ANNEX 1

Summary of the Workshop and Capacity Building Training on

“Rice Landscapes and Climate Change”

10-12 October 2018, Bangkok, Thailand

A – Workshop program
B – Presentations
C – Feedback and comments on workshop design and content
D – Participants list

A – Workshop program

Time	Session	Lead Organization
	Day 1	
08:30-09:00	**Registration**	FAO
09:00-09:10	**Opening remarks 1**	FAO
09:10-09:15	**Opening remarks 2**	MAFF Japan
09:15-09:30	**Welcome, Background to the Meeting and Objectives**	FAO
09:30-10:30	**Briefing Session: Significance of the Paris Agreement for Agriculture and measures for mitigation and adaptation in the agriculture sectors with a focus on rice landscapes**	ASEAN CRN
10:30-11:00	*Group Photo + Coffee Break*	
11:00-12:00	**Interactive Session: Country experiences in reducing emissions and increasing resilience in rice landscapes**	FAO
12:00-13:00	*Lunch*	
13:00-14:00	**Interactive Session: Challenges and opportunities: Tackling climate change in rice landscapes (Cont.)**	FAO
14:00-15:00	**Knowledge Session: Current initiatives and activities in the region on reducing emissions and increasing resilience in rice landscapes**	APEC
15:00-15:30	*Coffee Break*	
15:30-16:00	**Knowledge Session: Current initiatives and activities in the region on reducing emissions and increasing resilience in rice landscapes (cont.)**	APEC
16:00-17:30	**Knowledge Session: Current initiatives and activities in the region on reducing emissions and increasing resilience in rice landscapes**	WBCS
17:00 –17:15	**Wrap-up: Summary of the Day 1**	FAO
	Day 2	
08:30-09:00	**Registration**	

<table>
<tr><td>09:00-09:10</td><td colspan="3">Revisiting Workshop Objectives and Key Messages from Day 1</td><td>FAO</td></tr>
<tr><td>09:10-10:30</td><td colspan="3">Knowledge Session: Capacity Building for Climate Smart Rice Cultivation in Asia</td><td>APEC</td></tr>
<tr><td>10:30-11:00</td><td colspan="3">Coffee Break</td><td></td></tr>
<tr><td>11:00-12:30</td><td colspan="3">Knowledge Session: Capacity Building for Climate Smart Rice Cultivation in Asia (cont.)</td><td>FAO</td></tr>
<tr><td>12:30-13:30</td><td colspan="3">Lunch</td><td></td></tr>
<tr><td>13:30-15:30</td><td colspan="3">Interactive Session: Solution Matching</td><td>FAO</td></tr>
<tr><td>15:30 – 16:00</td><td colspan="3">Coffee Break</td><td></td></tr>
<tr><td>16:00 – 17:00</td><td colspan="3">Discussion Session : Facilitating research and investments to improve soil health and reduce emissions in rice landscapes – the way forward</td><td>SRP</td></tr>
<tr><td>17:00 – 17:15</td><td colspan="3">Wrap-up: Summary and workshop evaluation</td><td>FAO</td></tr>
<tr><td colspan="5">Day 3 – Sustainable Rice Landscapes</td></tr>
<tr><td>08:30-09:00</td><td colspan="3">Registration</td><td></td></tr>
<tr><td>09:00-10:00</td><td colspan="3">Briefing Session: Sustainable Rice Landscapes – An Introduction</td><td>FAO, UNEP,IRRI, WBCSD, GIZ</td></tr>
<tr><td>10:00-10:30</td><td colspan="3">Coffee Break</td><td></td></tr>
<tr><td>10:30 – 11:30</td><td colspan="3">Interactive Session: Sustainable Rice Landscapes – Developing a Regional Initiative</td><td>FAO, UNEP,IRRI, WBCSD, GIZ</td></tr>
<tr><td>11:30 – 12:00</td><td colspan="3">Wrap-up: Summary and way forward</td><td>FAO</td></tr>
<tr><td></td><td colspan="3">Workshop Close</td><td></td></tr>
<tr><td>12:00-13:00</td><td colspan="3">Lunch</td><td></td></tr>
<tr><td colspan="5">Follow-up Afternoon Meetings organized for selected participants</td></tr>
<tr><td>13:00 -</td><td><u>*Session I</u>
SRL Meeting</td><td><u>*Session II</u>
GRA Paddy Rice Research Group Meeting</td><td><u>*Session III</u>
Rice/Fish systems</td><td>Session I: SRL Partners
Session II: GRA
Session III: FAO</td></tr>
</table>

B – Presentations

Workshop

1. Dr Kazunori Minamikawa, “Assessing the feasibility of GHG mitigation through water saving techniques (AWD) in irrigated rice fields in southeast Asian economies (FYs 2013-2017 funded by MAFF of Japan), Outline of the MIRSA-2 project”

2. Mr Ali Pramono, “Assessing the feasibility of GHG mitigation through water saving techniques (AWD) in irrigated rice fields in Indonesia”

3. Mr Nghia Trong Hoang, “Assessing the feasibility of GHG mitigation through water saving techniques (AWD) in irrigated rice fields in Central Vietnam”

4. Dr Amnat Chidthaisong, “Evaluating the effects of alternate wetting and drying (AWD) on methane and nitrous oxide emissions from a paddy field in Thailand”

5. Ms Kristine Samoy-Pascual, “Assessing the feasibility of GHG mitigation through water saving techniques (AWD) in irrigated rice fields in the Philippines”

Capacity Building Training

6. Dr Bjoern Ole Sander, “Analysis of suitable environments for the implementation of low-emissions technologies in rice production”

7. Dr Yasukazu Hosen, “What kind of environment should be targeted for AWD introduction? – Through experience in the Mekong Delta –”

8. Dr Kazunori Minamikawa, “MRV for a GHG mitigation project with water management in irrigated rice paddies”

9. Dr Chitnucha Buddhaboon, “The overview and plan of the Thai rice NAMA project”

10. Dr Yasuhito Shirato, “Soil C sequestration for sustainable food production and climate change mitigation”

Knowledge 1a: Current initiatives and activities in the region on reducing emissions and increasing resilience in rice landscapes

Assessing the feasibility of GHG mitigation through water saving techniques (AWD) in irrigated rice fields in southeast Asian economies (FYs 2013-2017 funded by MAFF of Japan)

Outline of the MIRSA-2 project

Kazunori Minamikawa (JIRCAS, Japan)

MIRSA-2 project funded by MAFF of Japan

Completed 5-year international research project to support the activities of GRA Paddy Rice Research Group.
➔Asia sub-group meeting will be held on DAY3 afternoon.

Project goal was to develop improved water management based on AWD that can always reduce CH_4+N_2O emission from irrigated rice paddies in Asian economies.

