IRRI International Rice Research Institute

CGIAR

Low emissions rice and way forward for sustainable Agri-food system

Ando M. Radanielson

Session 2 – Can We Feed the World with Net Zero Emissions? August 12, 2025

Crawford Fund FOR A FOOD SECURE WORLD

The Crawford Fund Annual Conference

Progress and Prospects for Climate-Resilient Agrifood Systems: Actionable Recommendations for Policymakers and Practitioners

11-12 August 2025

Parliament House, Canberra, Australia, and online

Rice: The crop that feed us

Land Use
10% of total crop land

Feeds
4 billion people
56% of world population

Feeds
+ 135 million people

Land Use
10% of cropped land

2030

Kruseman et al 2020

Rice production for global food security by 2030

(1) Scope to sustainably increase rice production was assessed across four sites in Southeast Asia

(2) Rice yield gaps were decomposed into efficiency, resource and technology yield gaps using a novel approach combining crop modelling and stochastic frontier analysis

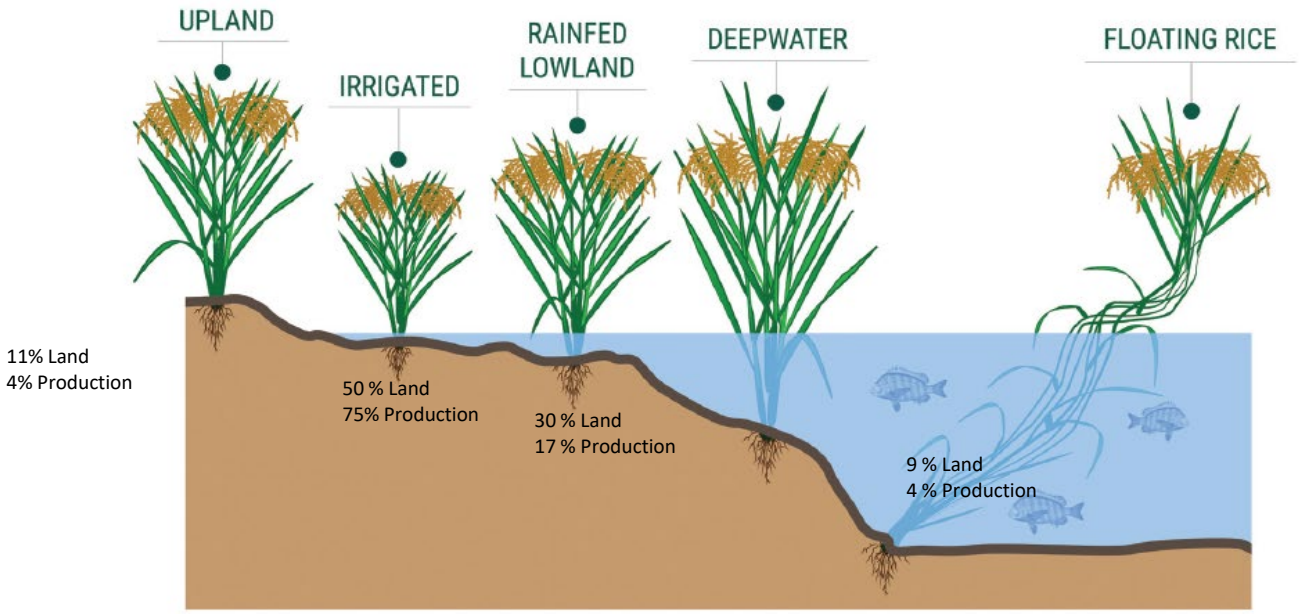
Ayeyarwady Delta Bago, Myanmar	**Java** Yogyakarta, Indonesia	**Chao Phraya** Nakhon Sawan, Thailand	**Mekong Delta** Can Tho, Vietnam
			
➢ Yield gap = 75% of Yp ➢ Narrow resource yield gaps through improved access and use of fertilizers and other inputs	➢ Yield gap = 57% of Yp ➢ Fine-tuning management practices to narrow efficiency yield gaps, while reducing fertilizer use	➢ Yield gap = 47% of Yp ➢ Integrated management practices to narrow efficiency, resource and technology yield gaps	➢ Yield gap = 44% of Yp ➢ Fine-tuning management practices to narrow efficiency yield gaps

This novel approach identified context-specific opportunities to narrow yields towards sustainable intensification of rice production systems in Southeast Asia

