

# **Assessing the carbon footprint of rice within different mechanization scenarios**

---

**Dr. Björn Ole Sander**  
Senior Climate Change Expert  
Country Representative to Vietnam  
International Rice Research Institute (IRRI)

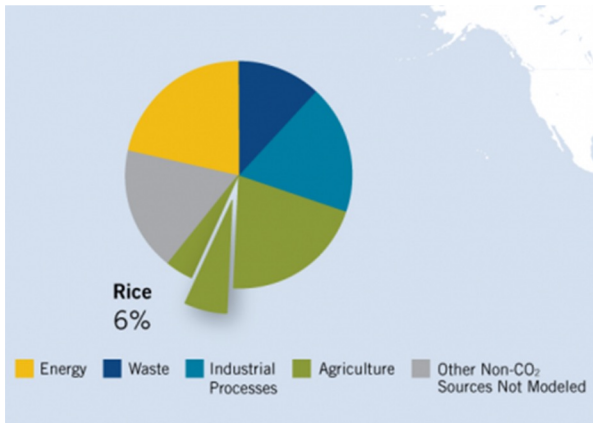
# OUTLINE

- GHGs in rice
- The CF-Rice tool
- Carbon Footprints



# Rice as a GHG source

## Global Non-CO<sub>2</sub> GHG emissions

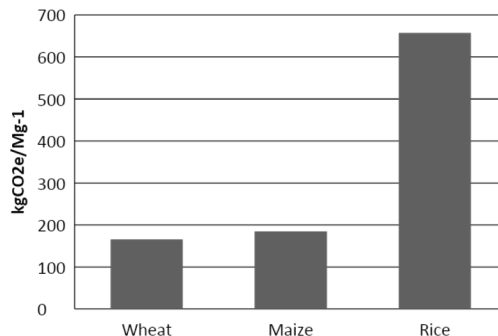


Source: [https://19january2017snapshot.epa.gov/global-mitigation-non-co2-greenhouse-gases/global-mitigation-non-co2-greenhouse-gases-rice\\_.html](https://19january2017snapshot.epa.gov/global-mitigation-non-co2-greenhouse-gases/global-mitigation-non-co2-greenhouse-gases-rice_.html)

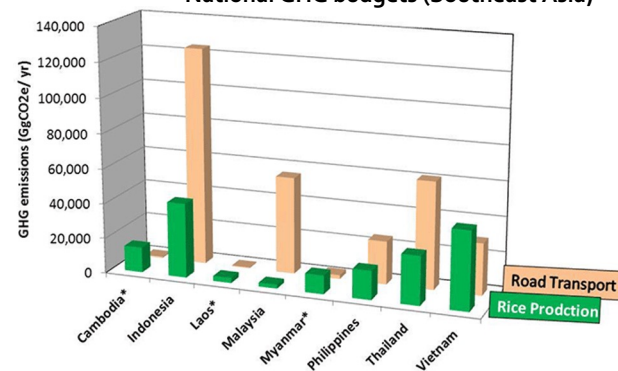
## Greenhouse gas emissions from rice

- Globally rice, wheat, and maize provide similar amounts of calories and protein
- Yet rice emits significantly more greenhouse gases

### Cereal crop GHG emissions



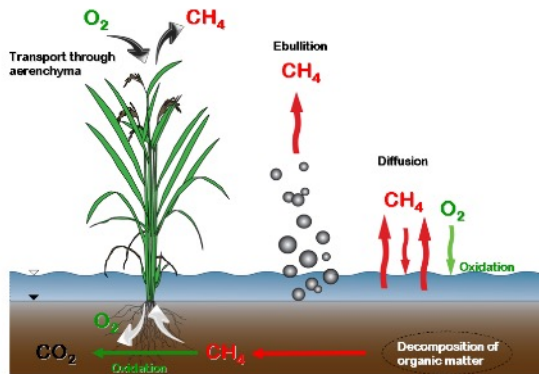
### National GHG budgets (Southeast Asia)



