Toward the development of new MRV methodology for multiple drainage in a large paddy area: A case study from Southeast Asian paddy fields

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What is MRV?

- Stands for Monitoring, Reporting, and Verification.
- MRV methodology is required to ensure the accuracy and reliability of asserted GHG emission reduction.

Responsible party implements monitoring & reporting processes according to the approved methodology.

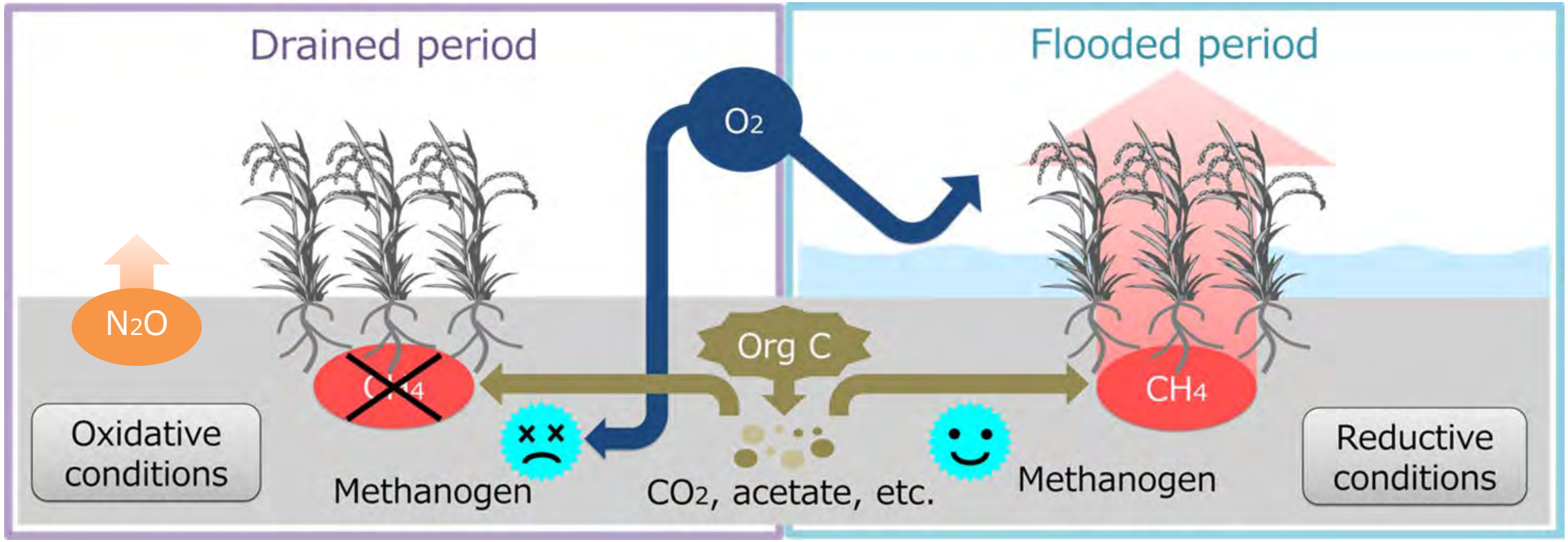
Monitoring

Reporting

Third party evaluates reported achievements and implements on-site inspection according to the approved methodology.

