers for fruits, vegetables and tea, and provide subsidies for the purchase and use of organic fertilizers. • Promote the recycling of agricultural films and environmentally friendly biodegradable film use. • Manage methane emissions from farmland, select and breed high-yield and low-emission rice varieties, and improve water and fertilizer management. • Improve agricultural carbon sequestration capacity through farmland management. • Strengthen the resource utilization of livestock and poultry manure. • Promote technologies such as low-protein diets, whole-plant silage and high-yield and low-emission livestock and poultry breeds. • Farmland carbon sink action. • Promote smart agriculture, livestock and fishery management. • Promote application of green agricultural machinery, include green machinery and intelligent equipment in agricultural machinery purchase subsidies.	*National Plan for Sustainable Agricultural Development (2015-2030)* *Opinions on Accelerating the Prevention and Control of Agricultural Film Pollution* *13th Five-Year Plan on Greenhouse Gas Emission Control Work Program* *14th Five-Year Plan on National Green Agricultural Development* *The Program for Improving and Protecting the Quality of Arable Land* *Views on Comprehensively Promoting Rural Revitalization and Accelerating Agricultural and Rural Modernization* *Digital Agricultural and Rural Development Plan (2019-2025)* *Opinions of the CPC and the State Council on the Complete and Accurate Implementation of the New Development Concept for Carbon Peaking and Carbon Neutrality* *The Action Plan for Carbon Peaking by 2030* *Implementation Plan for Carbon Emission Reduction and Sequestration in Agriculture and Rural Areas*
Farm-to-table	• Promote green packaging and recyclable express packaging; reduce overpackaging in e-commerce. • Develop green and low-carbon transportation for agricultural products. • Improve energy efficiency in the food processing industry. • Reduce the production and consumption of HFCs.	*Guiding Opinions on Accelerating the Transformation and Development of China's Packaging Industry* *14th Five-Year Plan on Circular Economy Development* *Opinions on Accelerating the Development of Cold Chain to Safeguard Food Safety and Promote Consumption Upgrading* *14th Five-Year Plan on National Agricultural Green Development Planning* *Kigali Amendment* *14th Five-Year Plan on Modern Energy System Planning*
Food consumption	• Municipal solid waste (MSW) sorting and kitchen waste resource reuse. • Reduce food waste, develop and revise relevant national standards, industry standards and local standards to prevent and reduce waste. • Promote a healthy dietary structure.	*Implementation Plan for the Household Waste Classification System* *Law of the People's Republic of China on the Prevention and Control of Environmental Pollution by Solid Waste* *Law of the People's Republic of China Against Food Waste* *China's Food and Nutrition Development Program (2014-2020)* *Dietary Guidelines for Chinese Residents*

Direct and indirect mitigation policies in China's agri-food system

As mentioned above, not all policies targeting the agri-food system are designed to address climate change, but they can produce the co-benefit of GHG emissions reduction. In this analysis, policies are divided into the two main categories of green development actions or low-carbon agriculture actions.

- **Green development actions** refer to measures with economic, environmental and social targets that show GHG reduction effects. Although the initial policy does not target climate change, actions in these areas nevertheless contribute to carbon peaking and carbon neutrality. Green development actions mainly relate to green ecological agriculture, green low-carbon energy systems, the circular economy and zero-waste cities.
- **Low-carbon agriculture actions** refer to GHG mitigation measures and actions in agricultural production with the primary goal of addressing climate change, taking carbon neutrality into consideration, i.e., GHG emission limits.

The following table provides a summary of actions in these two categories.

TABLE 2. Mitigation actions in the agri-food system by target

CATEGORY	MAJOR MEASURES	PRIMARY TARGETS	THE AGRI-FOOD SYSTEM BY STAGE		
			AGRICULTURE PRODUCTION	FARM-TO-TABLE	FOOD CONSUMPTION
Low-carbon agricultural action					
Low-carbon agricultural production	Emissions mitigation from rice cultivation	GHG mitigation	√		
	Emissions mitigation from low-carbon livestock farming	GHG mitigation	√		
Green development action					
Green ecological agriculture	Manure management in livestock farming	Emissions mitigation of water pollution	√		
	Fertilizer and pesticide reduction on farmland	Soil conservation and food safety	√		
	Agricultural inputs emission mitigation (agricultural film)	Rural pollution and solid waste pollution	√		
Clean and modern energy systems	Emissions mitigation from agricultural and rural energy consumption	Air pollution	√		
	Emissions mitigation from energy consumption of food processing	Industrial energy saving, air pollution, GHG mitigation		√	
	Emissions mitigation from energy consumption of food transportation and retail	Transportation energy saving, air pollution, GHG mitigation		√	
	Emissions mitigation from energy consumption of food cooking	Air pollution			√
	Emissions mitigation of refrigerants in food cold chain	GHG mitigation(F-gases)		√	
Circular economy and zero-waste cities	Emissions mitigation of food packaging	Solid waste pollution		√	
	Emissions mitigation from food waste disposal	Solid waste pollution			√

A QUANTITATIVE ANALYSIS OF GHG EMISSIONS MITIGATION POTENTIAL IN CHINA'S AGRI-FOOD SYSTEM

Research scope

In this analysis, the main agri-food system emission sources include food production, processing, packaging, transportation and retail through to consumption[1]. The main GHGs include CO_2, CH_4, N_2O, and F-gases, the latter being mainly hydrofluorocarbons (HFCs) used in refrigeration equipment. GHGs are standardized as CO_2 equivalents (CO_2e) based on Global Warming Potential[2] (GWP).