1. Field demonstration of AWD feasibility in SEA economies
➔This session's topic

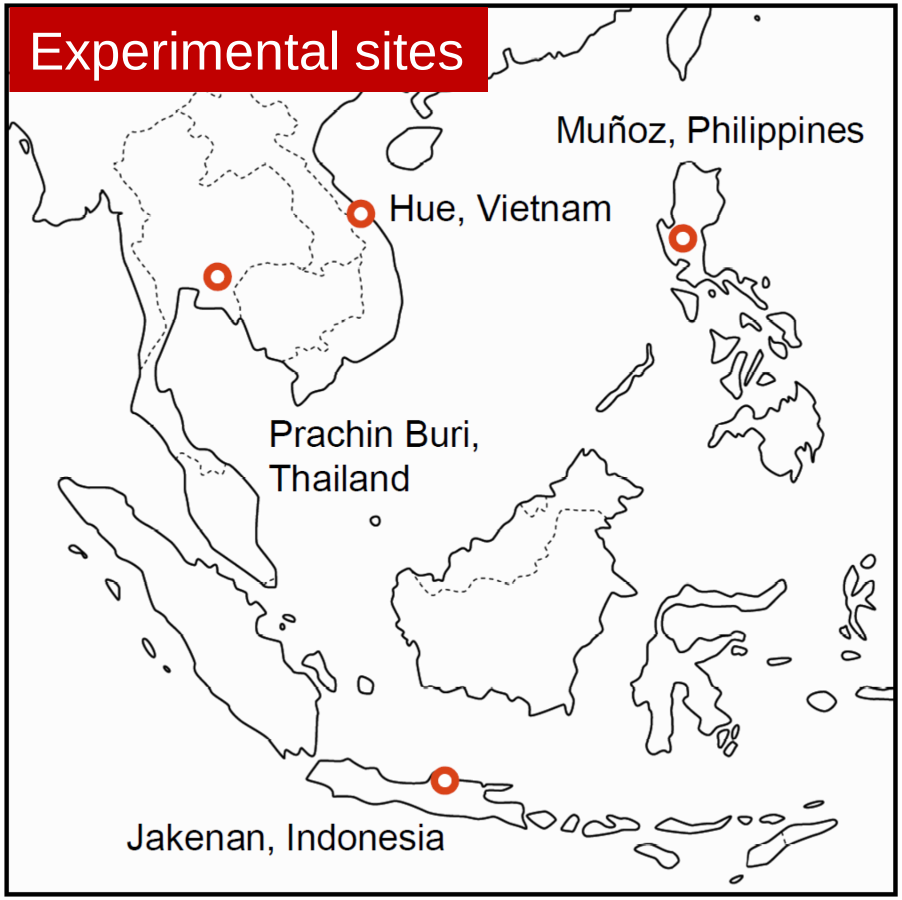
2. Development of MRV guidelines for paddy water mngm
➔My presentation's topic on DAY2 morning

MIRSA

GRA, Global Research Alliance on Agricultural Greenhouse Gases
AWD, Alternate Wetting and Drying
MRV, Monitoring, Reporting and Verification

Participating economies and institutes

- **Viet Nam**, Hue University of Agriculture and Forestry
- **Thailand**, The Joint Graduate School of Energy and Environment, KMUTT
- **Philippines**, Philippine Rice Research Institute and International Rice Research Institute
- **Indonesia**, Indonesian Agricultural Environment Research Institute
- **Japan**, National Agriculture and Food Research Organization



Department of Agriculture PHILRICE PHILIPPINE RICE RESEARCH INSTITUTE

IRRI

NARO

JGSEE

Benefits of AWD

Originally developed and being extended by the International Rice Research Institute since 1990's.

- Water saving for farmers
- CH_4 emission reduction for global environment
- Arsenic pollution control for local environment
- Negative possibilities: water stress, Cadmium pollution, N loss (N_2O), soil fertility, labor, etc.

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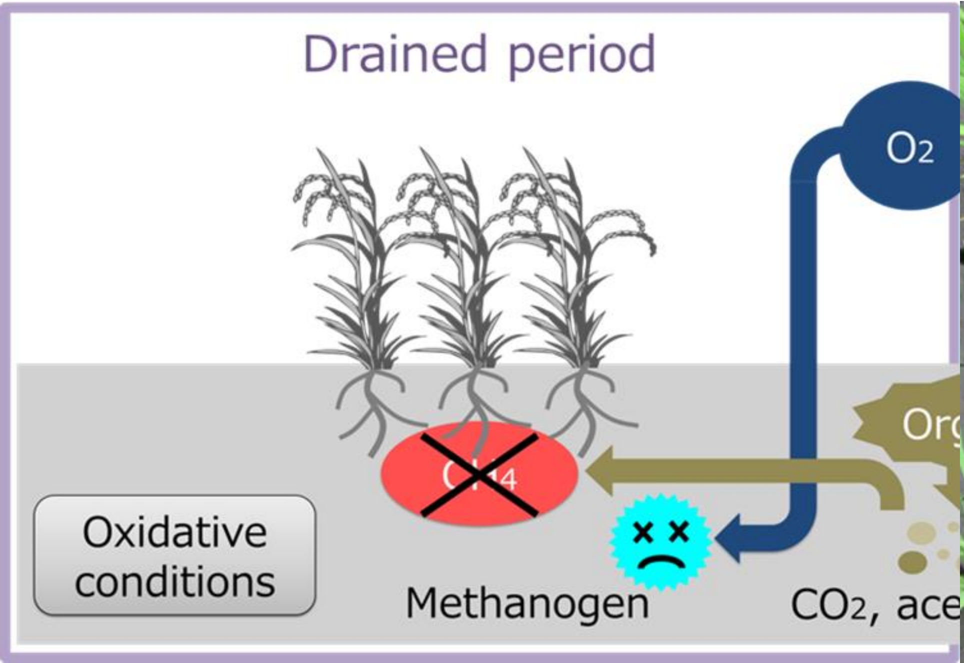
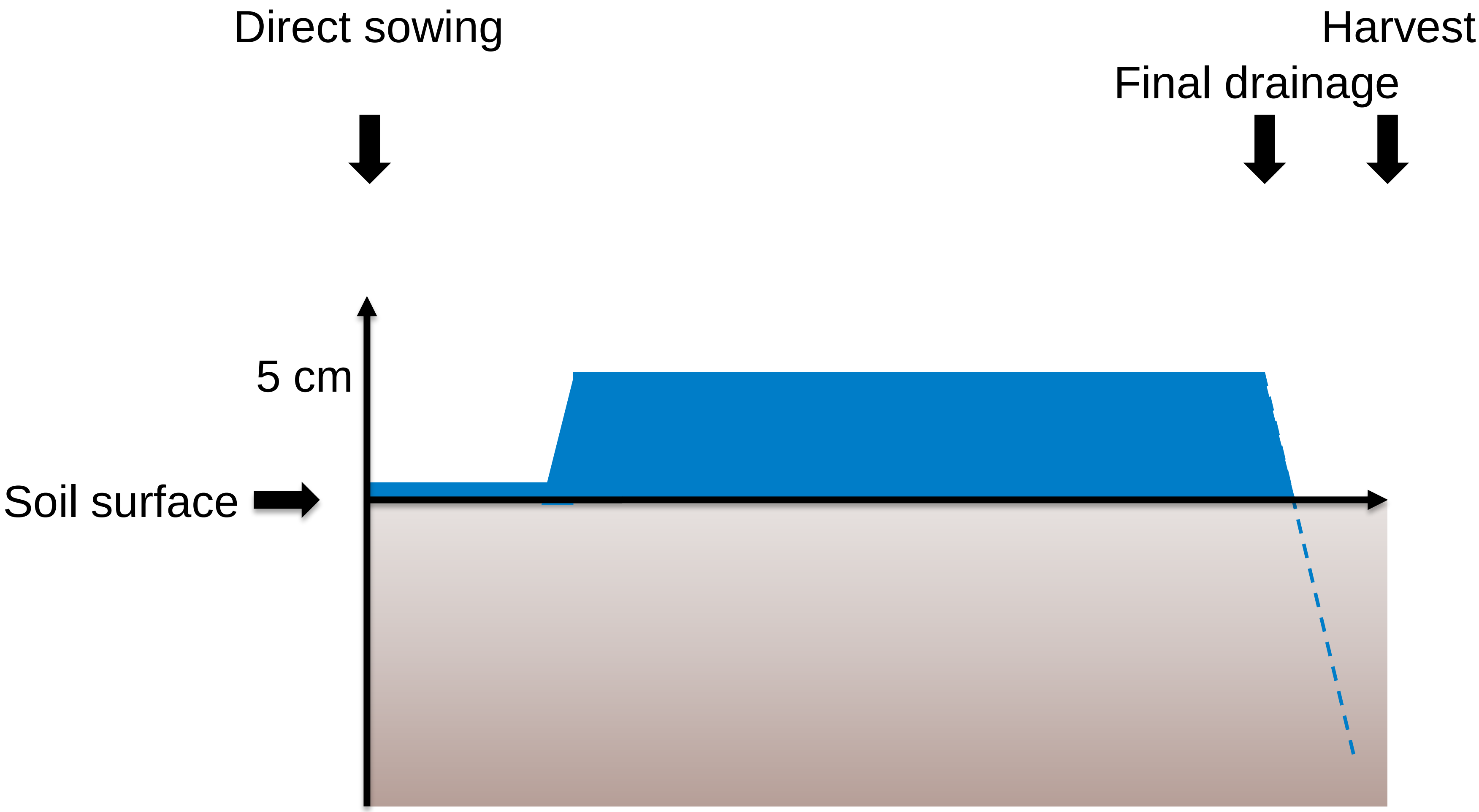
CH_4 emission from rice paddies

