

PATHWAYS TO REDUCING CHINA'S AGRICULTURAL METHANE EMISSIONS

July 2024

*Summary for
Policymakers*



PHOTO: OKOLI YANGSHUO

Authors

Rixin Zhu, Jessica Gordon, Fan Dai

About the California-China Climate Institute

The California-China Climate Institute was launched in September 2019 and is a University of California-wide initiative housed jointly at UC Berkeley’s School of Law (through its Center for Law, Energy, and the Environment) and the Rausser College of Natural Resources. It is chaired by Jerry Brown, former Governor of the State of California, and vice-chaired by the former Chair of the California Air Resources Board Mary Nichols. The Institute also works closely with other University of California campuses, departments, and leaders. Through joint research, training, and dialogue in and between California and China, this Institute aims to inform policymakers, foster cooperation and partnership, and drive climate solutions at all levels.

Acknowledgments

This report and analysis were led by the California-China Climate Institute (CCCI) at the University of California, Berkeley. We appreciate the financial support of the Institute for Governance and Sustainable Development.

We would like to gratefully acknowledge helpful comments from the following reviewers of this report: Meian Chen (Institute for Global Decarbonization Progress), Jennifer Turner (Wilson Center), Karen Mancl (Wilson Center), Shivani Shukla (Center for Law, Energy, and the Environment), Gil Damon (Center for Law, Energy, and the Environment), Ken Alex (Center for Law, Energy, and the Environment), Xiaopu Sun (Institute for Governance and Sustainable Development), Richard (“Tad”) Ferris (Institute for Governance and Sustainable Development), Jiang Lin (Lawrence Berkeley National Laboratory), Nina Khanna (Lawrence Berkeley National Laboratory), and Dan Mullen.

SUMMARY FOR POLICYMAKERS

KEY MESSAGES

- China, one of the world's largest methane emitters, must reduce its emissions from rice cultivation and manure management to achieve its national carbon neutrality target. Key challenges relate to data gaps, regulatory frameworks, and the small-scale nature of most farms.
- Reducing methane emission intensity is an effective strategy for reducing rice and manure methane in China. Innovation in low-cost technologies and policy support are needed to improve the profitability of methane mitigation projects.
- Adjustment to the structure of livestock production and consumption is an important driver of manure methane mitigation. Improving anaerobic digesters, dietary changes, and avoiding food waste are potential solutions.
- Mitigation measures should be tailored to regional characteristics. Manure methane mitigation should be prioritized in Sichuan, Hunan, Yunnan, Henan, Guangxi, and western provinces, while rice methane mitigation should be prioritized in Hunan, Jiangxi, Hubei, Anhui, and Jiangsu.
- Establishing a robust monitoring, reporting, and verification (MRV) system is crucial for methane mitigation in China. Various levels of government should support legal, institutional, and technical efforts in MRV development. China must also address gaps in emission data collection and conduct more local studies involving farmers and enterprises to refine its MRV systems.

Methane is a prominent greenhouse gas (GHG) with a high global warming potential compared to carbon dioxide. China is one of the highest methane-emitting countries in the world, and reducing these emissions will be essential to achieving its carbon neutrality goal by 2060. Rice cultivation and manure management are two important sources of the country's methane emissions, together accounting for over half (53.6%) of China's agricultural sector methane emissions and one-fifth of its human-caused methane emissions.

