

GLOBAL RESEARCH ALLIANCE

ON AGRICULTURAL GREENHOUSE GASES

Cynthia Rosenzweig, Sonali McDermid, Roberto Valdivia, Erik Mencos; AgMIP

Evaluation of Mitigation and Adaptation Co-benefits (MAC-B) of Agricultural GHG Emission Reduction Strategies Over Time

Methane (CH₄) emissions from paddy fields contribute significantly to agricultural greenhouse gas emissions, posing a critical challenge for achieving global climate goals.

Modeling is central to bridging experimental research data with actionable mitigation and adaptation strategies at scale. Current models can reliably simulate yield, water balance, and basic soil–nutrient interactions, but they struggle with trade-offs between methane reduction and nitrous oxide emissions, as well as with integrating soil carbon dynamics.

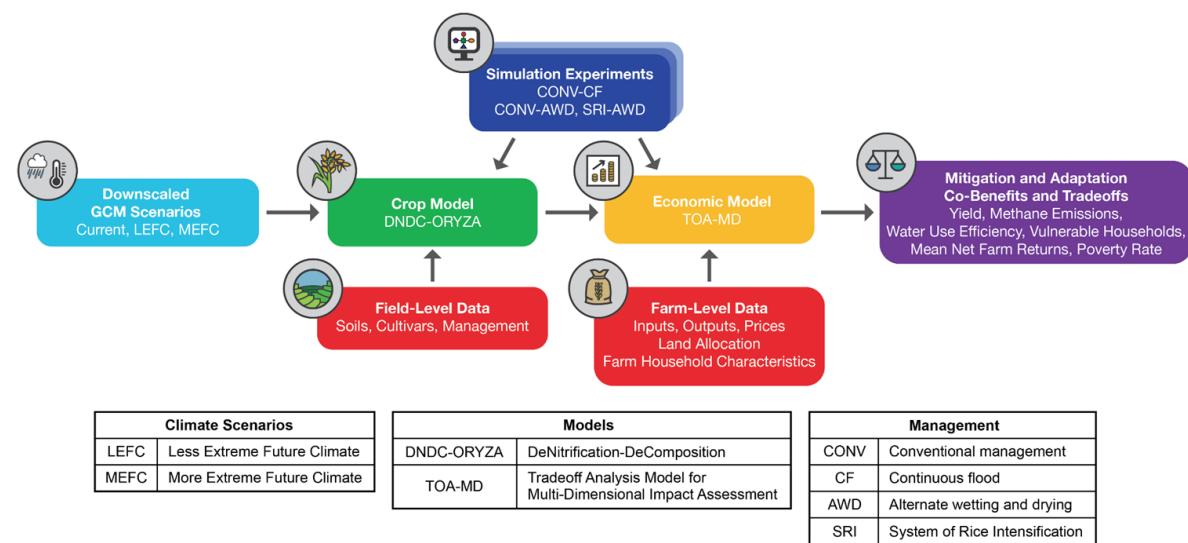
Owing to the serious impacts of the climate crisis in crop production and human health, global assessments of GHG emissions through measurements and modeling are urgently needed to accelerate efforts in developing resilient food systems in all rice-growing countries around the world.

Flagship Project Goal(s)

- **Implement a modeling approach** to rigorously and comprehensively evaluate agricultural practices that deliver both mitigation and adaptation benefits.
- **Work with key stakeholders** to accelerate the process of identifying the most promising options, and thus progress to trialing and scaling more quickly than has generally been done to date.
- **Apply this methodology for major agricultural systems** in many regions worldwide.
- **Link GHG field measurements, process-based modeling, and integrated assessments** for methane mitigation, resilience, MRV, and policy in rice systems.

Anticipated Flagship Outcomes/Impacts

- **New seed grant from Global Methane Hub** to develop a large-scale project to move rice systems from fragmented evidence to scalable climate action.
- **MAC-B Flagship Project has developed protocols** for national stakeholders to learn how mitigation strategies in agriculture interact with climate change, as well as adaptation.
- **MAC-B Flagship pilot project in Bangladesh** funded by ACIAR developed and applied new protocol-based methods to provide country-level decision-makers the evidence needed to ensure mitigation strategies have lasting impact.
- **The project has generated new knowledge with high scientific impact**, including work in Vietnam (data from AgResults) and India (funded by Carnegie Corp.)