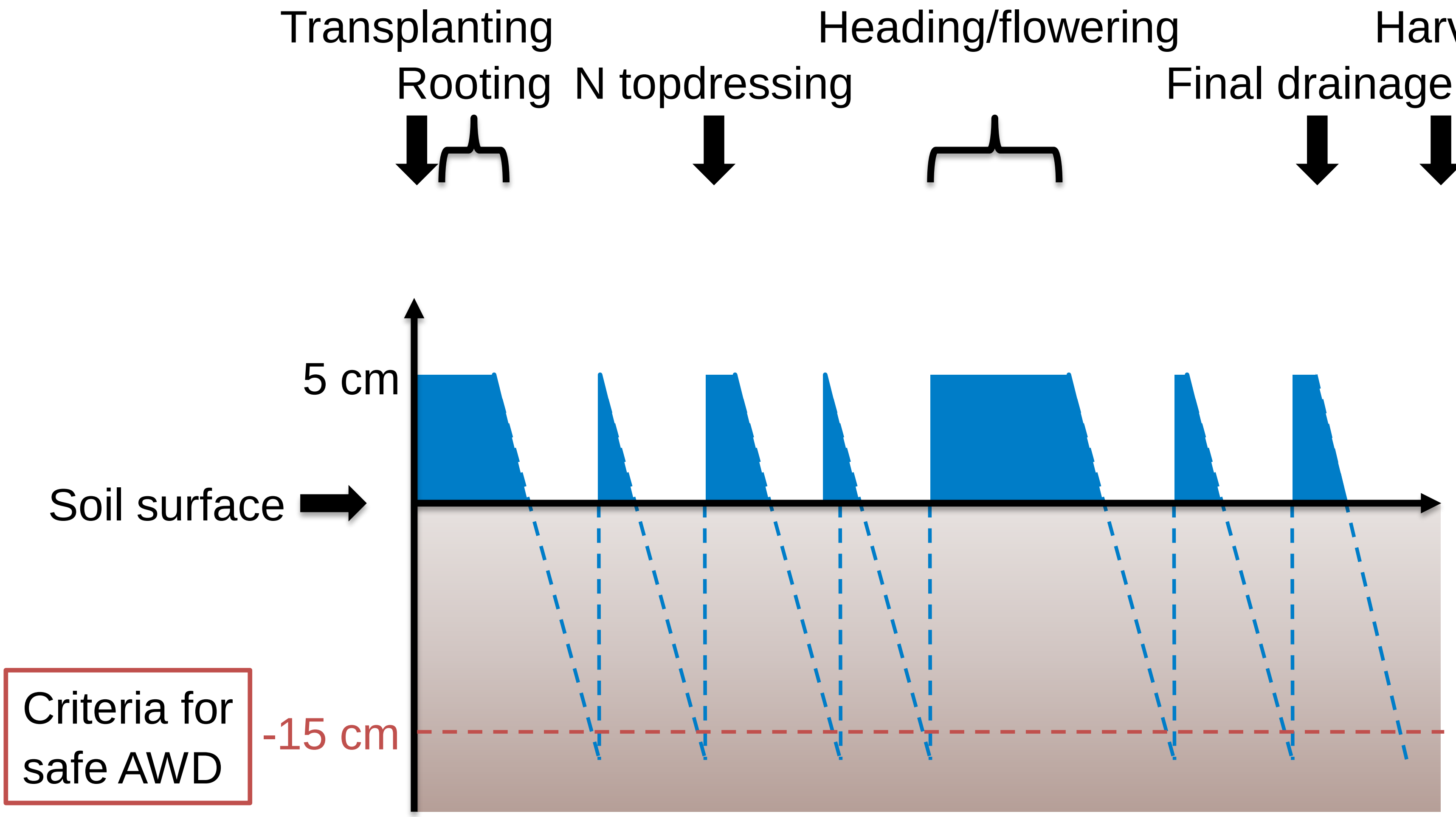
- Produced from easily decomposable organic C by microbes under strictly reductive soil conditions and emitted mainly through rice plants.
- Water management creates oxidative soil conditions, and thus effectively reduces CH_4 production and emission.



Shape of continuous flooding



Shape of AWD



Recommendation: Keep flooding to meet rice's water demand in rooting and heading/flowering stages and to improve N-use efficiency after N topdressing.

Shared experimental protocol

Objectives

- To assess the feasibility of AWD in irrigated rice paddies
- To derive the emission factor and scaling factor for CH_4 and N_2O

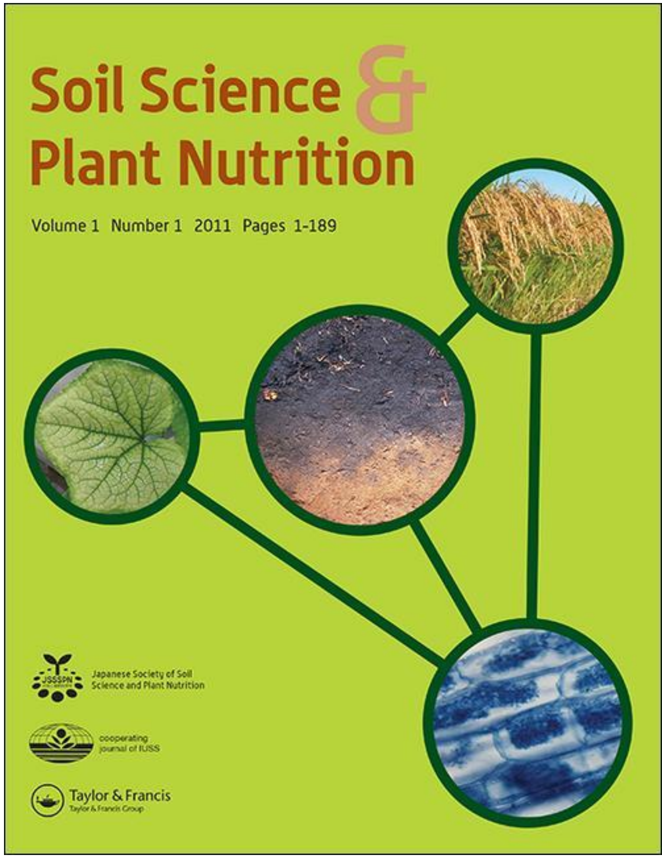
Setting

- 6 crops in 3 years: both dry and wet seasons (rice double cropping)
- 3 water management practices: continuous flooding, safe AWD, and site-specific AWD (explained later)
- Manual closed chamber method

An output from MIRSA-2 project

Five papers (four field papers and one synthesis paper) published from *Soil Science and Plant Nutrition* in 2018.

Open access



Synthesis of the four field studies

SOIL SCIENCE AND PLANT NUTRITION, 2018
VOL. 64, NO. 1, 2–13
https://doi.org/10.1080/00380768.2017.1409602

JSSSPN 日本土壌肥料学会

Taylor & Francis
Taylor & Francis Group

Check for updates

Site-specific feasibility of alternate wetting and drying as a greenhouse gas mitigation option in irrigated rice fields in Southeast Asia: a synthesis

Agnes Tirol-Padre[a], Kazunori Minamikawa[b], Takeshi Tokida[b], Reiner Wassmann[a,c] and Kazuyuki Yagi[b]

Kazunori Minamikawa (JIRCAS, Japan)