Addressing Yield Gaps with significant production increase

Silva et al 2022

Rice production for global food security by 2030

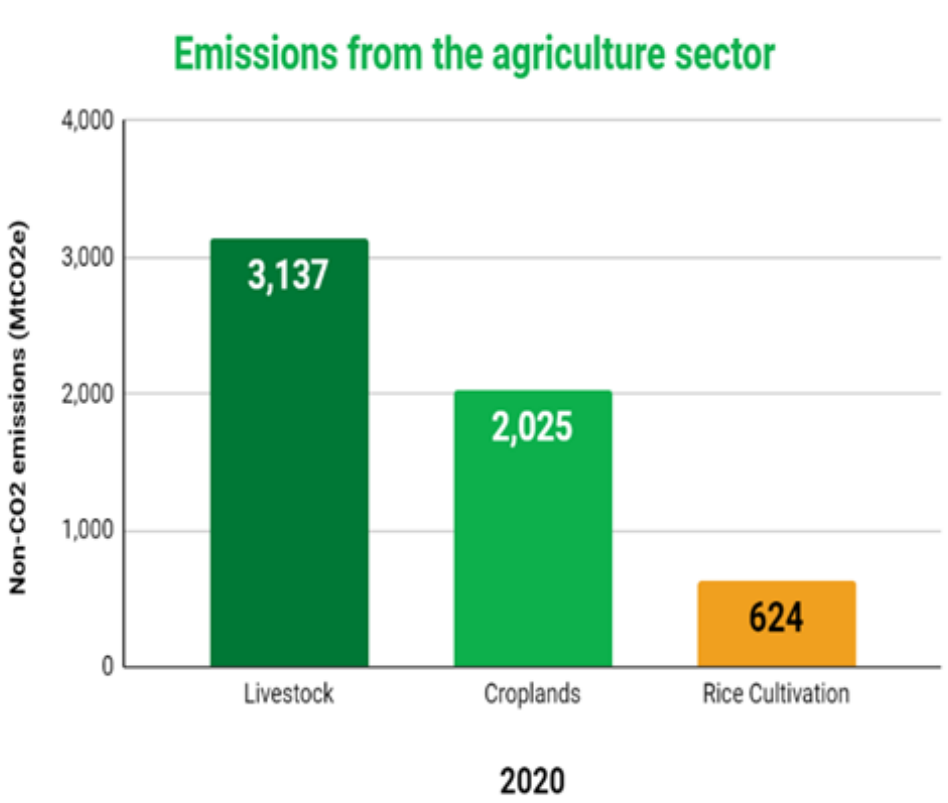


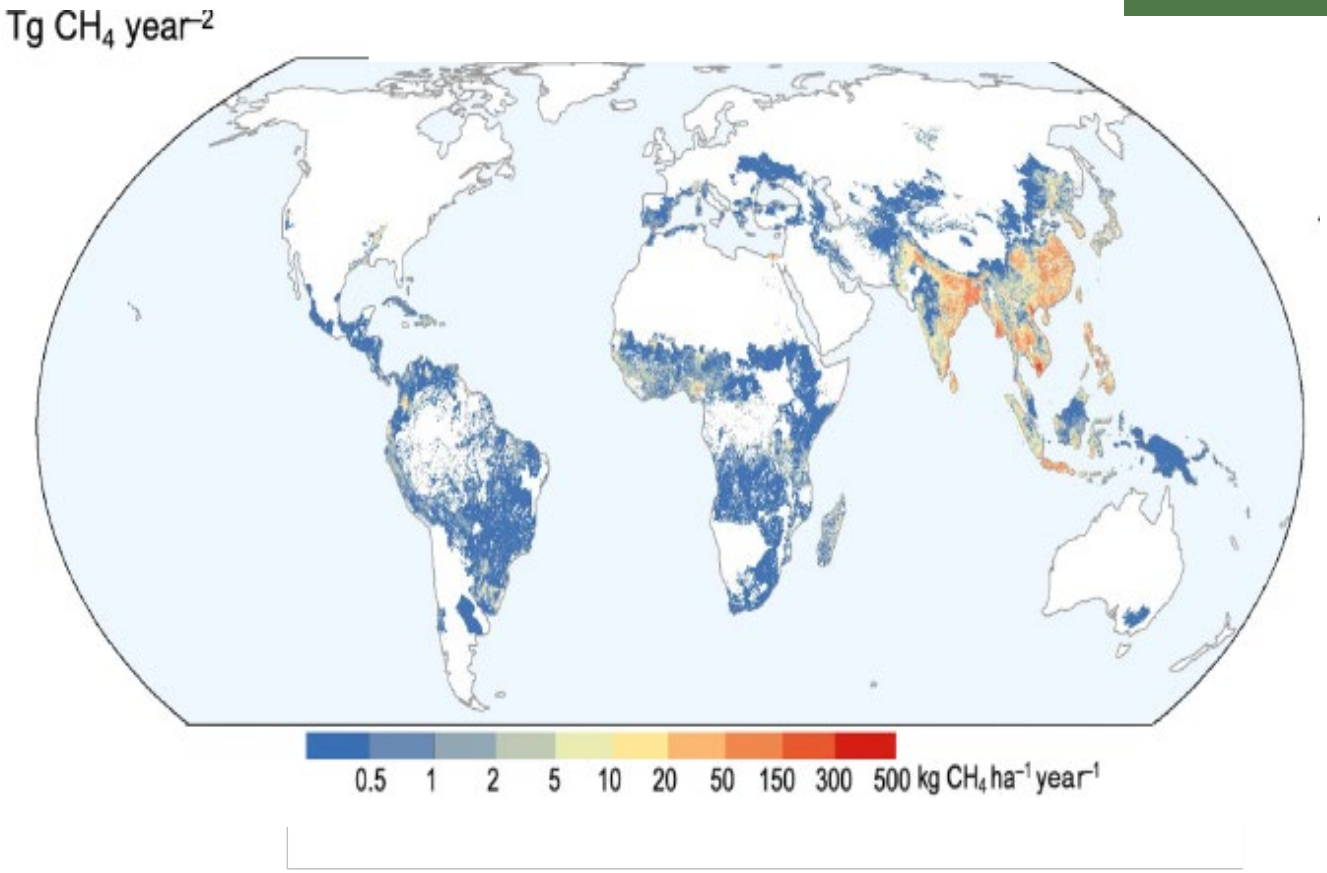
Year	2010	2030	2050	% change (2010–2050)
Cropped land (million ha)				
World	152.73	153.74	152.45	−0.18
Asia	135.31	134.47	131.51	−2.81
Africa	9.01	10.99	12.86	42.65
MENA				
SSA	8.36	10.39	12.25	46.6
LAC	6.42	6.22	5.79	−9.85