Modeling Mitigation and Adaptation Co-Benefits in Rice Systems in Bangladesh
Rosenzweig et al. 2026, ERFS

Flagship Project Partners

GLOBAL
RESEARCH
ALLIANCE

ON AGRICULTURAL GREENHOUSE GASES

Flagship Leadership

- AgMIP
- Oregon State University
- New York University
- Columbia University/NASA

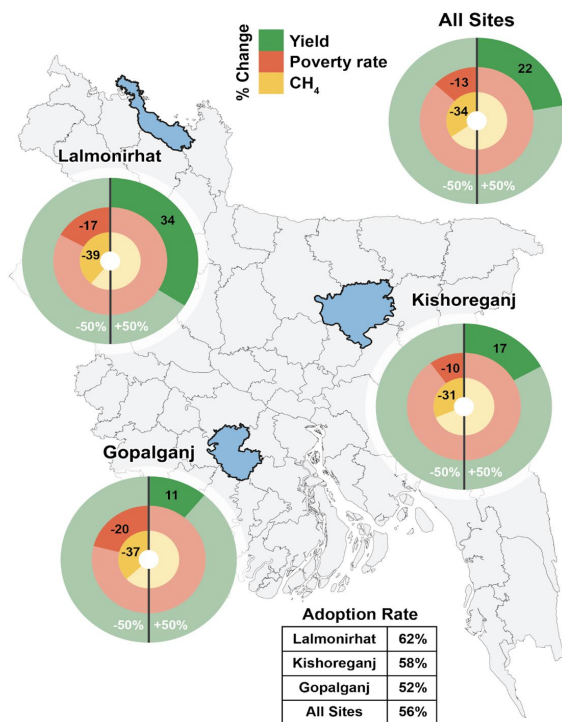
Partners

- International Rice Research Institute
- USDA
- FAO
- JIRCAS
- Regrow

Activities/Results To Date

1. A journal paper 'Modeling Mitigation and Adaptation Co-Benefits in Rice Systems in Bangladesh', based on the results of the MAC-B Flagship activity in Bangladesh, has just been published in *Env. Research: Food Systems*: <https://doi.org/10.1088/2976-601X/ae7e8e>

Relative changes in socio-economic and environmental outcomes resulting from SRI-AWD adoption by CONV-CF farmers



- Climate change (CC) reduces farm net returns at most sites and increases GHG emissions.
- Alternate Wetting and Drying (AWD) shows win-win co-benefits in reducing GHG emissions, increasing income, and reducing poverty rates.
- Sustainable Rice Intensification (SRI) shows the largest benefits.
- AWD and SRI are likely to be more resilient to CC compared to continuous flood systems.

Activities/Results To Date

2. As part of the new work funded by the Global Methane Hub, AgMIP has contributed to a recently published paper:

Rebolledo MC, Saito K, Adam M, Bartholomé J, Castro A, Clerget B, Cordero K, Singh Dhillon B, Dixit S, Fernandez R, Grenier C, Grondin A, Henry A, Katiyar S, **Mencos Contreras E**, Orn C, Peramaiyan P, Perin C, Pradal C, Staiger Rivas S, Senthilkumar K, **Valdivia R** and Alvarez MF (2026) Aerobic rice: a system-based genetic innovation for low water use and methane mitigation. Front. Sustain. Food Syst. <https://doi.org/10.3389/fsufs.2026.1841086>

And we have developed three position papers currently under review:

Minamikawa, K, et al. 2026. Toward Adaptive Yet Comparable Greenhouse Gas Measurements Across Global Rice Systems. Env. Research Letters. Submitted.

Hasegawa, T, et al. 2026. Coordinating Assessment of Climate Adaptation and Methane Mitigation in Rice-based Food Systems. Env. Research Letters. Submitted

Valdivia, R, et al. 2026. From Paddy Fields to Policy: Leveraging Advanced CH₄ Measurement and Modeling to Drive Climate Action and Carbon Market Transformation. Env. Research Letters. Submitted.

Activities/Results To Date

3. Our team has also published the following paper, which describes AgMIP's MAC-B work in Vietnam. This research was funded by Carnegie Corp.