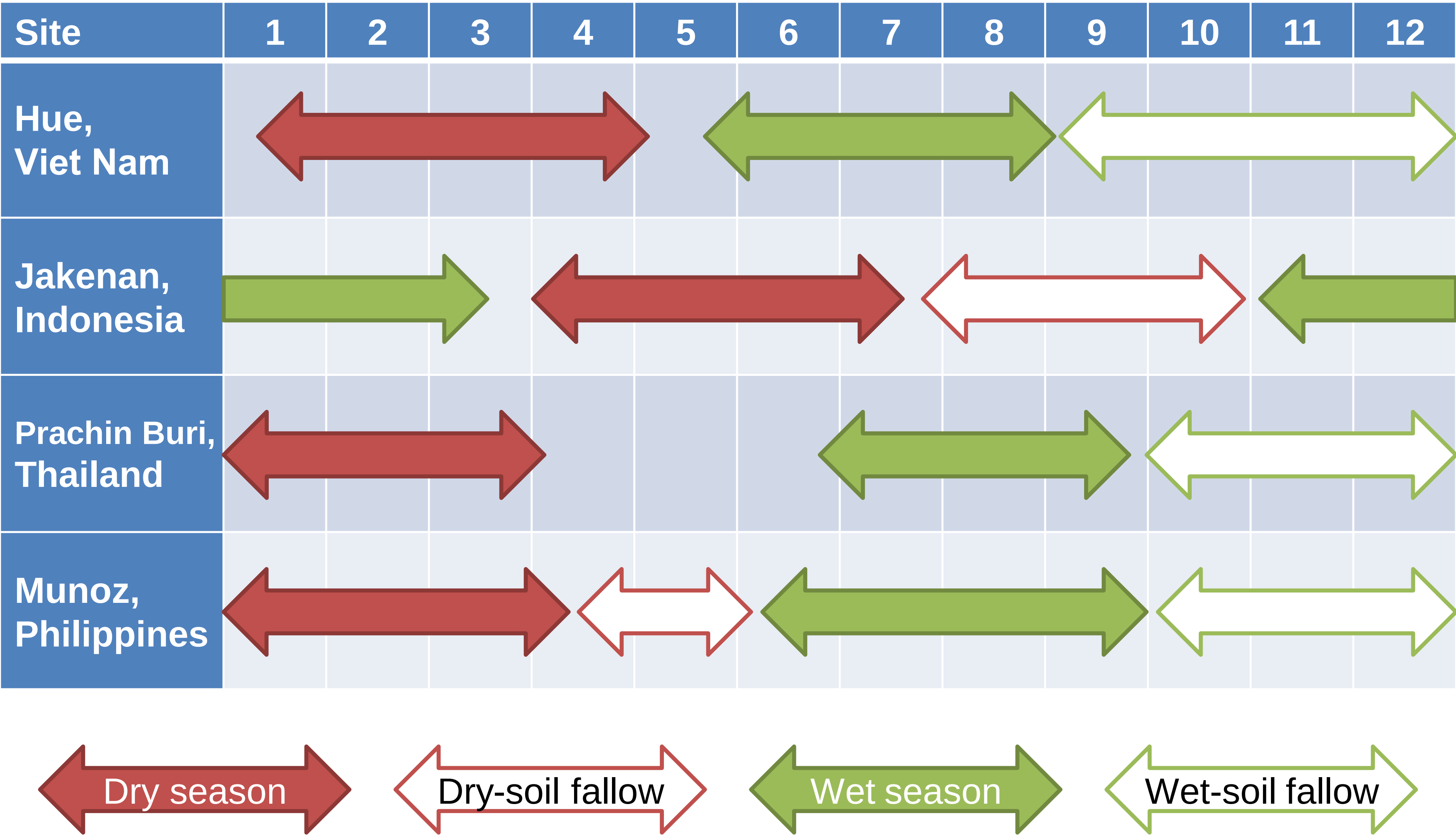
JIRCAS

Agronomic practices

	Hue, Viet Nam	Jakenan, Indonesia	Prachin Buri, Thailand	Munoz, Philippines
Rice variety	HT1	Cisadane	RD41	NSIC Rc238
Growth days	96–120	107–132	88–98	81–98
Crop establishment	Wet direct sowing	Wet: Direct sowing Dry: Transplanting	Pre-germinated seed sowing	Transplanting
Chemical N*	92–120	120	70	90–120
Chemical P*	72	60	37.5	40
Chemical K*	62–78	90	37.5	40
Organic amendment	Microbial organic fertilizer	Farmyard manure	None	None
Straw mngm	Removal	Removal	Removal	Removal

* N (kg N ha^{-1} $season^{-1}$); P (kg P_2O_5 ha^{-1} $season^{-1}$); K (kg K_2O ha^{-1} $season^{-1}$).

Crop calendar

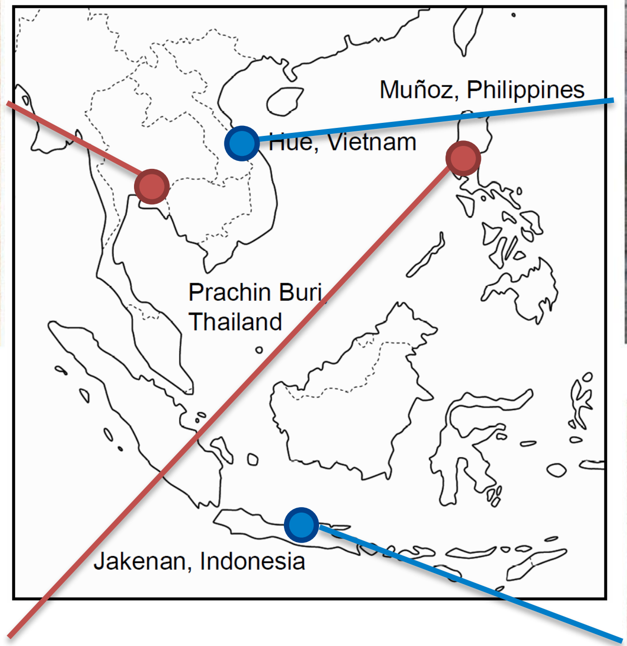


Soil properties

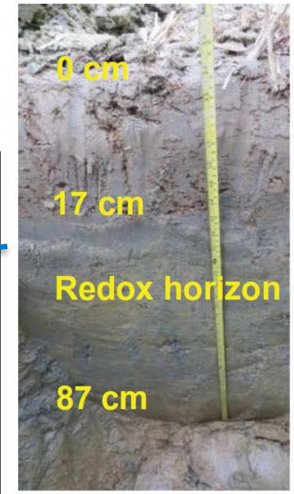
CLAYEY SOILS

Prachin Buri, Thailand
USDA: Vertic Endoaquepts

Munoz, Philippines
FAO: Dystric Fluvisols
USDA: Typic Endoaquepts



LOAMY SOILS



Hue, Viet Nam
FAO: Ustic Epiaquert
USDA: Eutric Vertisol

Jakenan, Indonesia
USDA: Aeric Endoaquepts

ANOVA statistics

*** 0.1%, ** 1%, * 5%, † 10%

	CH_4	N_2O	GWP	Grain yield	Yield-scaled GWP	Water use
Site (S)	***	***	***	***	***	***
Dry or wet season (DW)	**	ns	**	ns	**	***
Water mgmt (WM)	***	ns	**	ns	ns	***
S×DW	***	***	***	***	***	***
S × WM	ns	ns	*	ns	†	***
DW × WM	ns	ns	ns	ns	ns	ns
S × DW×WM	ns	ns	ns	ns	ns	*