Expansion to new areas as land suitability shifts with climate change

Maclean, 2002; Dobermann et al., 2004, Kruseman et al, 2020

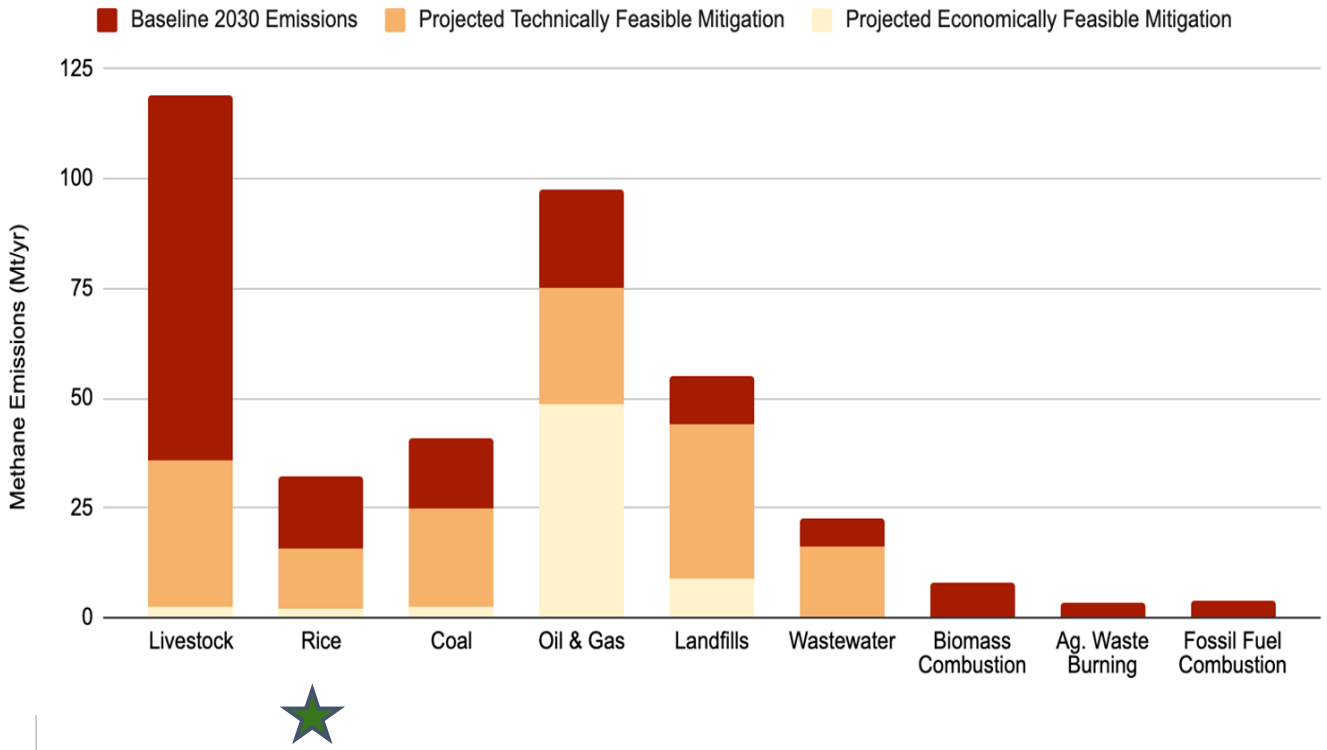
Rice: A contributing factor to emissions