TABLE 3. Scope of GHG emissions from the agri-food system in this briefing

MAJOR GHG EMISSION SOURCES		GHG EMISSIONS BY GAS			
		CO_2	CH_4	N_2O	F-gases
Agricultural production	Livestock management		√	√	
	Crop cultivation		√	√	
	Agricultural inputs (chemical fertilizers, pesticides, agricultural film)	√			
Farm-to-table	On-farm energy use	√			
	Food processing	√			
	Food packaging	√			
	Food transportation	√			√
	Food storage and retail	√			√
Food consumption	Food cooking	√			
	Kitchen waste disposal	√	√		

Scenario settings

This analysis assesses the emission and mitigation implications of three scenarios with varying degrees of policy ambition:

- Reference Scenario (RS): In this scenario, GHG emissions from the agri-food system are estimated based on China's current pathway for economic and social development and green low-carbon transition.
- Enhanced Action Scenario (EAS): This scenario maps out a mitigation pathway with the continuation and enhancement of already implemented green and low-carbon actions, as well as cost-effective mitigation actions that have not yet been adopted.
- Deep Decarbonization Scenario (DDS): This scenario describes a deep decarbonization pathway with the adoption of all feasible mitigation actions based on international and domestic mitigation practices. It includes actions that go beyond ones in EAS and includes 1), higher-cost mitigation practices 2), low-cost mitigation actions at a greater speed and coverage, and 3), mitigation actions from behavior changes on the consumption side.

[1] This briefing does not include GHG emissions from land use change from agricultural prodution, as these emissions are relatively small (AGFEP, 2021; Crippa et al., 2021; Vermeulen et al., 2012).

[2] GWP refers to the IPCC Fourth Assessment Report (AR4), calculated on a time scale of 100 years.

Key findings

1. China's GHG emissions from the agri-food system will continue to grow

In the reference scenario, GHG emissions from China's agri-food system continue to grow under existing mitigation measures, and total GHG emissions are 30% higher in 2060 compared to the 2019 level. GHG emissions from agricultural production continue to grow, while emissions from food processing, transportation, retail, cooking, and waste disposal show a slow downward trend after peaking, due in large part to energy efficiency improvements.

GHG growth is mainly attributed to methane and nitrous oxide emissions, which continue to grow in this scenario. Between 2019 and 2060, CH_4 emissions increase from 519 million tons of CO_2e to 1 billion tons, while N_2O emissions increase slowly from 273 million tons of CO_2e to 330 million tons. In addition, F-gas emissions continue to grow until around 2040 and then slowly decline. CO_2 emissions, however, begin to gradually decrease after 2030.

FIGURE 5. Projected GHG emissions by agri-food system component under the reference scenario (Mt CO_2e)