No trade-off

No negative effect

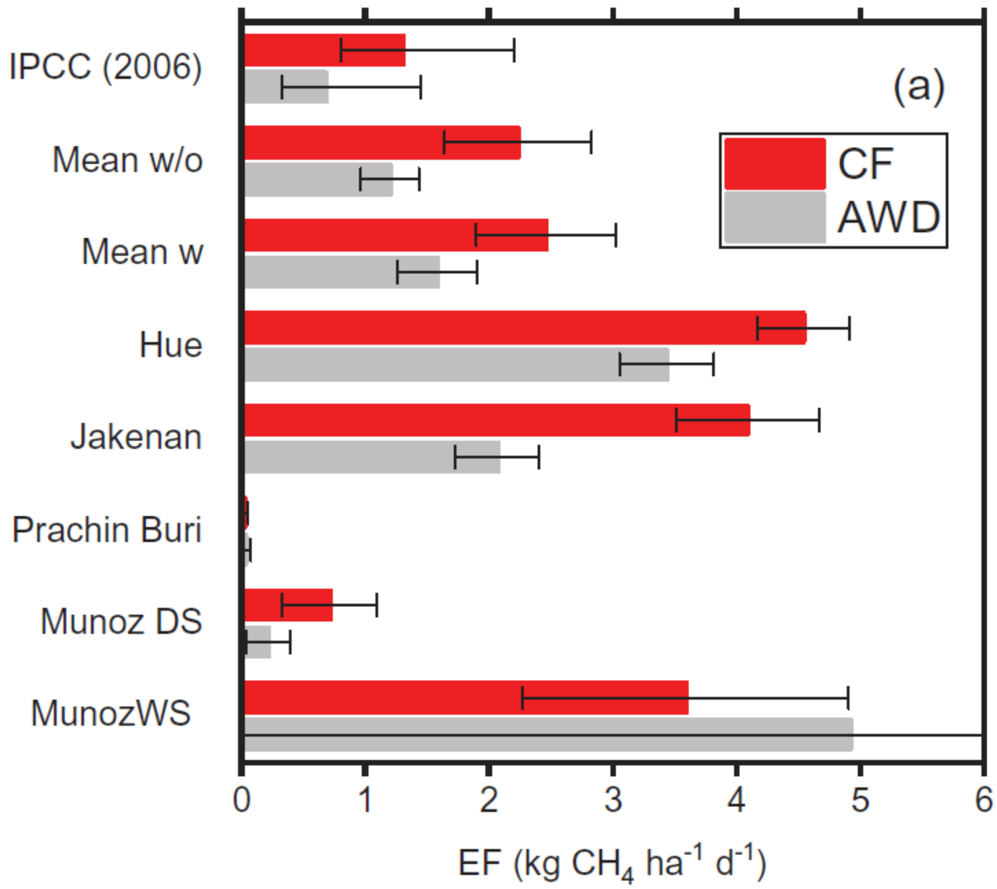
Saving

Mitigation

Mitigation

Inter-site variation

CH_4 Emission Factor

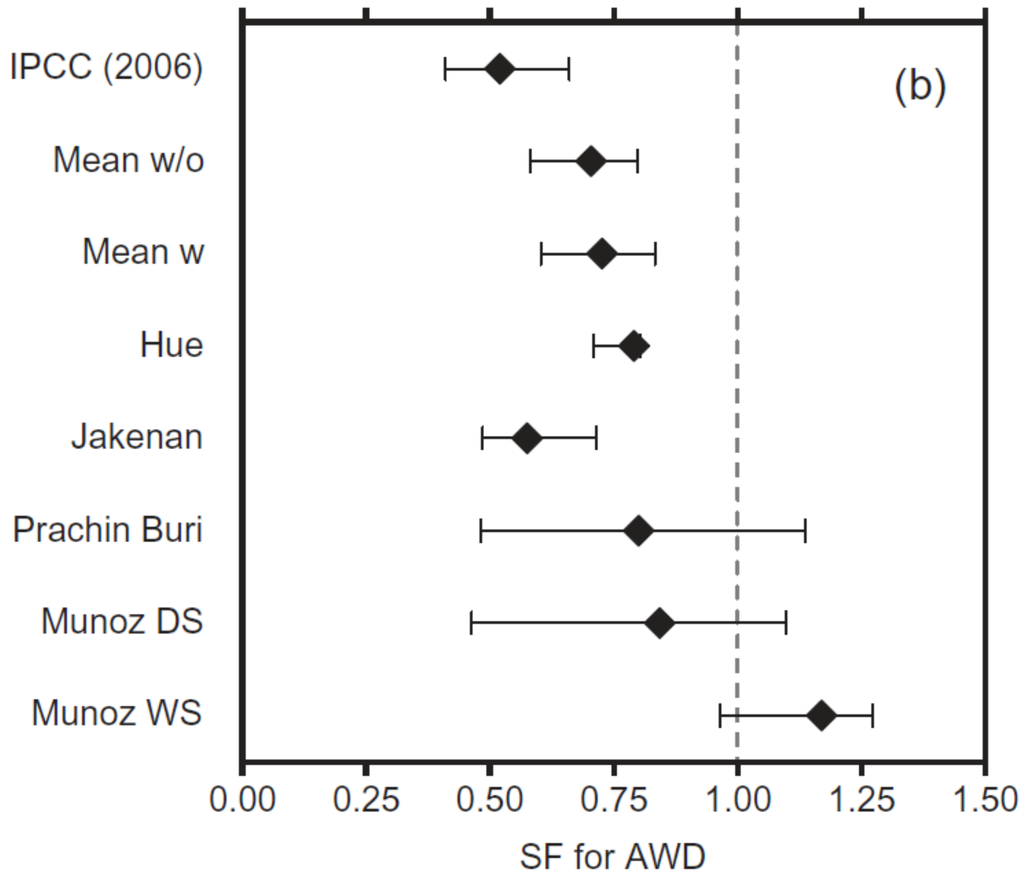


Notes

- IPCC's baseline EFs for continuous flooding (CF) and multiple aeration
- Weighted mean ± bootstrapped 95%CI
- Mean w/o & w: without & with Munoz Philippines WS
- Safe AWD and site-specific AWD combined
- DS, dry season; WS, wet season

Large spatio-temporal variation due to different environmental and agronomic setting.

CH_4 Scaling Factor for AWD

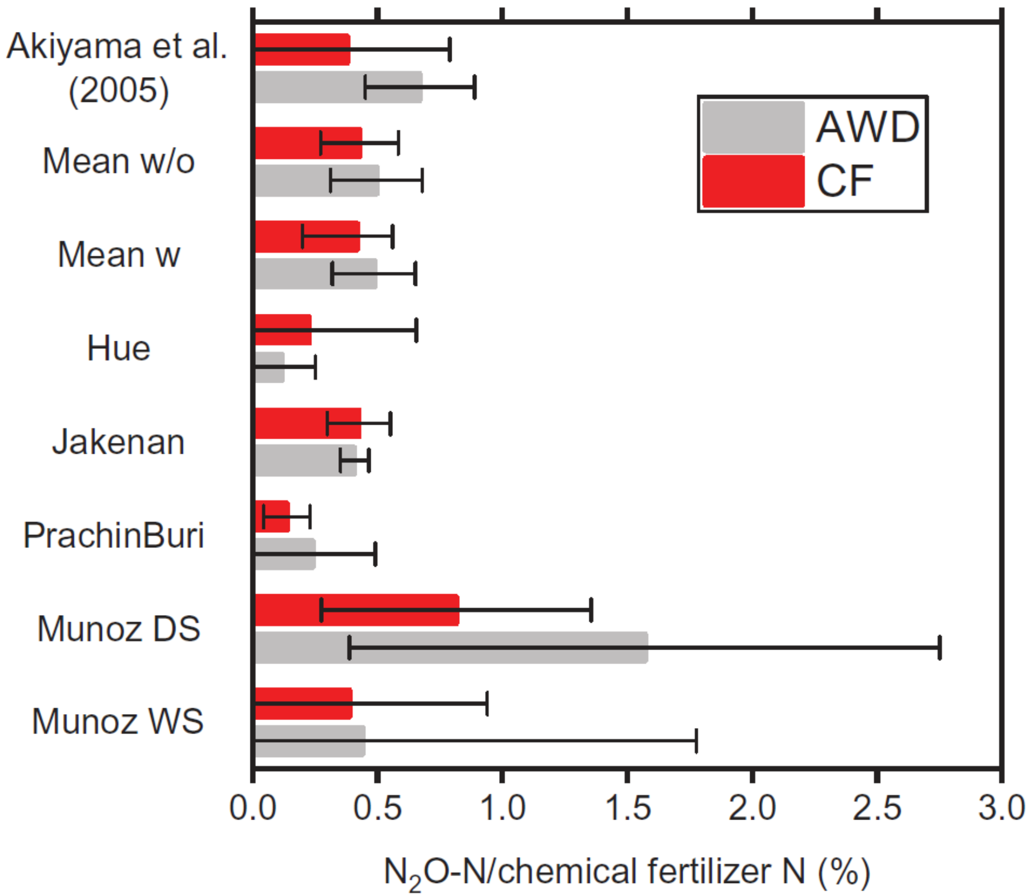


Notes

- IPCC's SF for multiple aeration
- Weighted mean ± bootstrapped 95%CI
- Mean w/o & w: without & with Munoz Philippines WS
- Safe AWD and site-specific AWD combined
- DS, dry season; WS, wet season

Lower CH_4 mitigation effect by AWD than IPCC's default SF due to varying weather conditions during the field experiment.