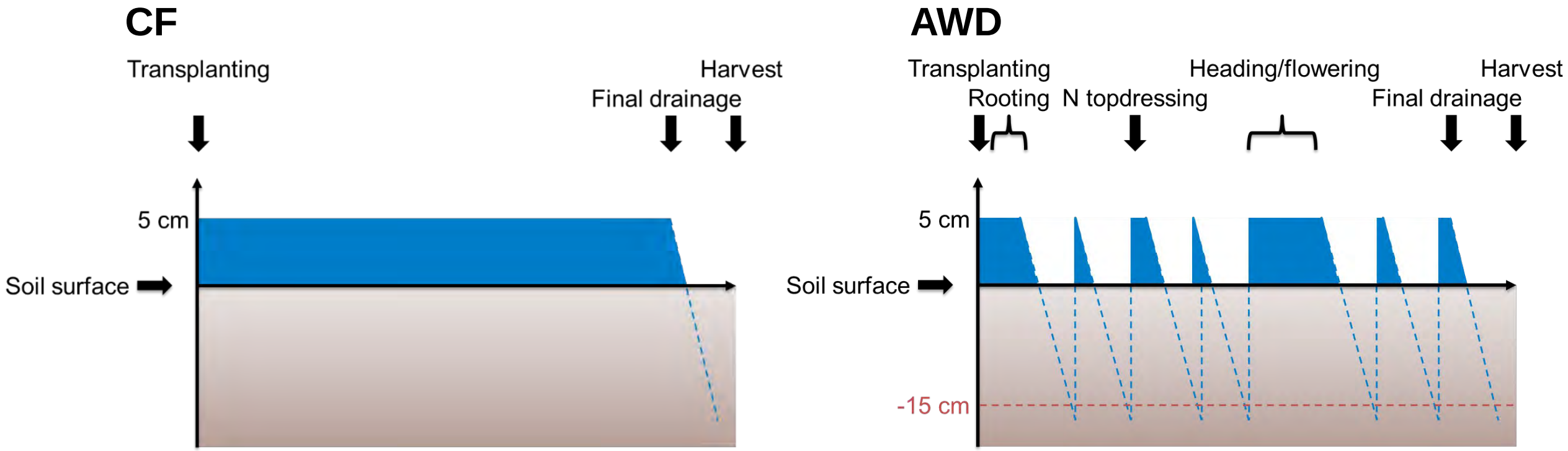
Validation/Verification

Methane emission as affected by water management



- Methane (CH_4) is produced from labile organic C by microbes under strictly reductive soil conditions that is developed by continuous flooding (CF).
- Drainage supplies oxygen (O_2) into the soil, thereby stopping CH_4 emission but enhancing nitrous oxide (N_2O) emission.

Purpose and principle of alternate wetting & drying (AWD)



- In many SEA countries, CF is implemented as the conventional practice.
- AWD is a multiple drainage practice based on surface water level.
- Has been developed by IRRI primarily for saving irrigation water.
- AWD using -15 cm threshold (i.e., safe AWD) achieves no rice yield loss.

Effects of AWD on GHGs and rice yield (vs. CF)

Reference	Scale	CH_4	N_2O	CH_4+N_2O	Yield
Bo et al. (2022)	Global	−54%	+92%	−56%	+0.4%
Carrijo et al. (2017)	Global				−5.4%
Feng et al. (2013)	China	−62%	+278%	−54%	+11%
Guo et al. (2017)	China	−57%			+11%
Jiang et al. (2019)	Global	−53%	+105%	−44%	−3.6%
Kajiura et al. (2018)	Japan	−39%			
Liao et al. (2021)	Global	−59%	+58%	−48%	−4.2%
Linquist et al. (2012)	Asia	−50%	+445%	−34%	+1.0%
Liu et al. (2019)	Global	−52%	+242%	−47%	+0.9%
Livsey et al. (2019)	Asia	−52%	+37%		
Tirol-Padre et al. (2018)	Asia	−31%			

How to disseminate AWD?

The dissemination of AWD is still middle-of-the-road.

Three dissemination approaches proposed (Minamikawa et al., 2018):

1. Voluntary (e.g., yield increase as an incentive for farmers)
2. Semi-institutional (e.g., subsidy, eco-labeling, ESG in the private sector)
3. Institutional (carbon credit, carbon tax)

JIRCAS is now:

- Implementing field study campaign to demonstrate the potential of AWD to increase rice yield under the Strategy for Sustainable Food Systems in Japan, MeaDRI.
- Challenging the institutional approach using carbon credit schemes.
  - Understanding the existing MRV methodologies.
  - Laying the groundwork for establishing the new MRV methodology.