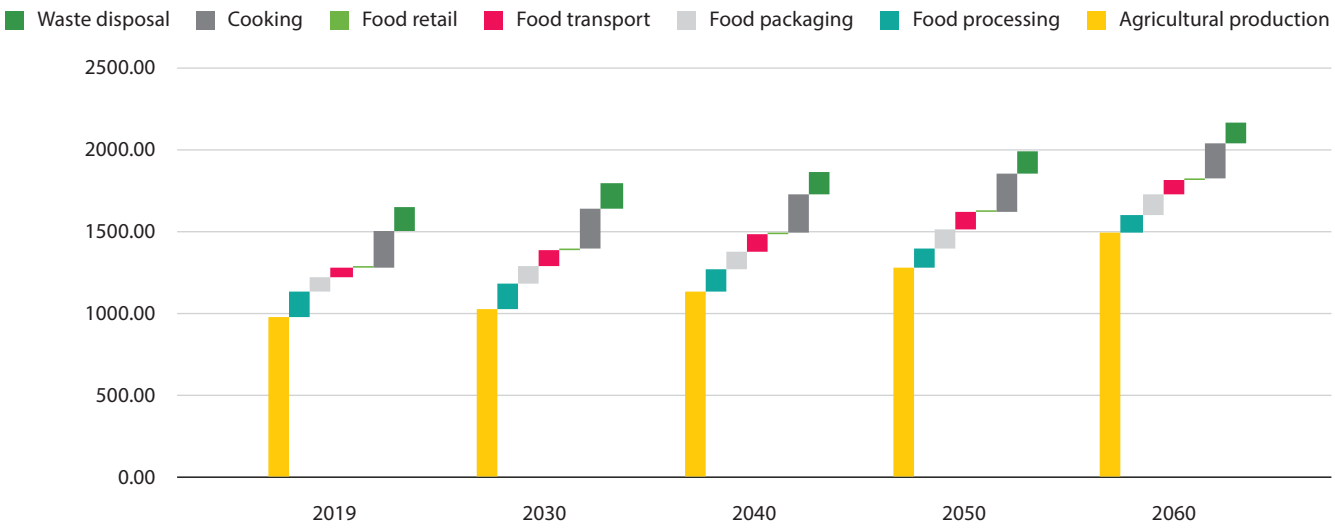
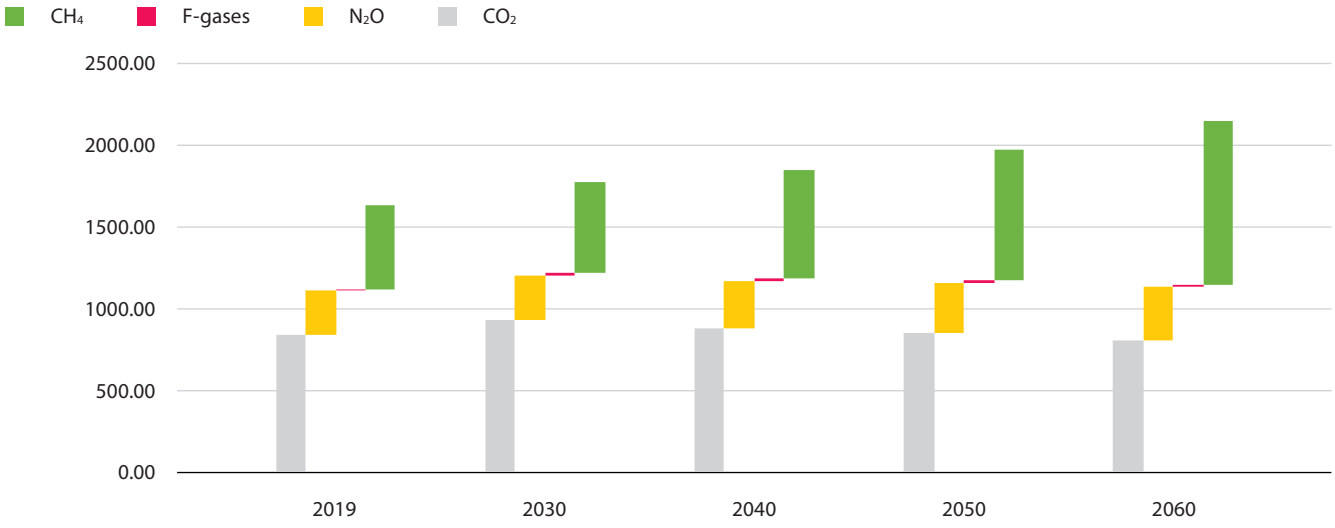


FIGURE 6. Projected GHG emissions by gas in China's agri-food system under the reference scenario (Mt CO_2e)



2. Carbon neutrality challenges in China's agri-food system

Figure 7 shows GHG emissions pathways for China's agri-food system under different scenarios.

Under the reference scenario, GHG emissions are 1.646 billion tons of CO_2e in 2019, increasing to 1.789 billion tons of CO_2e in 2030 and 2.162 billion tons of CO_2e in 2060.

Under the enhanced action scenario, GHG emissions from China's agri-food system start to gently decline from around 2025 to 1.614 billion tons of CO_2e in 2030 and to 1.58 billion tons of CO_2e in 2060, a 36% reduction compared to the 2060 level under the reference scenario. GHG emissions under this scenario maintain a small increase up to about 2048, mainly attributed to GHG emissions from livestock management.

Under the deep decarbonization scenario, GHG emissions from China's agri-food system are already on a gradual downward trend from 2020. They decrease to 1.408 billion tons of CO_2e and 651 million tons of CO_2e by 2030 and 2060, respectively, which in 2060 is 70% less than under the reference scenario. However, this scenario still fails to achieve near-zero emissions.

FIGURE 7. Projected GHG emissions in China's agri-food system under three scenarios (Mt CO_2e)