N_2O-N / chemical fertilizer-N



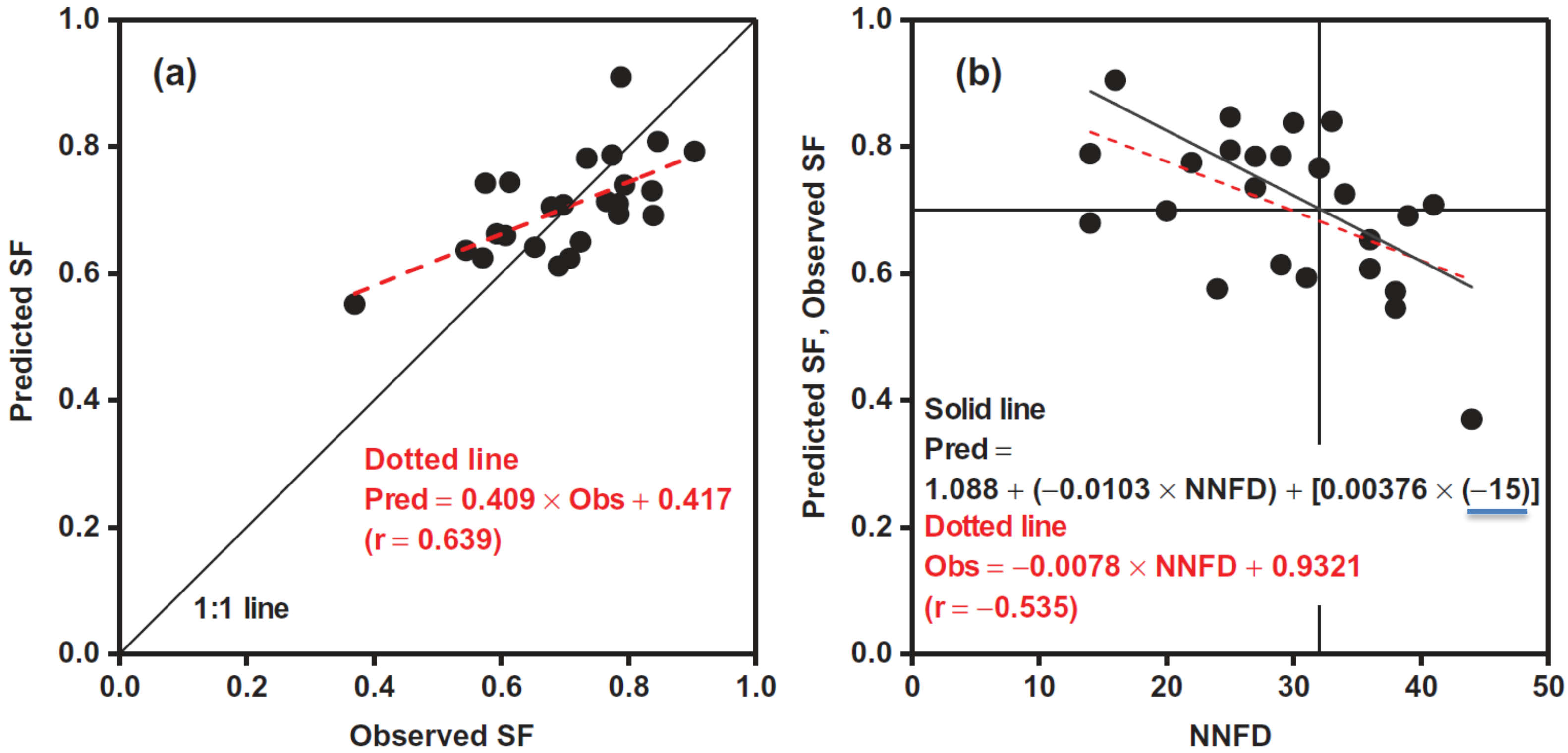
Notes

- Akiyama et al.'s values for CF and midseason drainage
- Weighted mean ± 95%CI
- Mean w/o & w: without & with Munoz Philippines WS
- Safe AWD and site-specific AWD combined
- DS, dry season; WS, wet season

Mean ratios comparable to Akiyama et al.'s values.

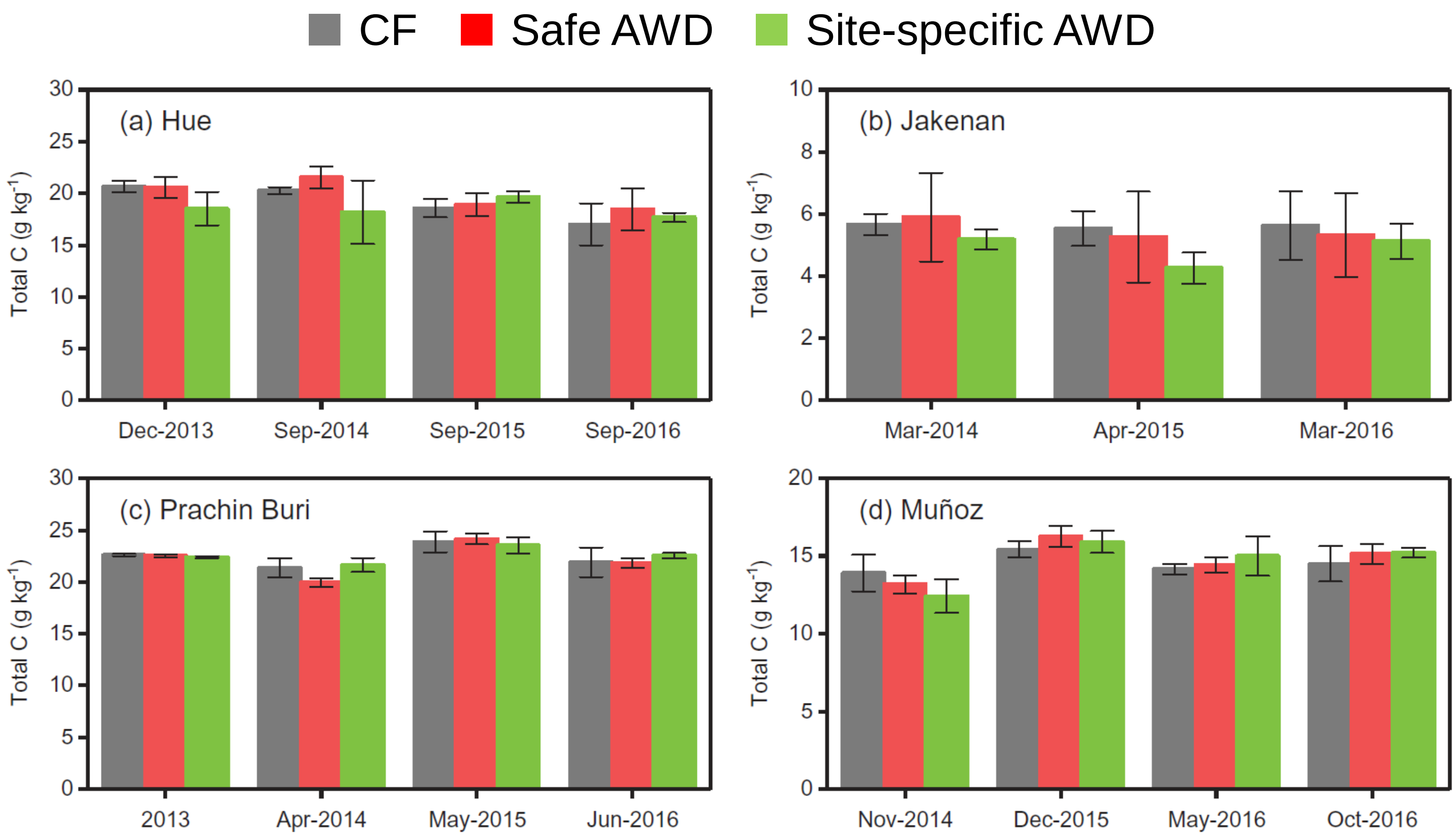
Munoz's high N_2O due to N topdressing during drained period.