# GHG emissions vs. carbon footprint

## GHG emissions:

Amount of GHG emitted at field level



**Unit:**

**kg CO<sub>2</sub>e/ha/year**

**Target group:**

Researchers, government agencies

## Carbon Footprint:

Amount of GHG emitted during the entire value chain of a rice product



**Unit:**

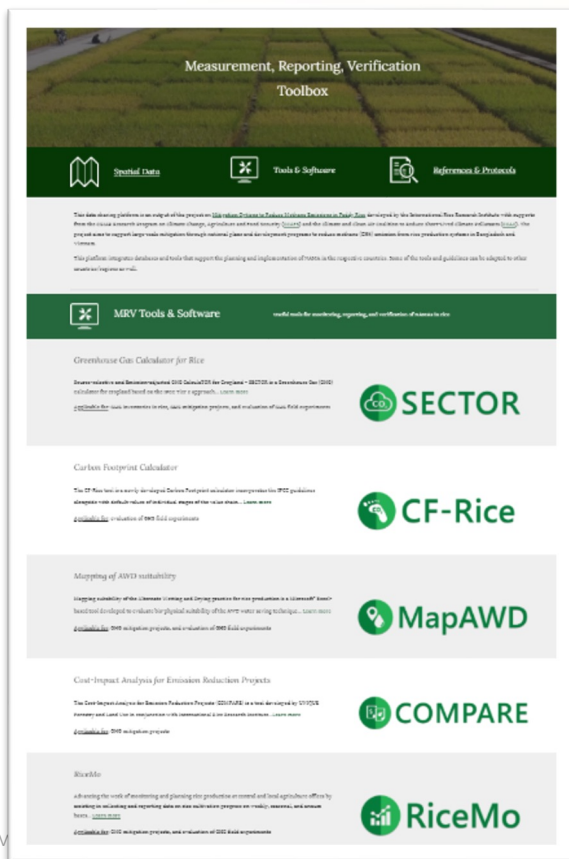
**g CO<sub>2</sub>e/kg rice**

**Target group:**

Consumers, traders, retailers etc.



# GHG calculation tools



**Measurement, Reporting, Verification Toolbox**

**MRV Tools & Software**

**Greenhouse Gas Calculator for Rice**

Greenhouse Gas Calculator for Rice (GHG-CR) is a tool developed by IRRI to estimate the GHG emissions from rice production. It is a web-based tool that calculates the GHG emissions from rice production based on the area, rice yield, and other parameters. [Learn more](#)

**Carbon Footprint Calculator**

The CF-Rice tool is a newly developed tool for calculating the carbon footprint of rice products. It is a web-based tool that calculates the carbon footprint of rice products based on the area, rice yield, and other parameters. [Learn more](#)

**Mapping of GHG emissions**

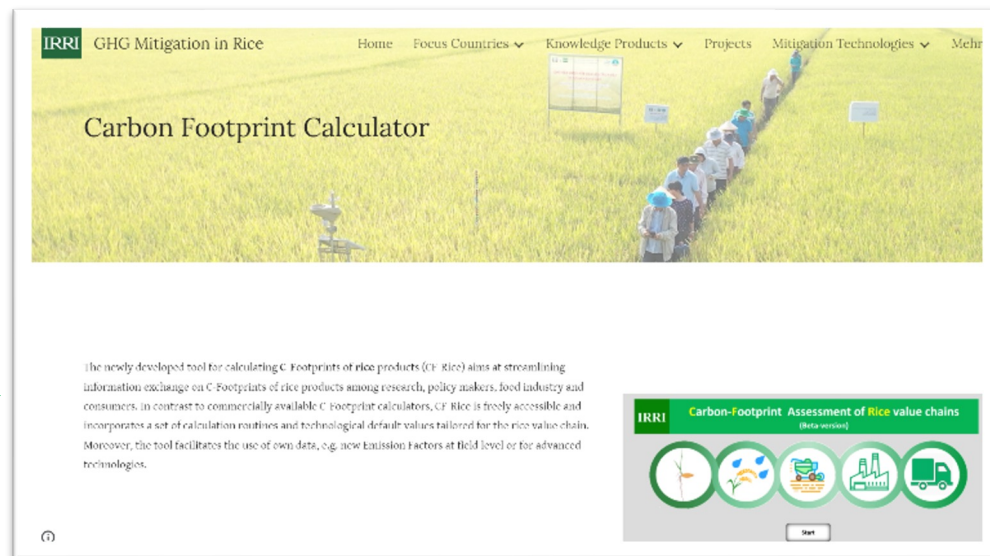
Mapping of GHG emissions (MapAWD) is a tool developed by IRRI to estimate the GHG emissions from rice production. It is a web-based tool that calculates the GHG emissions from rice production based on the area, rice yield, and other parameters. [Learn more](#)