Existing MRV methodologies and their limitations

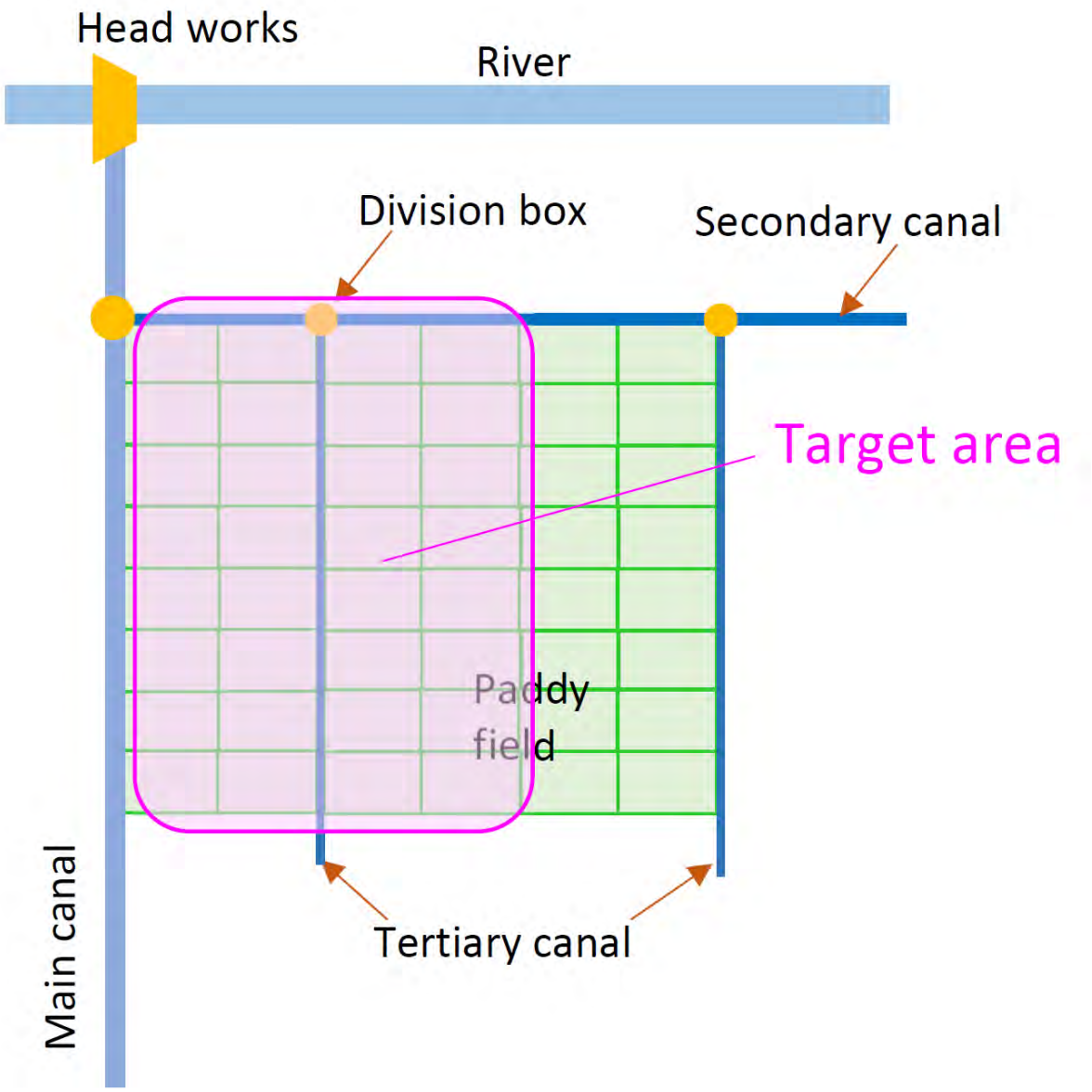
- CDM's methodology (AMS-III.AU) is a representative one for paddy water management.
- It is based on the water management in a single field and its logbook.

➔ Heavy load and high transaction cost for a large paddy area.

- The methodology using model simulation for several mitigation practices (California Air Resources Board) is superior in covering a large paddy area.
- It requires GHG dataset for model calibration and datasets/maps on weather, soil, agronomic practices, etc. for model simulation.

➔ Difficult to immediately apply to SEA countries due to the lack of the datasets/maps.

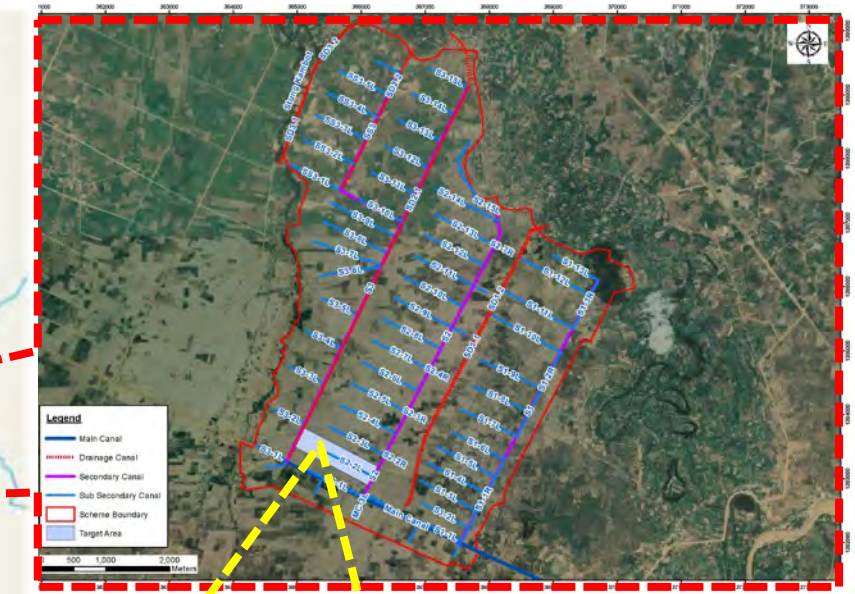
Challenges for AWD and its MRV in a large paddy area