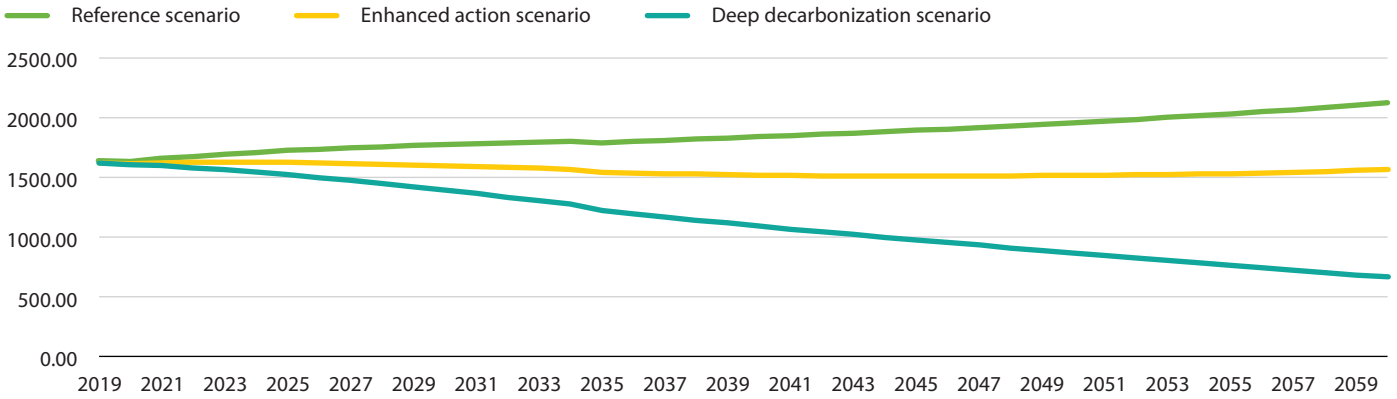


FIGURE 8. Mitigation potential by agri-food system component in the enhanced action and deep decarbonization scenarios (Mt CO_2e)

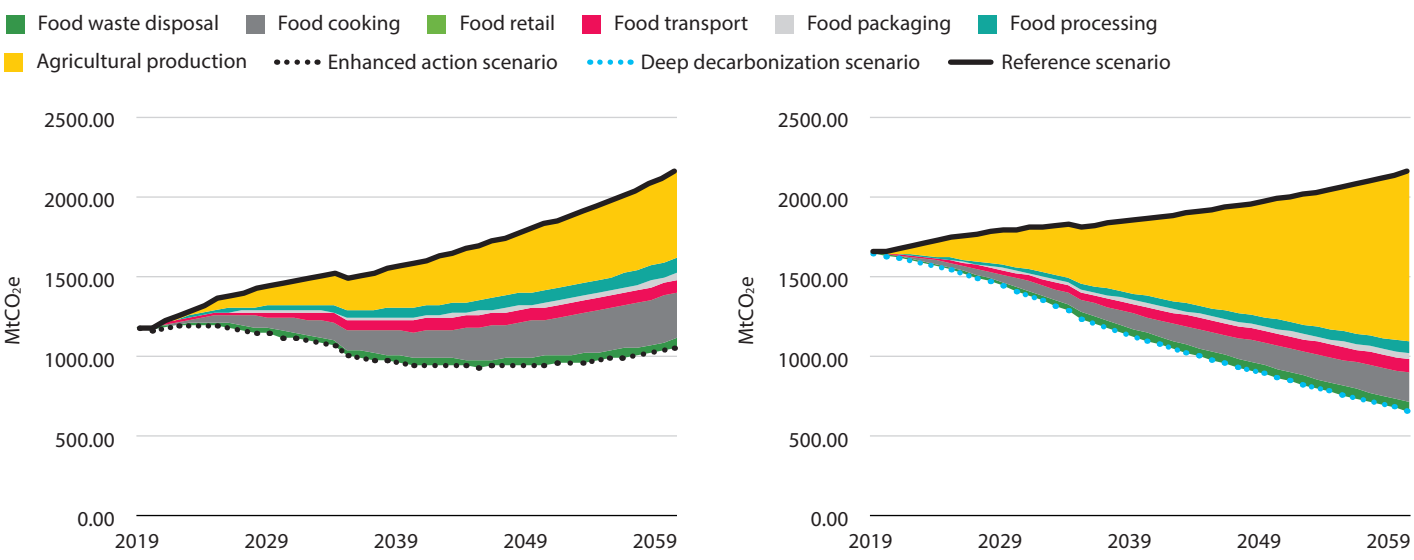


FIGURE 9. Mitigation potential by gas in China's agri-food system under the enhanced action scenario and deep decarbonization scenario (Mt CO_2e)