**Cost-impact Analysis for Emission Reduction Projects**

The Cost-impact Analysis for Emission Reduction Projects (COMPARE) is a tool developed by IRRI to estimate the GHG emissions from rice production. It is a web-based tool that calculates the GHG emissions from rice production based on the area, rice yield, and other parameters. [Learn more](#)

**RiceMo**

RiceMo is a tool developed by IRRI to estimate the GHG emissions from rice production. It is a web-based tool that calculates the GHG emissions from rice production based on the area, rice yield, and other parameters. [Learn more](#)



**IRRI GHG Mitigation in Rice**

**Carbon Footprint Calculator**

The newly developed tool for calculating C footprints of rice products (CF-Rice) aims at streamlining information exchange on C Footprints of rice products among research, policy makers, food industry and consumers. In contrast to commercially available C Footprint calculators, CF-Rice is freely accessible and incorporates a set of calculation routines and technological default values tailored for the rice value chain. Moreover, the tool facilitates the use of own data, e.g. new emission factors at field level or for advanced technologies.

**IRRI Carbon-Footprint Assessment of Rice value chains (Beta version)**

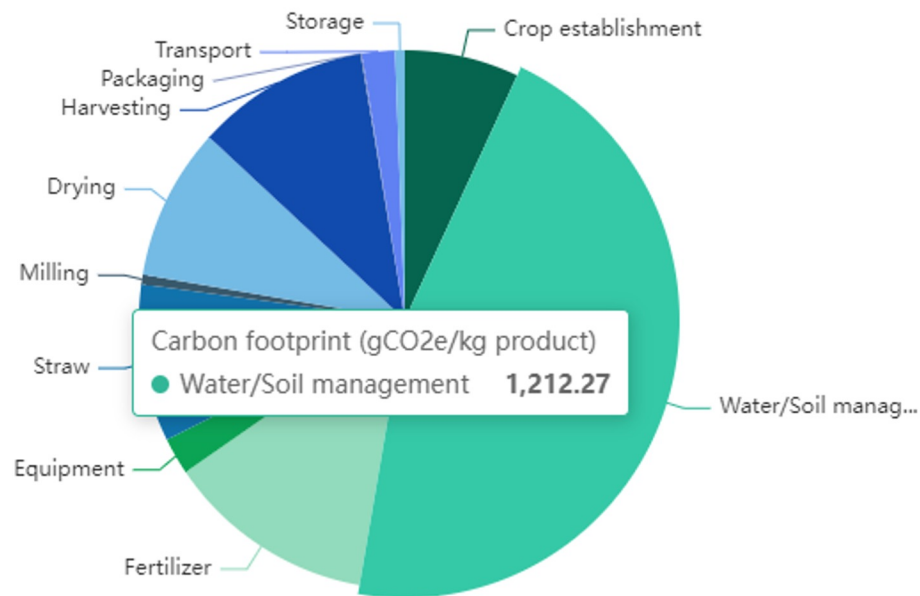
[Start](#)

**GHGmitigation.irri.org**  
**CFRice.irri.org**



# Carbon Footprint Assessment of Rice Value Chains

- Incorporates the emissions from field activities and off-field processes
- Accounts for losses during harvest and post-production processes and calculates emissions resulting from food loss
- Product-scaled emission results (kgCO<sub>2</sub>e per kg of product)
- Includes default measurements and the ability for users to enter values manually
- Tool for monitoring, reporting, and verification of low-emission practices along the entire rice value chain