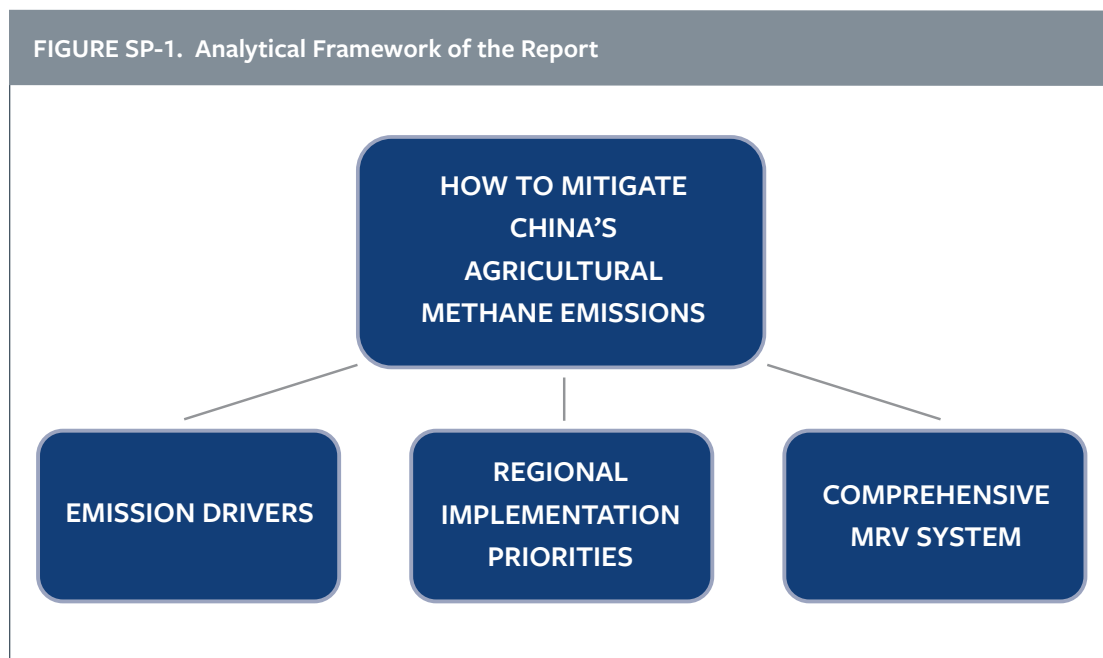
China acknowledges the importance of reducing its methane emissions and has begun taking action. Over the past decade, it has released policies mentioning agricultural methane mitigation and intends to include methane in its 2060 carbon neutrality target. In November 2023, China took a decisive step toward methane mitigation with the release of its first comprehensive, specialized policy document on methane emissions control. This document set targets for manure utilization rates and identified specific rice and manure methane mitigation measures.

China has made some progress in mitigating its agricultural methane emissions. Pilot projects for rice methane mitigation have appeared across the country, while the capacity of biogas power plants using manure keeps increasing. Nevertheless, several challenges remain. Major gaps exist in methane emission data and setting quantitative targets due to a lack of robust monitoring, reporting, and verification (MRV) systems for agricultural methane. Further, regulatory and management frameworks for rice and manure methane also need improvement. The small-

scale nature of most Chinese farms further complicates the widespread adoption of methane mitigation practices.

China can seize significant opportunities for mitigating methane emissions from agriculture. Political momentum supports reducing agricultural methane, and synergies exist between agricultural methane mitigation, the circular economy, and energy security, all of which are near-term priorities for China. The country's voluntary carbon market also offers an incentive for developing rice and manure methane mitigation projects.

To support China's ability to leverage these opportunities, implement its action plan, and ultimately reduce methane emissions, this report presents an integrated analytical framework (Figure SP-1). The purpose of this framework is threefold: (1) to facilitate understanding of the factors driving methane emissions; (2) to reflect regional agricultural contexts and the need for localized policy approaches; and (3) to recognize the need for a robust MRV system to measure the impact of policy. It should be noted that this report will focus only on methane from rice and manure.



Drivers of Agricultural Methane Emissions

China's agricultural methane mitigation efforts should target two key emissions drivers: (1) methane emission intensity; and (2) structural changes in livestock production and consumption.

Methane Emission Intensity

Studies show that reducing methane emission intensity (i.e., the amount of methane emissions per agricultural output value) is an effective strategy for reducing rice and manure methane in China. This requires technological innovation, enabling policies, and improved agricultural practices.

To mitigate rice methane, China should prioritize:

- Reducing technology costs
- Promoting the application of practices such as water management and biochar application
- Improving the collection and transportation system for rice straw
- Integrating technologies for crop yield improvement and soil productivity enhancement in the methane-mitigating technology portfolio.

To address manure methane, China should prioritize:

- Promoting large-scale, integrated manure management measures (e.g., large anaerobic digesters, manure drying, and solid-liquid separation)
- Improving the collection and transportation system for manure.