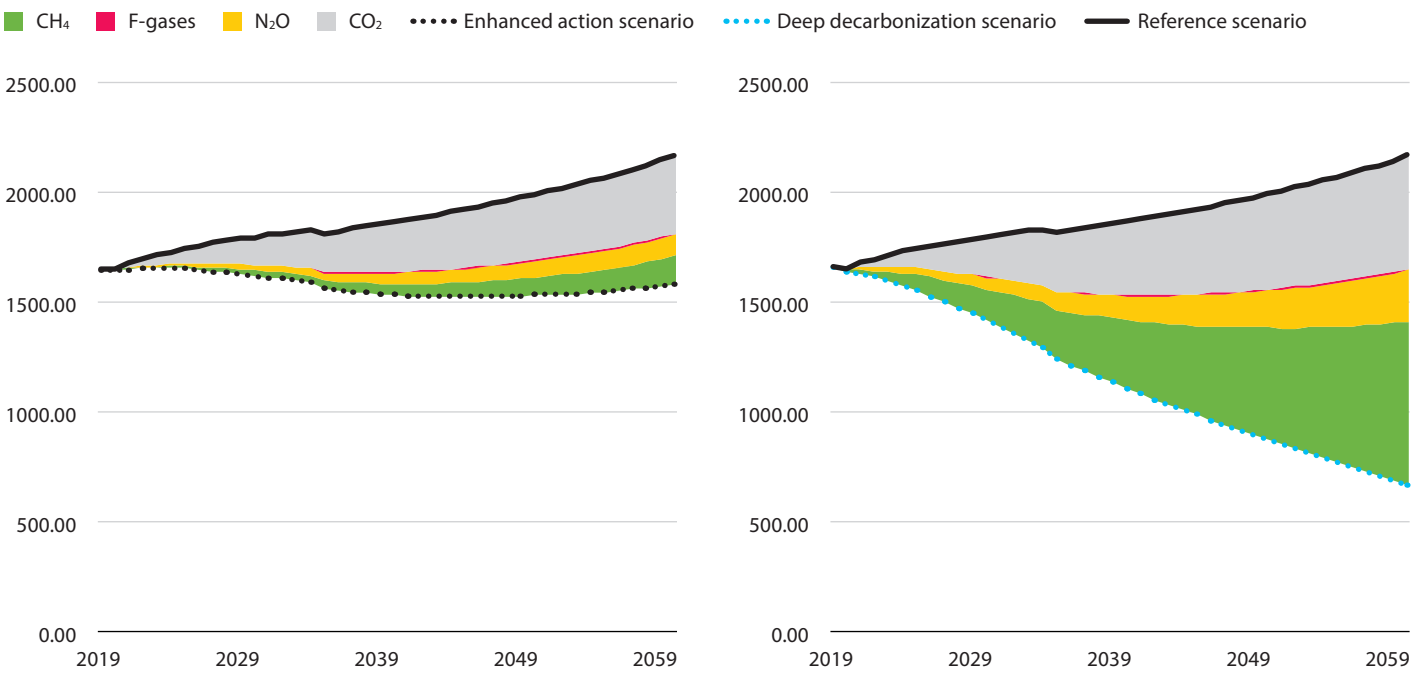


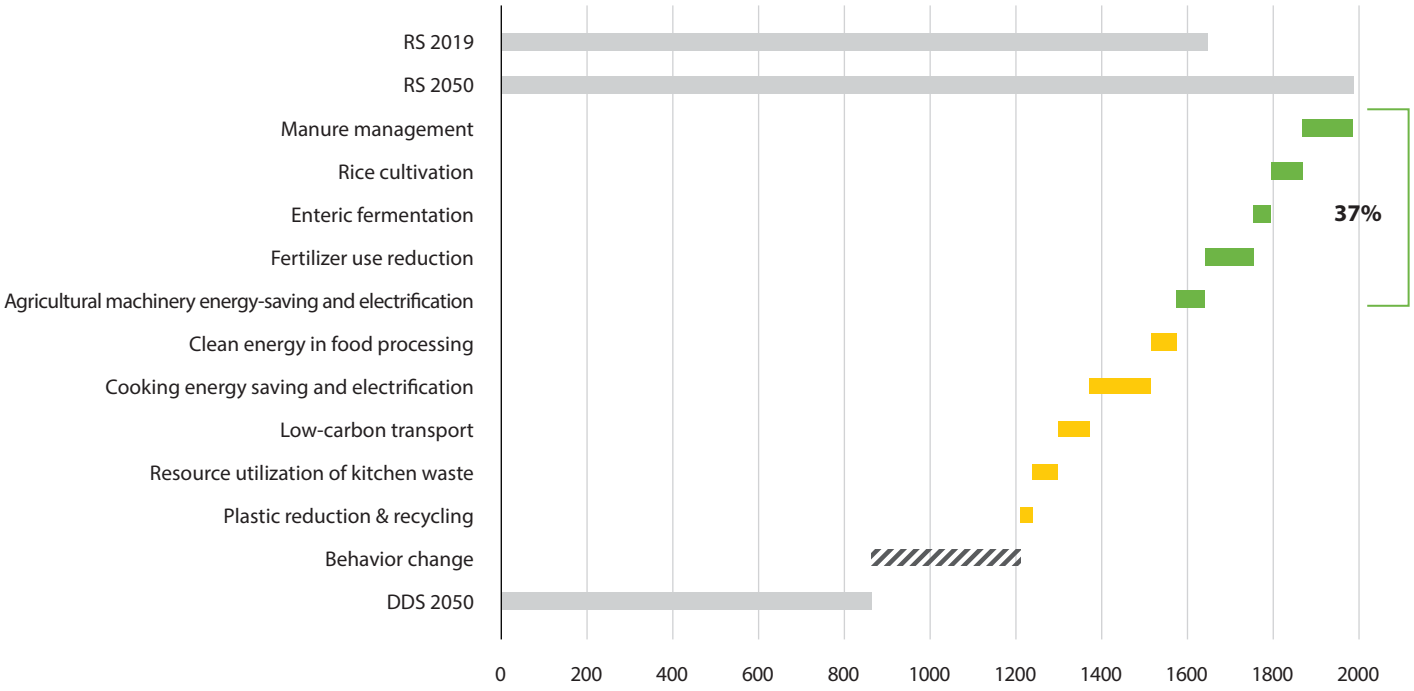
TABLE 4. GHG emissions mitigation by gas under enhanced action and deep decarbonization scenarios