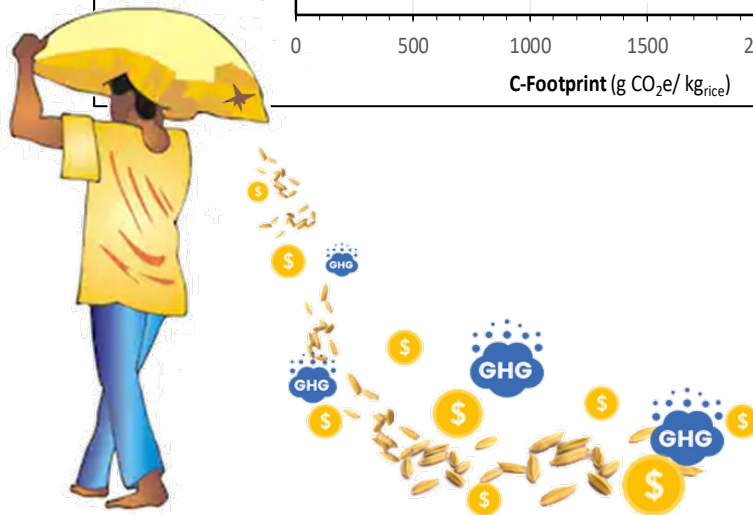
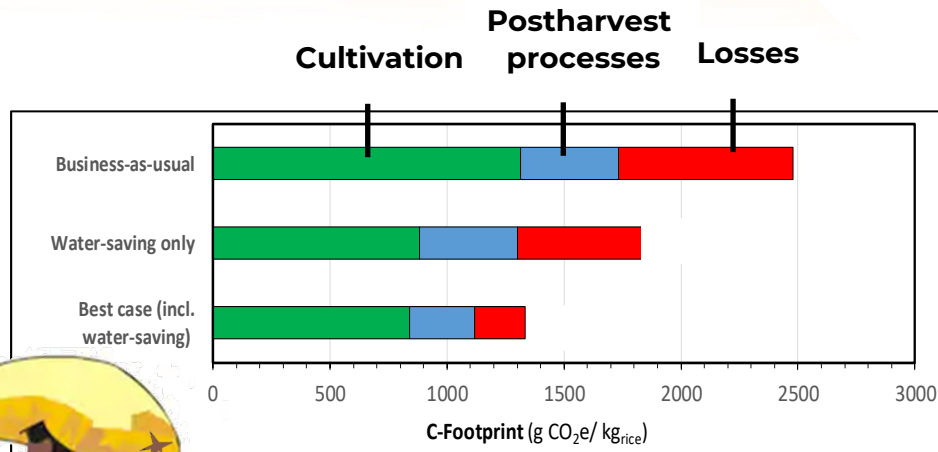
# Efficiency gains to reduce the Carbon Footprint

## Losses are unnecessary emissions

- Convert losses into equivalent GHG emissions
- Calculate the economic value of the losses
- Win-win: More efficient value chain, lower C-footprint

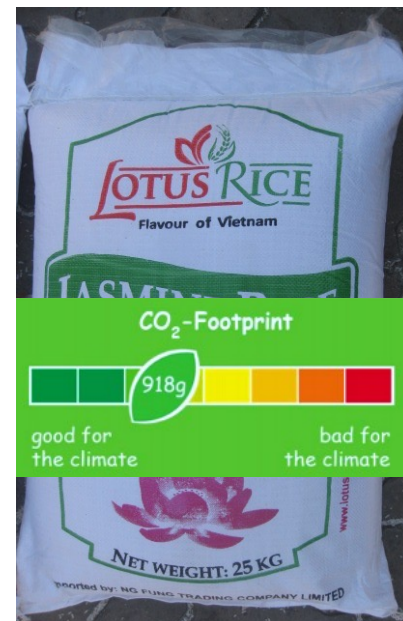
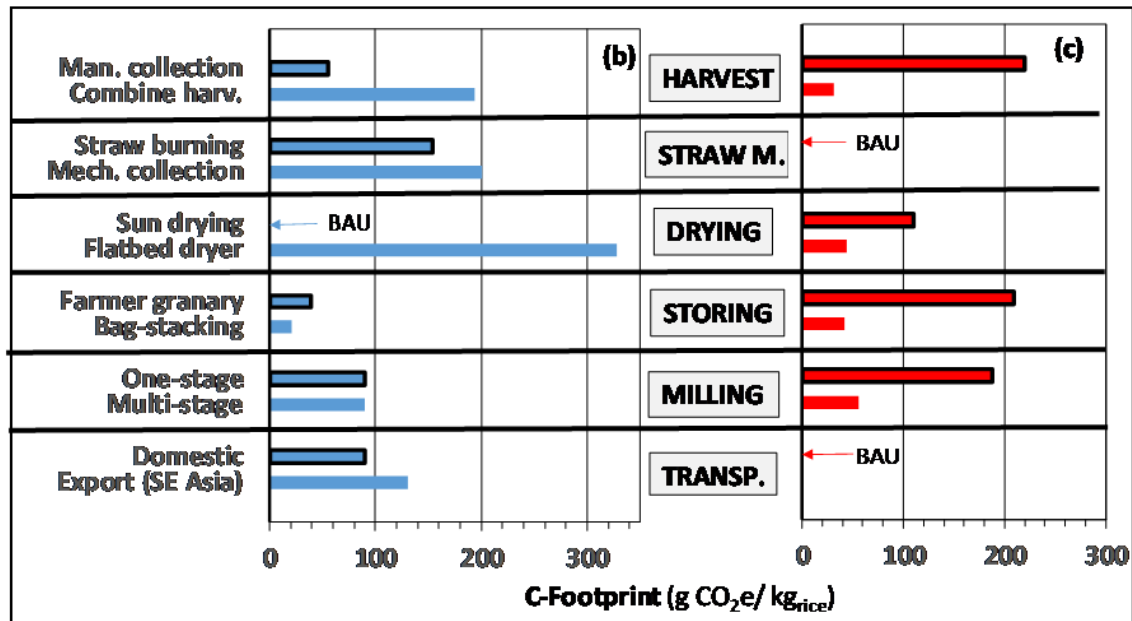
## Carbon Footprint reduction