Supportive policies are also important, particularly those aiming to improve the profitability of emission intensity reduction projects. Potential policy solutions include increasing government financing, implementing climate-smart agricultural commodity programs, and incorporating methane mitigation projects into China's voluntary carbon market through the China Certified Emission Reduction (CCER) program. Collectively, these instruments can help China address its methane reduction challenge by establishing a regulatory and management framework, minimizing gaps in emission data, directing investment to rice and manure methane projects, and promoting mitigation practices, especially at small farms.

Structural Changes of Livestock Production and Consumption

China's rapid economic development has brought growing demand for food, especially beef. Beef production is growing, and cattle farms' profitability is increasing, surpassing that of pig and poultry farms. Studies show that the share of beef production in the livestock industry is an important driver of methane increases, as cattle generally produce more manure methane than goats, sheep, or pigs. Potential solutions (that do not compromise food security) include:

- **Targeted investment and innovation** in anaerobic digesters and manure methane capture. This is particularly important for intensive cattle feeding systems, which help satisfy growing demand for beef but generate more emissions.
- **Encouraging dietary changes** for the public. This will both reduce the overall methane footprint of beef production and improve public health.
- **Reducing food waste**, especially for beef and dairy products, to slow the production of food and its associated manure methane emissions.

Regional Variation in Implementation

China is a large country, with different regions having diverse characteristics of rice cultivation and manure management. Implementing measures tailored to regional circumstances is important for effective methane mitigation.

Sichuan, Hunan, Yunnan, Henan, and Guangxi have the largest manure methane emissions, and China should therefore prioritize these provinces for manure methane mitigation investments. Further, it will also be necessary to improve western provinces' mitigation capacity for methane emissions from manure. This is because China's livestock industry is expected to migrate to these provinces, which have less agricultural infrastructure and human and financial resources compared to other, more economically developed provinces.

Hunan, Jiangxi, Hubei, Anhui, and Jiangsu have the highest amount of rice methane emissions; consequently, China should prioritize these provinces for rice methane mitigation investments. For Hunan, Jiangxi, Hubei, and Anhui, interest in rice farming is waning as people seek higher-paying opportunities in more economically developed provinces nearby (e.g., Guangdong and Jiangsu), making it difficult to promote mitigation technologies in these provinces. It is therefore crucial to explore strategies that not only reduce emissions but also keep rice yield steady or even increase it, thus making cultivation more profitable. Two potential solutions are compensation or subsidies for climate-smart rice farming and the promotion of water-saving and drought-resistant rice breeds in these provinces.

Establishing a Comprehensive MRV System

Robust MRV systems can identify emission trends, pinpoint sources, and guide mitigation actions, making them crucial to successful methane mitigation efforts. However, progress in establishing MRV systems for agriculture has been slow in China compared to other industries, and consequently its MRV systems for agricultural methane are in a nascent stage.

Going forward, China faces both challenges and opportunities for MRV system development:

- 1. Insufficient legal and institutional support exists** for MRV development. The agricultural methane MRV system is a complex structure consisting of laws, regulations, and technical standards whereby the system's operation can be institutionalized. China has not yet established such a structure, leading to challenges in complying with national carbon neutrality targets and developing MRV among localities and businesses due to institutional uncertainty. To address this barrier, China's national departments should lead the development of MRV technical guidelines, which will form the foundation for making subsequent laws and regulations. Designating a government agency to oversee MRV systems for agricultural methane and fostering interagency collaboration will also help.
- 2. Emission data collection gaps must be closed.** The absence of legal and technical standards results in inadequate data to support the monitoring of agricultural methane. China should explore advanced measures (e.g., remote sensing) to enhance methane monitoring and calculate and refine methane emission factors in different scenarios based on monitoring data. Introducing third-party verification is another important measure to ensuring the data quality and credibility of MRV systems.
- 3. More micro-level studies are needed.** Research on agricultural methane emissions monitoring has primarily focused on macro-level analyses at the national and provincial levels, with limited attention given to micro-level studies involving farms and enterprises. However, considering farmers' production decisions and their direct impact on methane emissions is crucial for acquiring accurate data and evaluating trends. Additionally, more studies of farmers' and enterprises' willingness to install MRV systems will provide useful feedback on the overall direction of MRV technology innovation and the refinement of MRV technical guidelines.