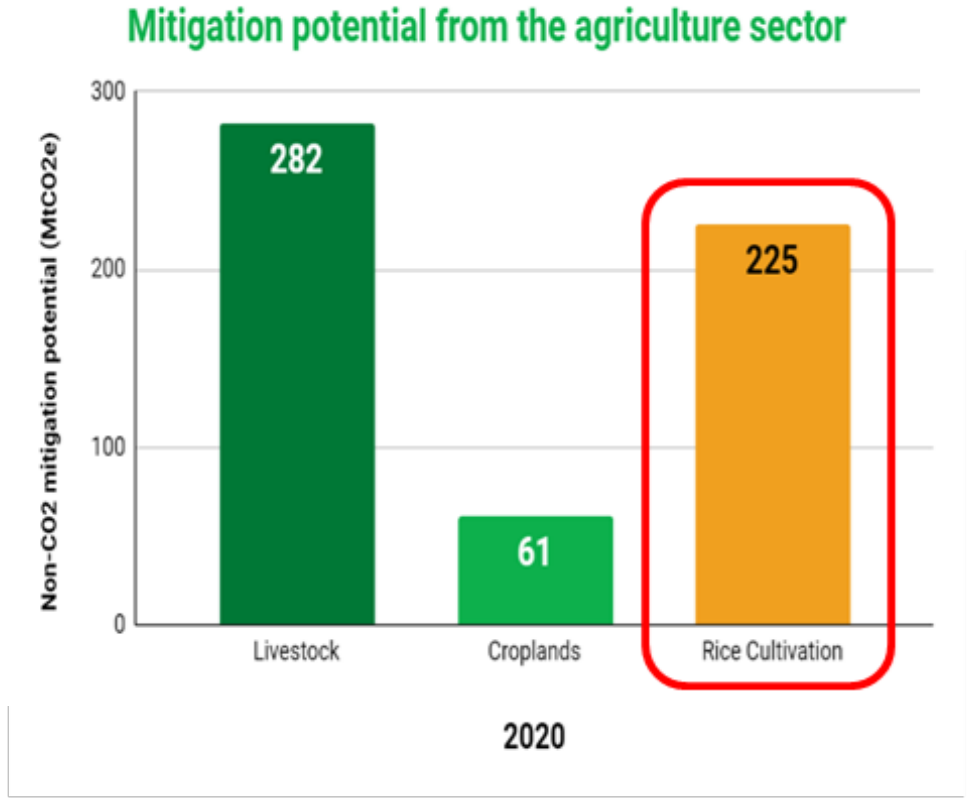




(Roe et al, 2021, Wang et al 2023)

Rice: A solution to transition to net Zero





(Roe et al , 2021Ocko et al. 2021 & Davidson et al 2023)