	ENHANCED ACTION SCENARIO 2050 VS. 2019	DEEP DECARBONIZATION SCENARIO 2050 VS. 2019
CH_4	Increase by 40%	Decrease by 43%
N_2O	Decrease by 14%	Decrease by 50%
F-gases	Peak around 2030 and then slowly decrease to 2020 level	Peak around 2030 and then slowly decrease to 2020 level
CO_2	Decrease by 34%	Decrease by 50%

3. Actions in agricultural production only contribute to one-third of mitigation potential

As illustrated below, focusing only on reducing emissions from agricultural production will not achieve carbon neutrality in China's agri-food system. In 2050, only 37% of the mitigation potential in the agri-food system will come from agricultural production. A great effort will have to be made to unlock the large mitigation potential in other components of the agri-food system.

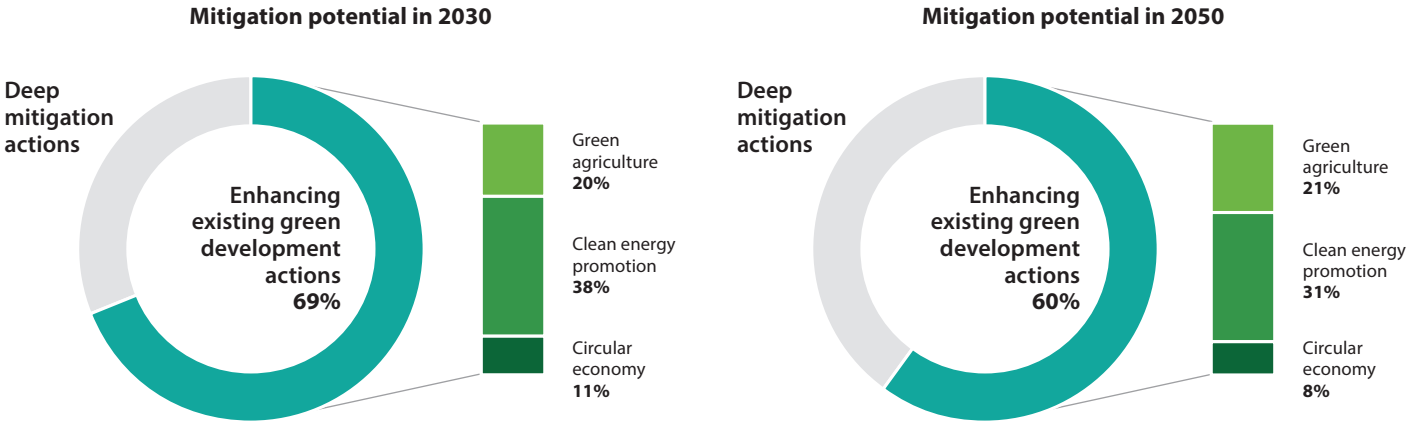
FIGURE 10. Mitigation potential of major reduction actions under the deep decarbonization scenario (Mt CO_2e)



4. Existing green development actions can contribute to about two-third of mitigation potential

As shown in Figure 11, 69% and 60% of mitigation potential in 2030 and 2050, respectively, will come from enhancing existing green development actions, including actions in green agriculture, clean energy promotion and the circular economy designed to address environmental pollution and protect public health. The remaining one-third comes from strengthening low-carbon actions, including low-carbon agricultural actions and behavior change at the food consumption end.