The severer drainage, the lower CH_4 in loam



- Combination of the minimum surface water level (MinWL, cm) and the number of non-flooded days (NNFD) explained 41% of the variability in SFs for AWD in loamy soils (i.e., Viet Nam and Indonesia).
- When MinWL = -15 cm (i.e., criteria for safe AWD), 30% reduction in CH_4 emission can be achieved if NNFD ≥ 32 based on the predicted SF.

No negative effect on SOC decomposition



Total C and N concentrations in 0-20 cm soil layer did not significantly differ among 3 water management practices through the 3-year experiment at each of the four sites.

Summary

- The mean CH_4 SF for AWD was 0.69 (95%CI: 0.61-0.77) among the four sites (➔ lower mitigation potential than IPCC's SF of 0.52).
- In Viet Nam and Indonesia sites, AWD was effective even in wet seasons, both of which had a loamy soil.
- In Thailand and Philippines sites, AWD was unsuitable in wet seasons due to the frequent rainfall and the slow water percolation in clayey soils.
- The results indicate that IPCC's SF may only be applied to irrigated rice fields where surface water level is controllable for a substantial period.
- This synthesis underscores the importance of practical feasibility and appropriate timing of water management in successful GHG reductions by AWD.

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ASSESSING THE FEASIBILITY OF GHG MITIGATION THROUGH WATER SAVING TECHNIQUES (AWD) IN IRRIGATED RICE FIELDS IN INDONESIA

Ali Pramono, Terry Ayu Adriany and Helena Lina Susilawati

Indonesian Agricultural Environment Research Institute (IAERI)
Indonesian Center Agricultural Land Resources Research and Development (ICALRRD)
Indonesia Agency for Agricultural Research and Development-Ministry of Agriculture

2018

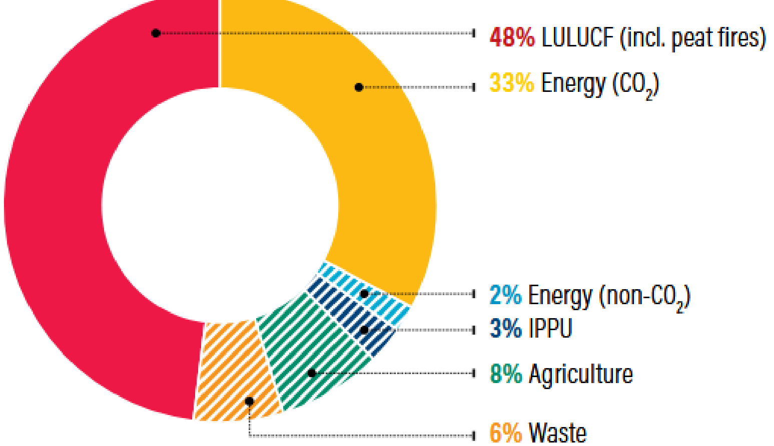
OUTLINES

- INTRODUCTION
- OBJECTIVE
- METHODS
- RESULTS
- AWD IMPLEMENTATION
- CONCLUSIONS
- FUTURE WORK

INTRODUCTION

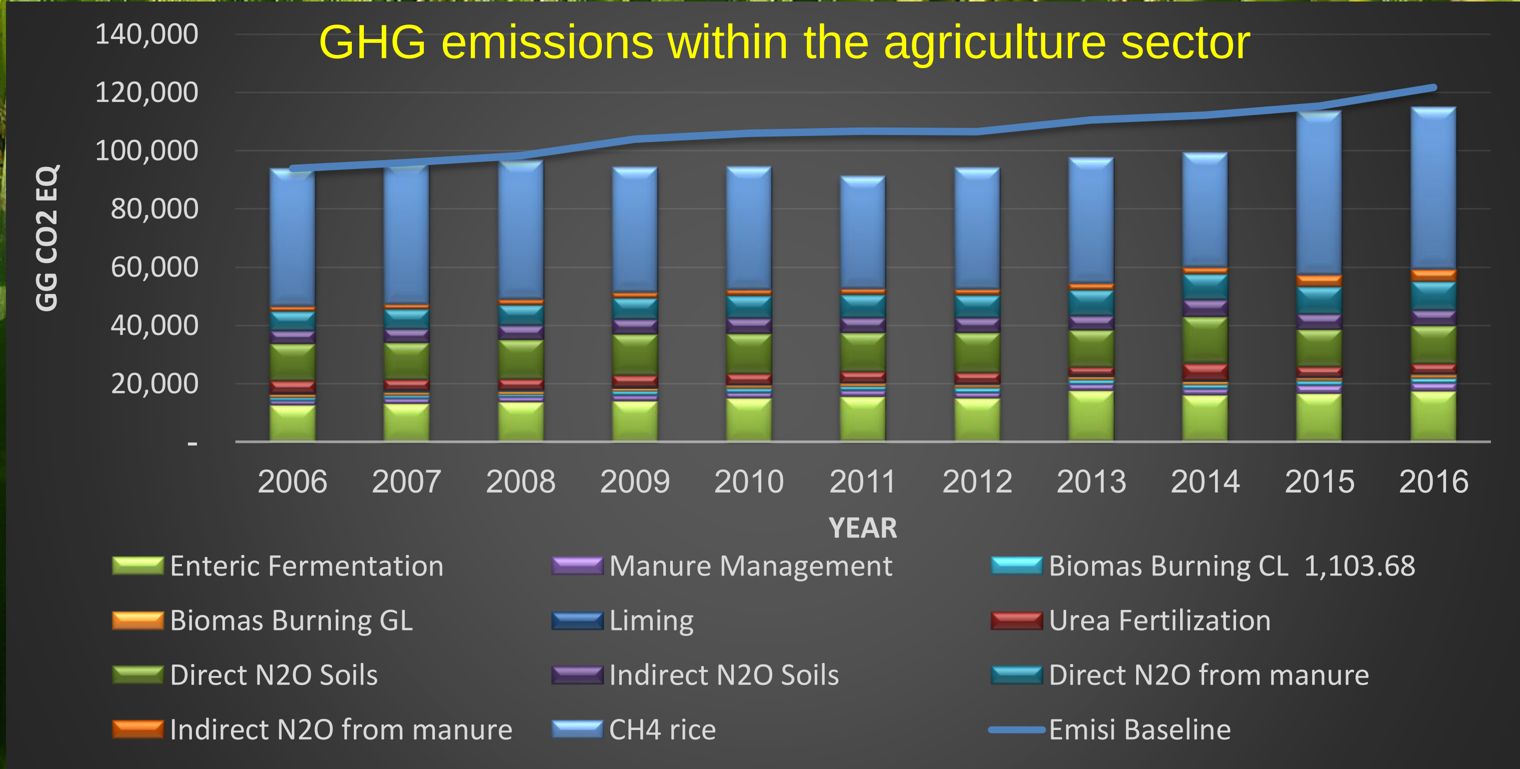
Indonesia commits to reduce GHG emission by 29 percent below business as usual in 2030 and 41 percent with international cooperation on the Leader Statement Event of the UN Framework Convention on Climate Change (UNFCCC), Conference of Parties (COP) 21, in Paris.