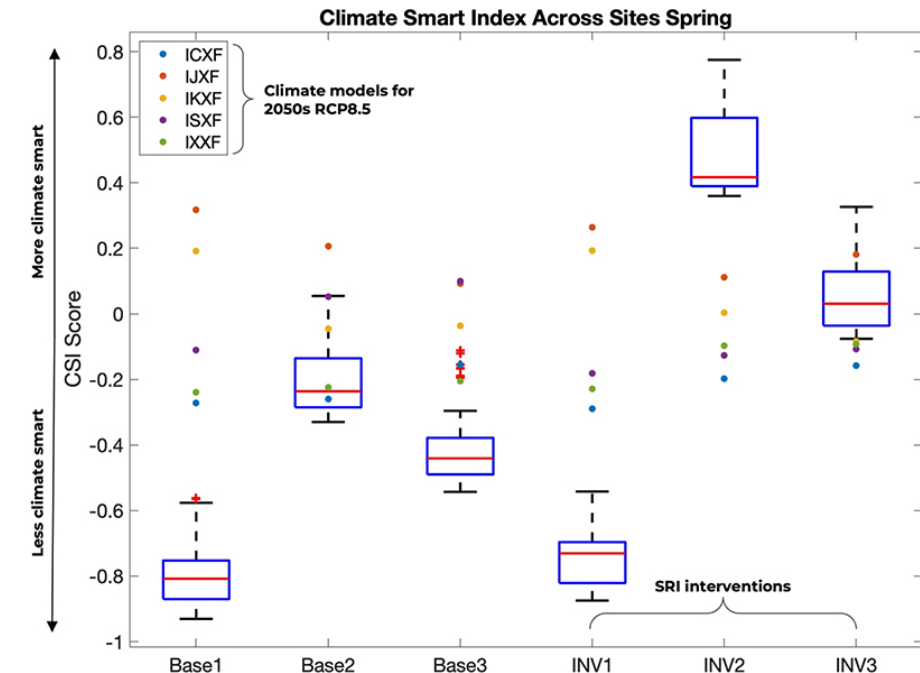
Li, T., **McDermid, S. S., Valdivia, R.**, Sundaram, P. (2024). Climate change mitigation and adaptation for rice-based farming systems in the Red River Delta, Vietnam. CABI Publishing. <https://doi.org/10.1186/s43170-024-00308-0>

This is part of a MAC-B special collection at CABI Agriculture and Bioscience, which also includes:

Hellin, J., Fisher, E., Taylor, M., Bhasme, S. and Loboguerrero, A.M., 2023. Transformative adaptation: from climate-smart to climate-resilient agriculture. CABI Agriculture and Bioscience, 4(1), p.30.

Homann-Kee Tui, S., **Valdivia, R.**, Descheemaeker, K., Sisito, G., Moyo, E.N. and Mapanda, F., 2023. Balancing co-benefits and trade-offs between climate change mitigation and adaptation innovations under mixed crop-livestock systems in semi-arid Zimbabwe. CABI Agriculture and Bioscience, 4(1), p.24.

Iizumi, T., Hosokawa, N. and Wagai, R., 2021. Soil carbon-food synergy: sizable contributions of small-scale farmers. CABI Agriculture and Bioscience, 2, pp.1-15.



Li et al., 2024, CABI A&B

Activities/Results To Date

4. AgMIP hosted its **10th Global Workshop** at CIMMYT in El Batan, Mexico (April 2025) (<https://agmip.org/agmip10/>). One of the key themes of the Workshop was 'Mitigation and Adaptation Co-Benefits and Life Cycle Analysis'. A side-session on 'Rice Modeling for Mitigation and Adaptation' was held with representatives from rice modeling groups from around the world..



Mitigation and Adaptation Co-Benefits and Life Cycle Analysis panelists



IRRI-AgMIP Fluxes and Modeling Workshop

5. AgMIP co-hosted with IRRI The **“Greenhouse Gas Fluxes and Modeling from Rice Workshop”** held from 1–5 September 2025 at the International Rice Research Institute (IRRI), Los Baños, Philippines. The workshop gathered more than 80 participants from 40 organizations across 25 regions and brought together perspectives from research, stakeholders engaged in national GHG inventories, UNFCCC reporting, and the carbon market.

Opportunities to get involved

GLOBAL
RESEARCH
ALLIANCE

ON AGRICULTURAL GREENHOUSE GASES

- Members of all GRA Research Groups can provide data and tools and partner with AgMIP to apply the MAC-B protocols for a range of agricultural systems.
- The 11th AgMIP Global Workshop (AgMIP11) will feature “Mitigation and Adaptation Co-Benefits and Trade-Offs” as one of its key themes. We welcome participation from all members of the GRA at the workshop

Feb 22-26, 2027 at ILRI in Nairobi, Kenya: <https://agmip.org/agmip11/>

Contacts: crr2@columbia.edu; Roberto.Valdivia@oregonstate.edu;
sps246@nyu.edu; erik.mencos@columbia.edu