Global climate action efforts to reduce emissions

13 CLIMATE ACTION

30% GHG reduction

2030

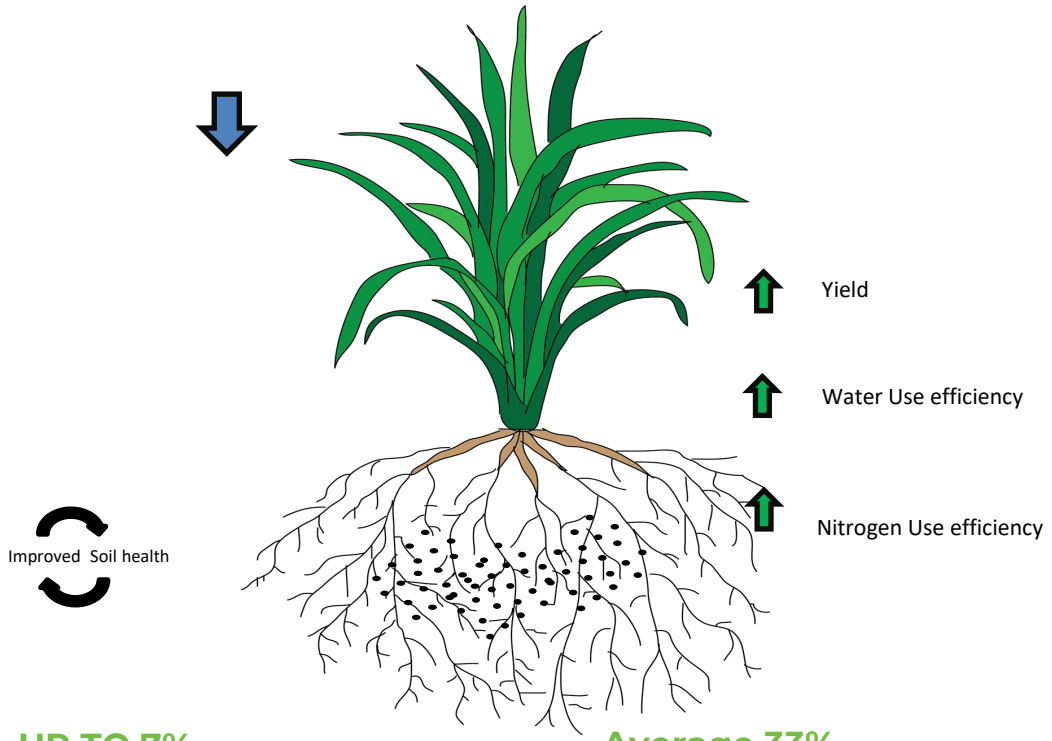
https://www.globalmethanepledge.org

Low Emissions Rice Systems

IRRI

INNOVATIONS FOR
LOW EMISSION
RICE SYSTEMS

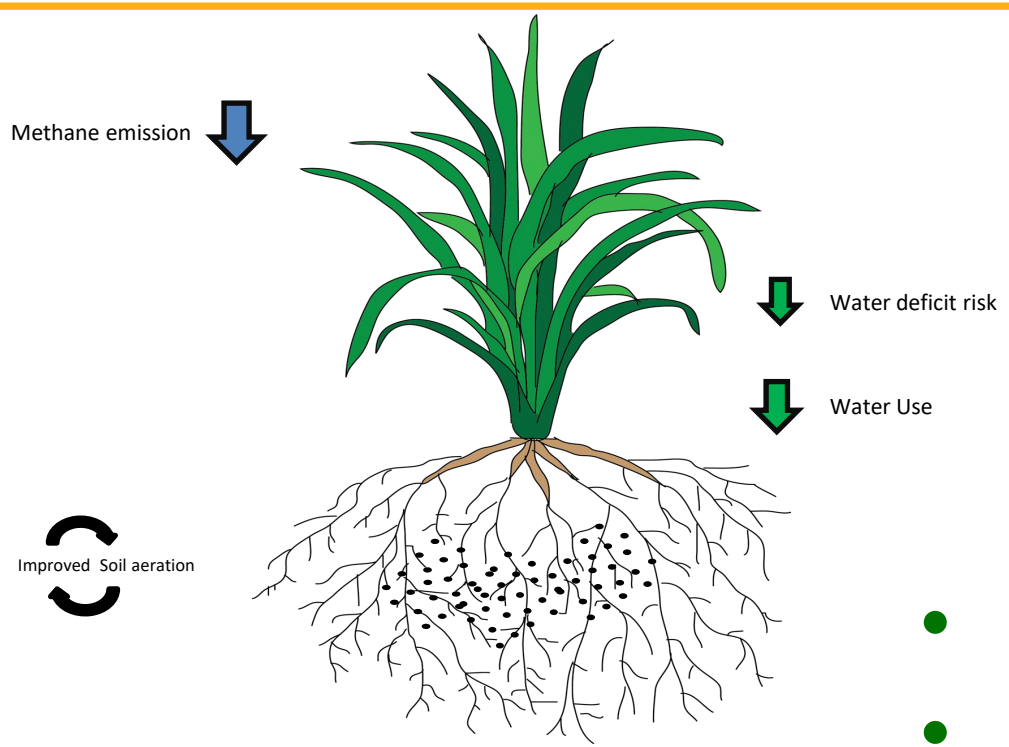
GHG/ CH4
Reduction



10 %	UP TO 7%	Average 33%	UP TO 15%
Timing of residue incorporation	Planting short-duration rice varieties	Alternate Wetting & Drying, Efficient use of fertilizer	*Amount* of residue left after harvest