- Increasing efficiency reduces the relative emissions per grain
- Assessing the economic and climate impacts of improved cultivation and post-harvest practices along the rice value chain



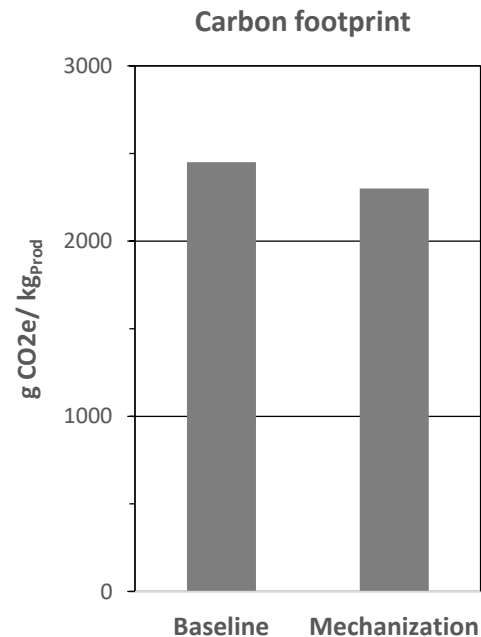
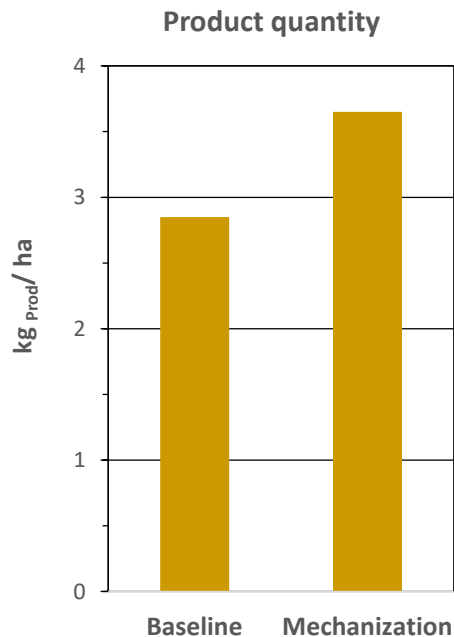
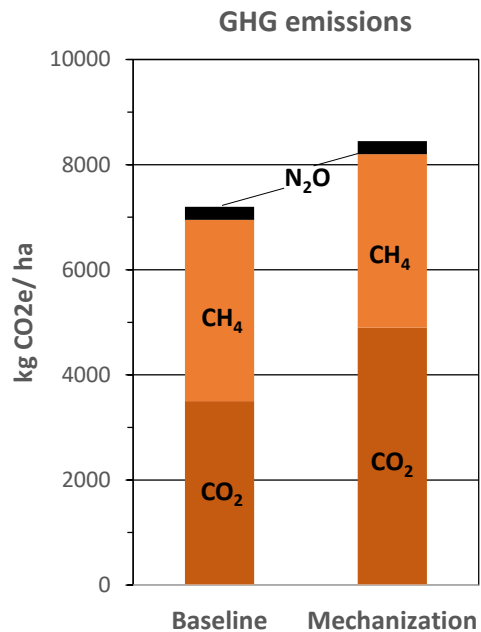
# Emissions and losses at different steps of the rice value chain

- Different technologies are associated w/ different amounts of GHGs (blue) and losses (red)
- Mechanization of value chain steps reduces losses