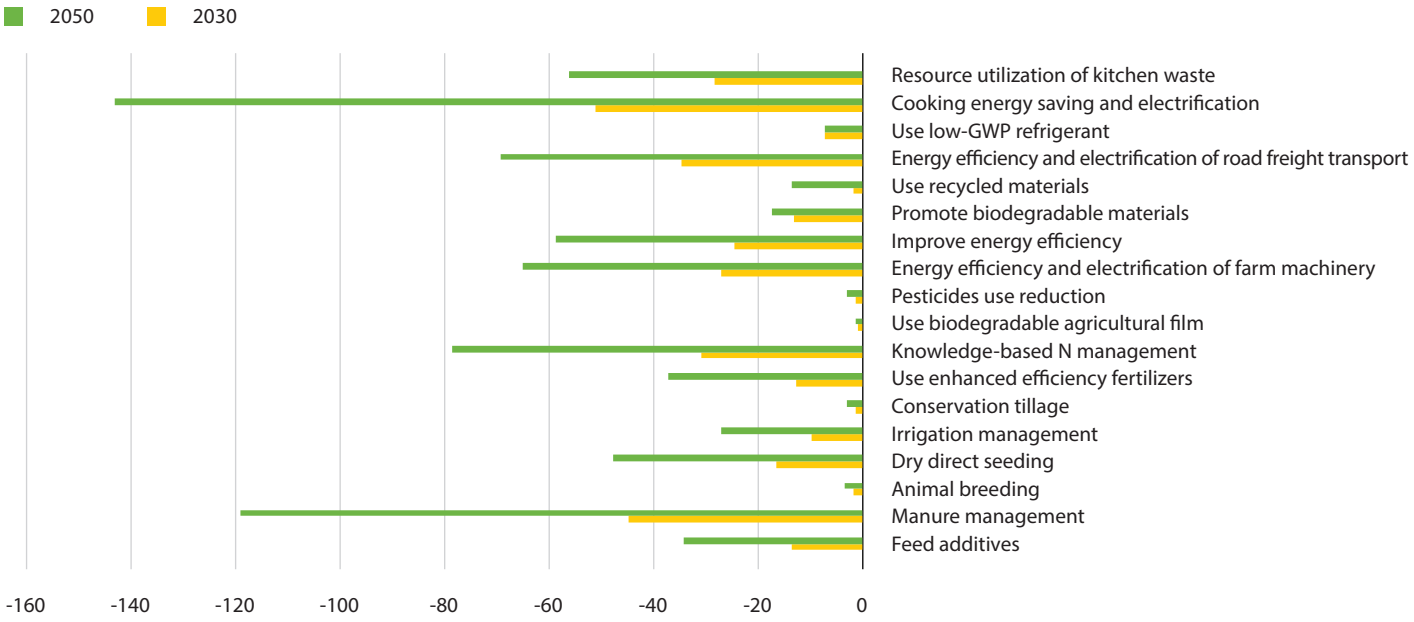
FIGURE 11. Mitigation potential of green development actions under the deep decarbonization scenario



Note: The analysis of mitigation potential in this figure is based on the mitigation categories in Table 2.

5. Mitigation potential of major measures

FIGURE 12. Mitigation potential of major measures under the deep decarbonization scenario (Mt CO_2e, 2030 and 2050)



Major mitigation actions in China's agri-food system

Based on the 2050 GHG reduction potential under the deep decarbonization scenario, we identify the following ten priority actions and the main obstacles they are facing.

TABLE 5. GHG emissions mitigation by gas under two different scenarios

PRIORITY ACTIONS	MAJOR MEASURES	MITIGATION POTENTIAL IN 2050	MAIN OBSTACLES
Manure management	Biogas recovery	11%	Lack of economic incentives
Nitrogen fertilizer use reduction	Use of nitrification inhibitor and slow-release fertilizer, conservation tillage, knowledge-based nitrogen management	10%	Lack of strong economic incentives
Agricultural machinery energy-saving and electrification	Agricultural machinery energy efficiency improvement and electrification	5.8%	Lack of policy and standards guidance for agricultural machinery electrification
Cooking energy saving and electrification	Cooking energy saving and electrification	12.8%	Lack of economic incentives
Low carbon transportation	Transportation energy efficiency improvements, freight electrification, low-GWP refrigerants	7%	Lack of policy guidance
Clean energy application in food processing	Energy efficiency improvements	5%	Lack of policy guidance
Kitchen waste resource utilization	Waste sorting and kitchen waste resource utilization	5%	Lack of economic incentives for the scale development of waste recycling
Methane mitigation in rice fields	Irrigation management, dry direct seeding	6.6%	Lack of low-cost technology Implementation difficulty
Emissions mitigation in enteric fermentation	Animal breeding, feed additives	3%	Lack of low-cost technology
Plastic reduction and recycling	Recyclable packaging, biodegradable packaging materials	2.8%	Implementation difficulty
Dietary shift and behavior change*	Plant-rich diets, eating local	-	Implementation difficulty

***Note:** Dietary shift mainly refers to reducing animal-based food consumption and encouraging local food consumption, which can reduce emissions in agricultural production and food transportation. Considering the large uncertainty surrounding behavior change, quantitative analysis is not performed here. Numerous studies have shown that reducing animal food consumption has large emissions reduction potential, a dynamic that deserves greater attention.

Policy suggestions

- **Develop an integrated carbon neutrality strategy for the agri-food system**

  Since food production and consumption involve multiple sectors – agriculture, transportation, industry and waste – an integrated carbon neutrality strategy for the agri-food system as a whole can provide a comprehensive approach to reduce GHG emissions, help coordinate cross-sector mitigation actions, and promote stakeholder participation.

- **Strengthen existing green and low-carbon actions in the agri-food system to achieve further GHG mitigation, especially methane reduction**

  Numerous policies have been created to promote green agricultural development both in China's National Determined Contribution (NDC) and domestic policy documents, such as reduction of chemical fertilizer and pesticide use, collection and biogas recovery, promotion of organic fertilizers, and promotion of knowledge-based N management and green agricultural machinery. Optimizing existing policies and measures, especially by strengthening methane reduction in existing actions, can not only mitigate agricultural pollution, protect agricultural resources and improve the quality of agricultural products, but can also reduce GHG emissions with cost-effective measures (Table 6 provides policy suggestions for incorporating the agri-food system into China's NDC).