Nguyen et al 2019

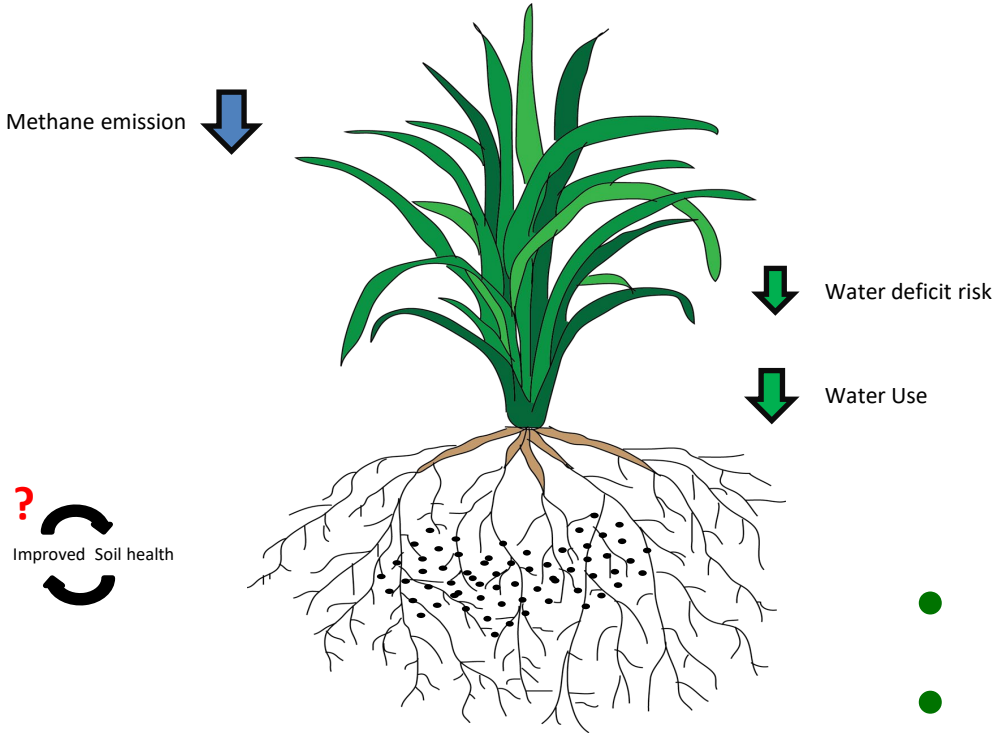
Low Emissions Rice Systems with AWD



- Water use reduction by 15-30%
- Methane emissions reduction by ~ 50%
- Yield ~ increase by 0-10%

(Lampayan et al 2015)

Low Emissions Rice Systems with AWD



- Water use reduction by 15-30%
- Methane emissions reduction by ~ 50%
- Yield ~ increase by 0-10%
- Suitability – MapAWD
- Incentives : Carbon credits and Co- benefits

Carbon Registries for certifying emission reduction in rice

United Nations
Framework Convention on Climate Change

Gold Standard
Climate Security & Sustainable Development

Verified Carbon Standard
A VERRA STANDARD

SOCIALCARBON®

AWD in Methodologies

- **Clean Development Mechanism (CDM): *AMS-III.AU***
  - Initially developed for Kyoto Protocol (mandatory emission reduction)
  - Previously accepted by voluntary carbon markets (VCS, Gold Standard, etc.) but as of March 20, 2023 Verra has inactivated the methodology

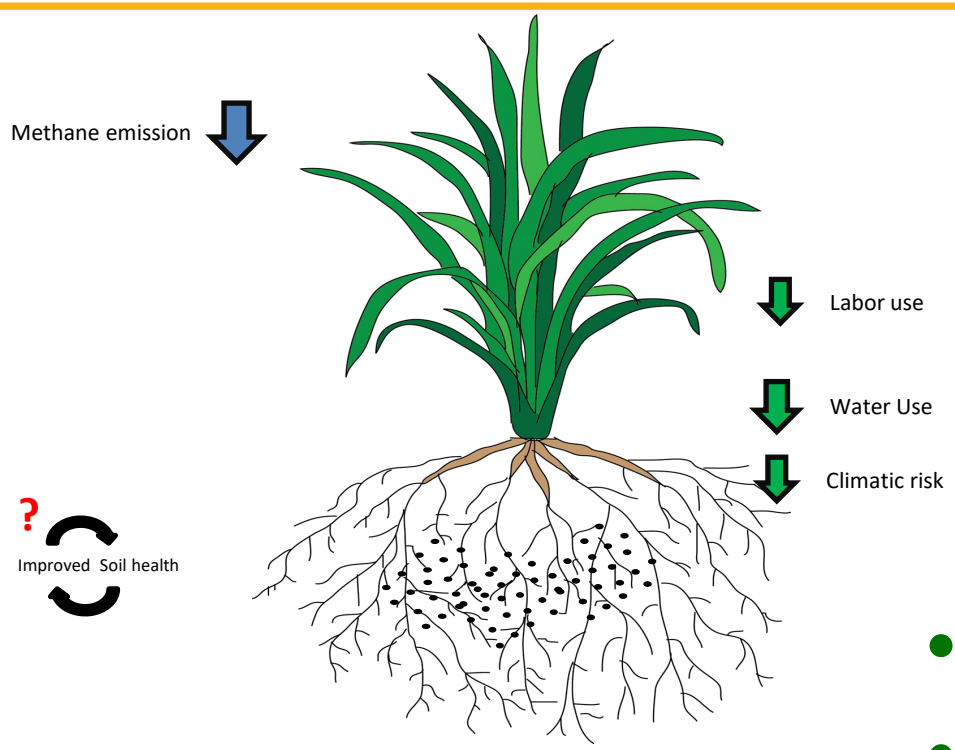
Voluntary carbon market approved methodologies:

- Gold Standard: Released July 7, 2023 - Methane emission reduction by adjusted water management practice in rice cultivation - includes N20; field stratification; standardized in-field measurements; all project sizes; new additionality requirements

- Verra VCS: ***VM0042*** *Methodology for Improved Agricultural Land Management* (complex models, not appropriate for flooded paddy soils or small-scale, highly variable management; focused on increasing soil organic carbon (SOC) storage)

- Social Carbon registry: SCM0002: Methane emission reduction by adjusted water management practice in rice cultivation

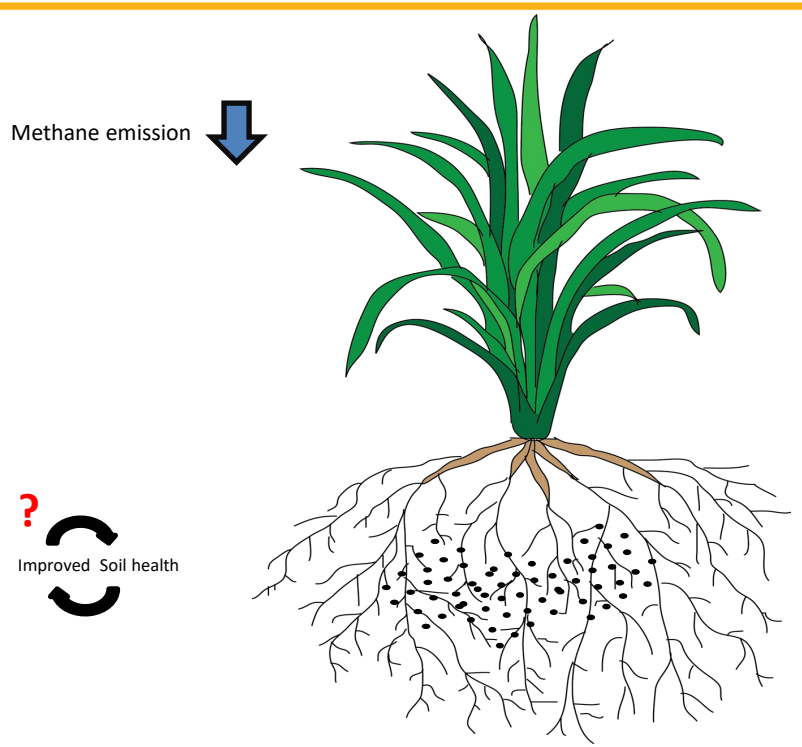
Low Emissions Rice Systems with DSR



- Labor and water use reduced by 15-30%
- Climate risk reduced
- Methane emissions reduction by ~ 25%
- Accessibility and affordability

