

## SESSION 2: CASE STUDY 1

### Low emissions rice and the way forward

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#### Abstract

Rice consumption is expected to increase by up to 50% from 2010 levels by 2050, with demand largely in Asia and, more recently in Africa. Rice-growing areas will need to intensify and expand in these regions. Conventional intensified irrigated rice systems have been critical in ensuring global food security. They are also among the major sources of anthropogenic Greenhouse gas (GHG) emissions, particularly methane and nitrous oxide. Practice changes towards climate-smart agriculture and low-emissions management, such as direct seeded rice (DSR), alternate wetting and drying (AWD), short duration variety and improved straw management, have led to increased yields, reduced inputs use and cost of production, and GHG emission reductions averaging from 7% to 30% across

different regions. These benefits are site-specific and depend on the local context of production, requiring strategic packaging and targeted implementation. This presentation will provide an overview of our current understanding of the impacts and co-benefits of proven low-emission practices as well as the challenges to their scalability. We will also explore emerging technologies such as varietal improvement and soil health engineering that present potential for emission reductions. Finally, we will discuss how these solutions can accelerate the system transformation and how partnerships and collaboration among development organisations, private and public institutions can co-create ethical and sustainable impact for rice farmers, consumers and the planet at scale.

#### Introduction

Rice is more than just a crop — it is life for nearly half of humanity. It grows on around 10% of the world's cropland and underpins food security across Asia and beyond. By 2030, the world will need to feed another 135 million people, largely with the same land we farm today. That means we must grow more food without expanding land use — and we must do so sustainably. But rice is also a significant contributor to greenhouse gas emissions. Globally, rice is the second-largest source of methane, after livestock (FAO, 2021). In countries like Vietnam and the Philippines, rice is the single largest source of methane, even exceeding the transport sector. For these countries, reducing rice-related emissions is not only a sustainability question but also a food security imperative.

### Rice and the Transition to Net-Zero

Rice offers a paradox. It contributes substantially to emissions, yet it also provides some of the most immediate and technically feasible mitigation options in agriculture. Unlike fossil fuels, where technological transitions take decades, rice already has solutions that can reduce emissions today.

Estimates suggest that rice has a mitigation potential of up to 36% of its total emissions, making it nearly as significant as livestock in absolute terms but proportionally even more impactful (IPCC, 2019). This positions rice as a key sector in the global transition to net-zero, supporting the broader climate commitments such as the Paris Agreement's goal of limiting warming to well below 2°C.

### Defining Low-Emission Rice Systems

Low-emission rice systems are not about sacrificing yield. Smallholder farmers, who dominate rice cultivation, cannot afford to reduce productivity. Instead, these systems integrate practices that sustain or increase yield while improving resource efficiency and reducing emissions.

Examples include:

- **Improved straw management:** Incorporating rice straw earlier can reduce methane by 10%; removing or repurposing straw can cut emissions by 15–50% (Yadav et al., 2019). Repurposing straw is an alternative to burning, though adoption requires labour, logistics, and incentives.
- **Short-duration varieties such as Hybrid:** Can lower emissions by 7% while increasing yields by 20% compared to traditional varieties (Peng et al., 2021).
- **Improved water management:** Alternate wetting and drying (AWD) can reduce methane by 30–50% and lower water use by up to 30% (IRRI, 2019).
- **Direct-seeded rice:** Expanding rapidly in India, this practice reduces water use and labour needs while lowering emissions by 25% (Chauhan et al., 2015).

Individually, these technologies have a significant impact. When combined, they could reduce rice emissions by as much as 65%. But adoption is uneven and often driven by goals like water savings or yield improvement, rather than explicit climate mitigation.

### Incentives and Carbon Markets

The challenge is scaling. Practices like AWD or direct seeding require farmers to deviate from traditional methods, facing risks like weed pressure or upfront equipment costs. Incentives are essential. Carbon markets are emerging as one pathway to support the adoption of low-emissions practices. In rice systems, AWD has been recognised as the Clean Development Mechanism since 2015 and for voluntary markets like Gold Standard and Verra for carbon claim (Choudhury et al., 2022). Carbon credits can provide financial rewards, but they require robust monitoring, reporting, and verification systems — a major challenge to implement in small holding systems, such as in many rice-growing regions.

### Challenges and Trade-Offs

Despite promising technologies, several challenges hinder the scaling of low-emissions rice systems:

- **Access to required machinery and infrastructure** remains limited for many farmers,

- There remains **limited understanding of how various mitigation strategies interact** when applied together, complicating integrated approach development. Most are tested in isolation.

Some promising emerging approaches include:

- Biochar applications, potentially reducing emissions by 11% (Jeffery et al., 2017).
- Chemical amendments and biostimulants, offering 20–25% reductions while further validations may be needed.
- High-yielding, climate-resilient varieties, with site-specific impacts considering the greenhouse gas intensity indicator. s

However, we lack a clear understanding of how these interventions interact when combined. Developing integrated technology packages will be critical for practical adoption. Addressing the above challenges and gaps are essential for establishing comprehensive and scalable solutions in rice systems.

### **The Way Forward**

Low-emission rice systems represent both a challenge and an opportunity. They are essential for sustainable intensification, meeting the rising demand for rice, and contributing to global climate goals.

To advance, we must:

- Package technologies into site-specific, farmer-friendly solutions.
- Build transparent monitoring and verification systems.
- Provide incentives, especially through carbon finance.
- Strengthen partnerships among universities, research institutes, governments, and development organisations.

Net Zero Rice production may not be the ultimate goal in transforming rice systems towards sustainability outcomes, but reduced and lower-emitting rice systems can help drive the global transition to net-zero, providing immediate and scalable mitigation while sustaining the food security of billions.

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