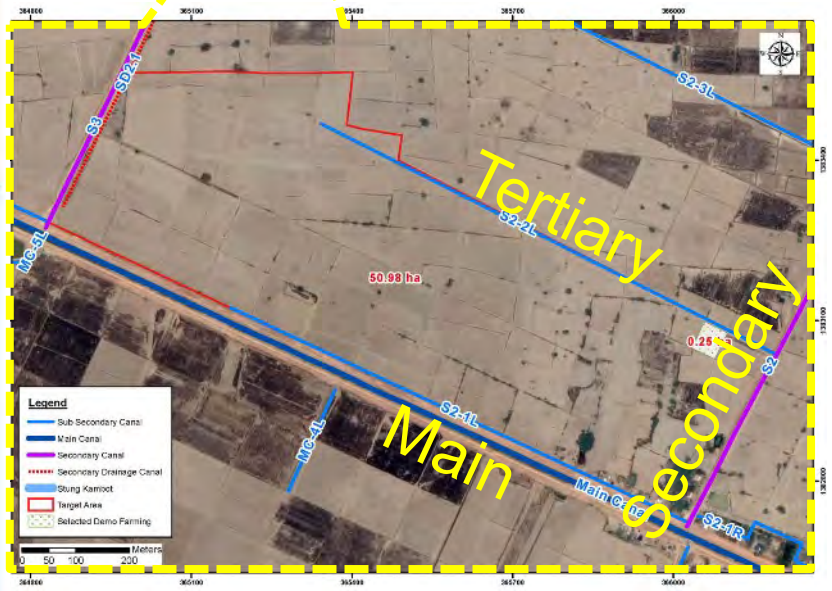


JIRCAS proposes the simultaneous water management for a large paddy area as functional unit, by switching canal inlet and/or ditch outlet, to simply acquire a large carbon credit.

- How many adjoining fields can we simultaneously control water level?
- What size or how many fields is the optimum as the functional unit?
- What are the limiting factors?
- What indicator can we use as the monitoring parameter in MRV?

Our pilot site in Pursat province, West Tonle Sap, Cambodia





- Damnak Ampil Irrigation Scheme
- Rehabilitated by JICA's ODA loan
- Approx. 2,500 ha

Our pilot site

- Approx. 60 ha
- 33 farmers
- 136 fields
- 98 for double rice
- 38 for triple rice

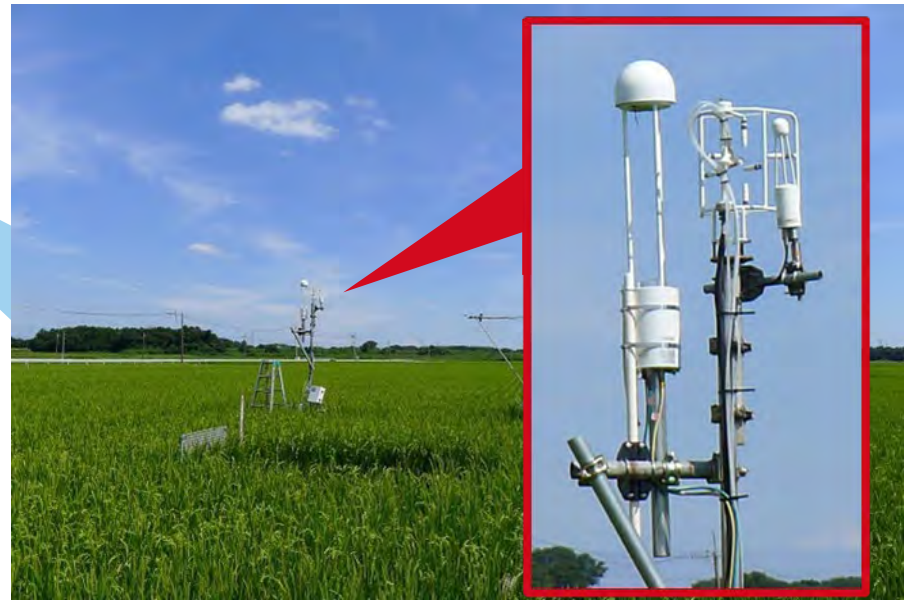
What we do now and will do?

From a single field to multiple fields:

- Background GHG monitoring by a closed chamber method
- Conventional rice yield level and agronomic practices, including water management, using remote sensing, etc.

For the 60-ha pilot site in the near future:

- Tower GHG monitoring by the eddy covariance method (i.e., micrometeorological method)
- Monitoring and management of canal water level using ICT device
- Finding the quantitative relationship between total irrigation water volume vs. CH_4 emission reduction



Summary

- Multiple drainage can reduce CH_4 emission from a paddy field by ~50% compared to continuous flooding, if the field is successfully drained.
- JIRCAS is developing a new and simple MRV methodology for multiple drainage in a large paddy area targeting Cambodia as an example.
- This MRV methodology is to be a universal one applicable to SEA countries, etc. under various carbon credit schemes.