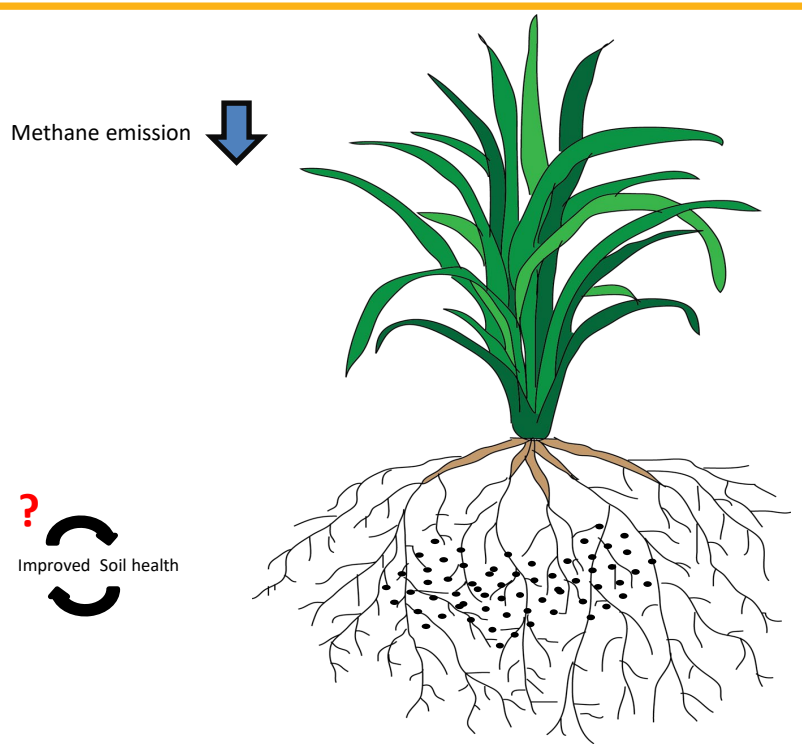
Ahmed et al 2025

Low Emissions Rice Systems with ISM



- Removal reduce emission by ~ 50%
- Early incorporation by 15%
- Behavior change and Economic Viability

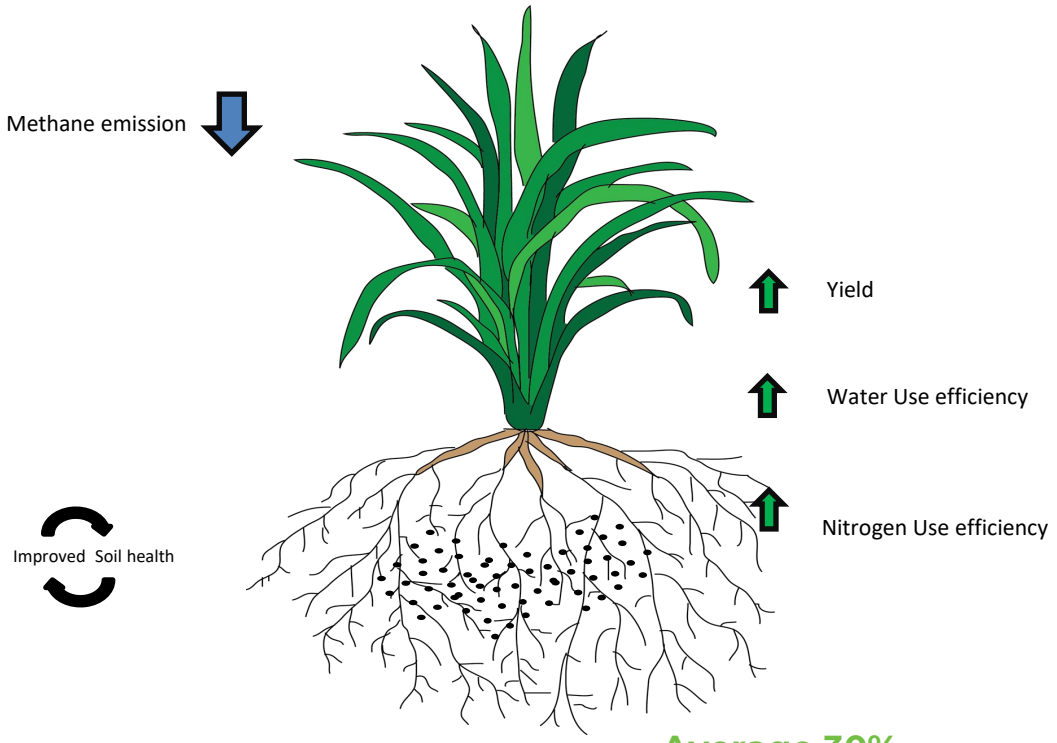
Low Emissions Rice Systems with HYV



- Yield increase by ~ 20%
- Short duration variety Emission reduced by 7%
- GHG Intensity reduced up to 30 %
- Availability and site specific responses (Vo et al 2025)
- Further research for targeted breeding and recommendations

(Vo et al 2024, Kathibi et al 2025)

Scaling Low Emissions Rice Systems



- **Interactions**
- **Methodologies for carbon accounting**

UP TO 10%

Average 30%

UP TO 15%

+ 11%

DSR Amendments → HYV → AWD → *ISM*

+ 20-25 %

New indicator

MRV Systems

Summary

- Low emissions system is key for sustainable intensification and expansion to meet the growing population demand for rice and the global targets towards net zero
- Solutions are available, feasible and economic viable for rice systems particularly with the emerging rice carbon market system
- Advancing our understanding of the interactions low emissions practices may provide opportunities for fit of purpose packaging of low emissions systems and leverage their co benefits that farmers and consumers are more receptive of.

Low emissions rice systems provide opportunity for additional value creation in rice systems BUT require targeted interventions and transparent and robust MRV.

Way forward- A new model of partnership

Thank you

a.radanielson@cgiar.org