- **Promote the electrification of agricultural machinery and clean energy for rural cooking and heating**

  GHG emissions from energy consumption in different components of the agri-food system, such as agricultural machinery, food transportation and cooking, call for attention. Introducing policies that can accelerate the electrification of agricultural machinery, including the marketing of electric tractors, microtillers and lawn mowers, subsidizing the application of efficient household appliances for clean stoves in rural areas, as well as promoting energy saving and electrification in the food cold chain are all recommended.

- **Establish a GHG emissions database for the agri-food system to support scientific decision-making and behavior change**

  The database should include data on GHG emissions from the agri-food system classified by stage and by gas as well as environment data on associated activities. The GHG emissions data can provide support for mitigation policies in the agri-food system, and environmental and carbon data labelling can facilitate behavioral change. In addition, China's 2021 updated NDC, which proposes gradually establishing a non-CO_2 GHG emissions inventory system, as well as a policy framework and management system for non-CO_2 GHG emissions, can also provide policy support for emissions data collection from and analysis of the agri-food system. China's work on product carbon labeling could also extend to the agri-food system, and include carbon information in the existing labelling systems for ecological food and green food.

- **Promote innovative agricultural practices such as community-supported and regenerative agriculture**

  Explore different types of sustainable agriculture to improve the resilience of the agri-food system in the face of resource scarcity, environmental pollution and climate change. For example, in addtion to industrial agricultural production, given China's smallholder-based agriculture, take actions to promote community-supported agriculture, which can provide healthy food for consumers and financial support for the operations of producers. Another example is promotion of regenerative agricultural practices such as conservation tillage and cover crops to improve soil health.

- **Enhance existing actions under China's zero-waste city program to reduce food waste and waste-related methane emissions**

  Enhancement of material recycling and reuse at the production, packaging, transportation, and consumption stages can unlock considerable GHG emissions mitigation potential. These measures include the development and promotion of fully biodegradable mulch, the use of biodegradable and recyclable materials in food packaging, as well as biogas recovery and resource recycling of food waste. These actions are also in line with the circular economy and zero-waste city policies that China has been pursuing.

TABLE 6. Policy suggestions for incorporating the agri-food system into China's NDC

	MAJOR SOURCES OF GHG EMISSIONS	2015 NDC	2021 NDC	SUGGESTION FOR IMPROVEMENT
System-wide				• Develop a systematic approach to the agri-food system to cope with climate change. • Formulate agricultural GHG emissions reduction targets. • Plan for agricultural adaptation to climate change.
Agricultural production	Agricultural input (fertilizer)		• Intensify efforts to promote the reduction and efficiency of chemical fertilizers and pesticides.	• Reduce the use of and increase the efficiency of chemical fertilizers and replace them with organic fertilizers.
	Agricultural input (pesticide)		• Intensify efforts to promote the reduction and efficiency of chemical fertilizers and pesticides.	• Pesticide reduction and efficiency improvement.
	Agricultural input (agricultural film)			• Control the usage of plastic film and promote the recycling of agricultural film. By 2025, the recovery rate of waste agricultural film should increase to 85%.
	On-farm energy consumption			• Promote green agricultural machinery.
	Crop production (farmland soil)	• Control methane emission from paddy fields and nitrous oxide emission from farmland.	• Reduce fertilizer and increase efficiency, and replace organic fertilizer.	• Reduce and increase efficiency of chemical fertilizer and replace organic fertilizer.
	Crop production (rice cultivation)	• Control methane emission from paddy fields and nitrous oxide emission from farmland.		• Improve the fallow system and cropping rotation.
	Livestock production (manure management)	• Promote the comprehensive utilization of straw, utilization of agricultural and forestry wastes and comprehensive utilization of livestock and poultry manure.	• Improve the treatment and utilization of livestock and poultry manure and reduce GHG emissions in livestock management.	• In 2025, utilization rate of livestock and poultry manure should reach 80%.
	Livestock production (enteric fermentation)			• Improve feed efficiency.
Farm to Table	Food processing			
	Food packaging			• Promote green packaging. • E-commerce express should basically eliminate secondary packaging, and the application scale of recyclable express packaging should reach 10 million.
	Food transportation		Ratify the Kigali Amendment.	• Develop green and low-carbon transportation of agricultural products. • Control the production and consumption of HFCs under Kigali Amendment.
	Food storage and retail		Ratify the Kigali Amendment.	• Promote green and efficient refrigeration. • Control the production and consumption of HFCs under Kigali Amendment.
Food consumption	Food cooking			• Implement measures such as energy saving subsidies and *Replacing the Old with the Green*, and support residents to purchase green and efficient refrigeration products with subsidies and incentives.
	Kitchen waste disposal	Strengthen methane collection and utilization in landfills.	Accelerate the development of the circular economy.	• By 2025, develop a sound municipal waste classification system and increase the resource utilization rate of municipal waste to about 60%. • By 2030, the municipal waste classification system should be fully covered and the resource utilization rate of municipal waste increased by 65%.

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