# Scenario Assessment: Mechanization



# Mechanization options in rice with mitigation co-benefits

**Laser land leveling (LLL)**



- Income ↑ 10-25% (5-year cycle)
- GHGs ↓ 10% (reduced inputs)

**Transplanter and direct seeder**



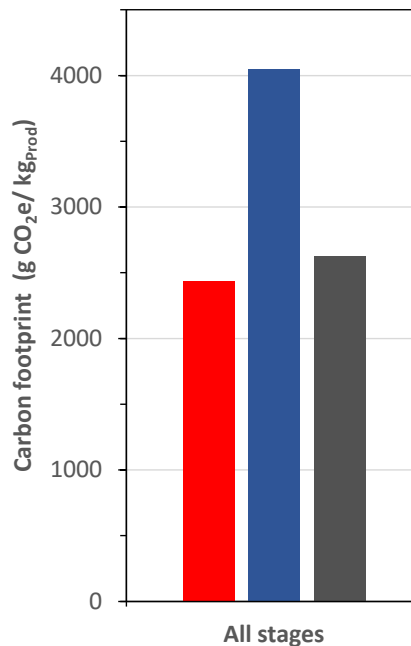
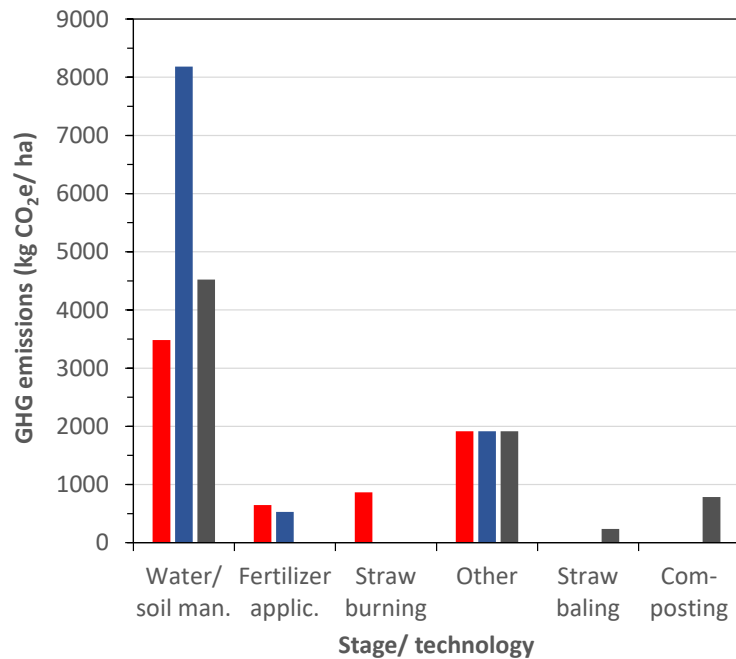
- Yield, grain quality ↑
- Seed rate, grain losses ↓

**Combine harvesters and balers**



- harvesting cost ↓ 50%;
- postharvest losses ↓ -5%
- Benefits for mushroom farmers and other SMEs

# Scenario Assessment: Straw management



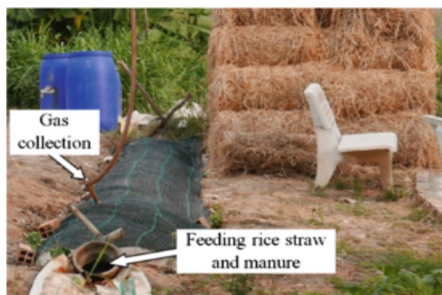
- **Straw burning + Chemical Fert.**
- **Straw Incorp. + Chemical Fert.**
- **Compost**

# Straw removal and management options

- Mechanized straw collection using balers offers new use options
- Avoids burning and reduces field emissions
- Innovative uses of rice straw that provide additional income to farmers, reduce waste of resources, and contribute to circular agro-economy



**Roller baler pulled by a tractor**



**Anaerobic digestion of straw for biogas**

Source: Ngan N.V.C. et al. (2020)



**Straw mushroom production**

Source: Thuc L.V. et al. (2020)



**Mechanized composting**

Source: Hung et al. (2019)



**Bio-plastics**

# Thank you!



ClimateChange.irri.org  
GHGmitigation.irri.org  
irri.org/rice-straw-management  
**b.sander@irri.org**