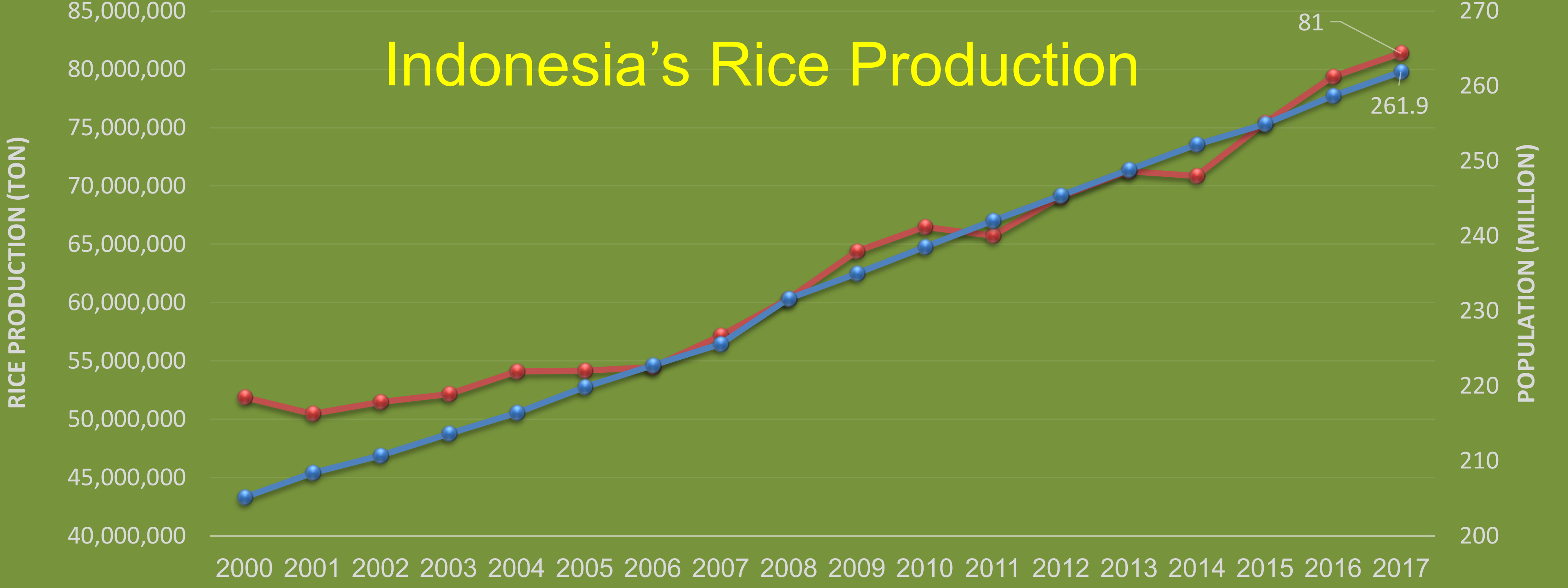
Percentages of Total GHG Emissions from CO_2-e Emitted All Sectors in Indonesia, 2012



Notes: LULUCF =Land use, land-use change, and forestry; IPPU=industrial processes and product use. Solid colors show sectors and gases covered in the analysis. Patterned colors show sectors and gases not covered in the analysis.

Source: Republic of Indonesia 2015b.





- The current population of **Indonesia** is **265 million.**
- Indonesian rice field :

Wetland	: 8,186,469 ha
Irrigated	: 4,781,494 ha
Non irrigated	: 3,404,975 ha

- 14 M ha of harvested area
- Paddy fields in Indonesia are commonly cultivated under continuous flooding irrigation → GHG emission
- Water scarcity in the future
- There is a need for the development of efficient rice cultivation methods

OBJECTIVE

To develop improved water management based on AWD that can reduce soil-derived CO_2-eq emission (CH_4 + N_2O) during rice growing season from irrigated rice paddies in Asian countries by 30% compared to the conventional practice.

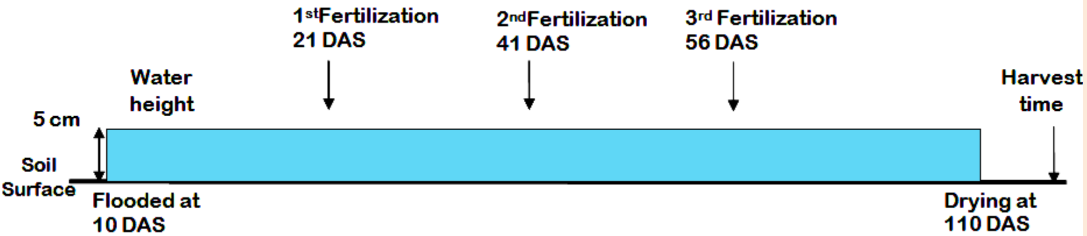
METHODS

LOCATION
Indonesian Agricultural Environment Research Institute (IAERI)
Pati-Central Java Province, Indonesia

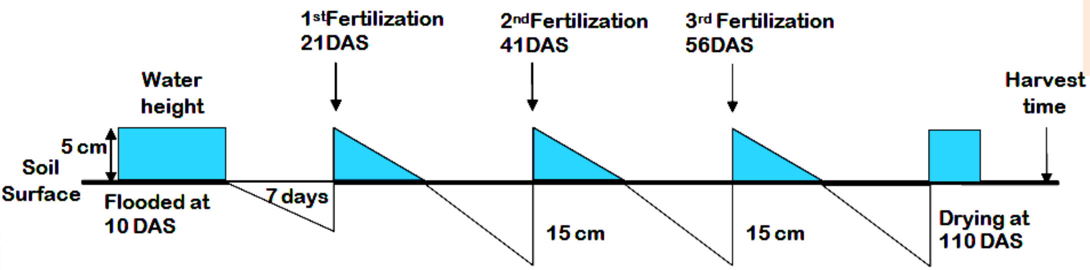
Activity	WS 2013/2014	DS 2014	WS 2014/2015	DS 2015	WS 2015/2016	DS 2016
Planting	Oct 21. 2013	March 12. 2014	Nov 21. 2014	April 4. 2015	Nov 13. 2015	April 4. 2016
Harvest	Feb 28. 2014	June 28. 2014	March 27. 2015	July 23. 2015	March 21. 2016	July 16. 2016
Time periode	128 days	122 days	123 days	111 days	129 days	103 days

TREATMENT

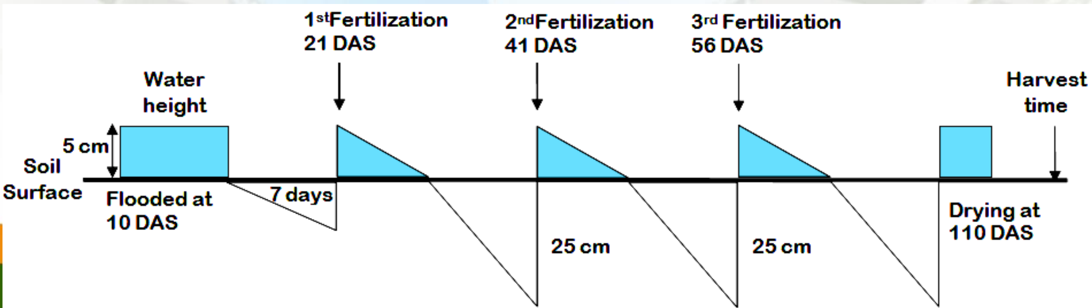
1. Continuous Flooding (A1). water height 5 cm from soil surface continuously



2. Safe AWD (A2). water height 5 cm until descent to 15 cm depth



3. Site Specific AWD (A3). water height 5 cm from soil surface and drying until 7 days before 25 DAS and 41 DAS (Season 1.2).
water height 5 cm until descent to 25 cm depth (Season 3.4.5.6)

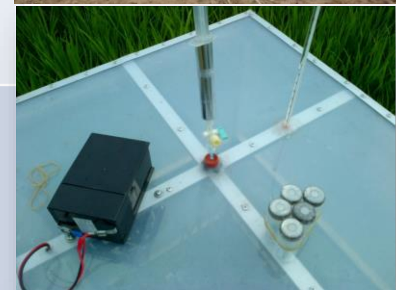


Plot Size → 5 m x 7 m
Plot Bund → Lined with plastic, 40 cm depth
Rice Cultivar → Cisadane (long periode)
Plant Spacing → 20 cm x 20 cm

Fertilizers Application :
1. FYM 5 Ton/Ha (17.5 Kg/plot)
2. 120 Kg N/Ha (Urea : 0.913 Kg/plot)
3. 60 Kg P2O5/Ha (SP36 : 0.583 Kg/plot)
4. 90 Kg K2O/Ha (KCl : 0.525 Kg/plot)

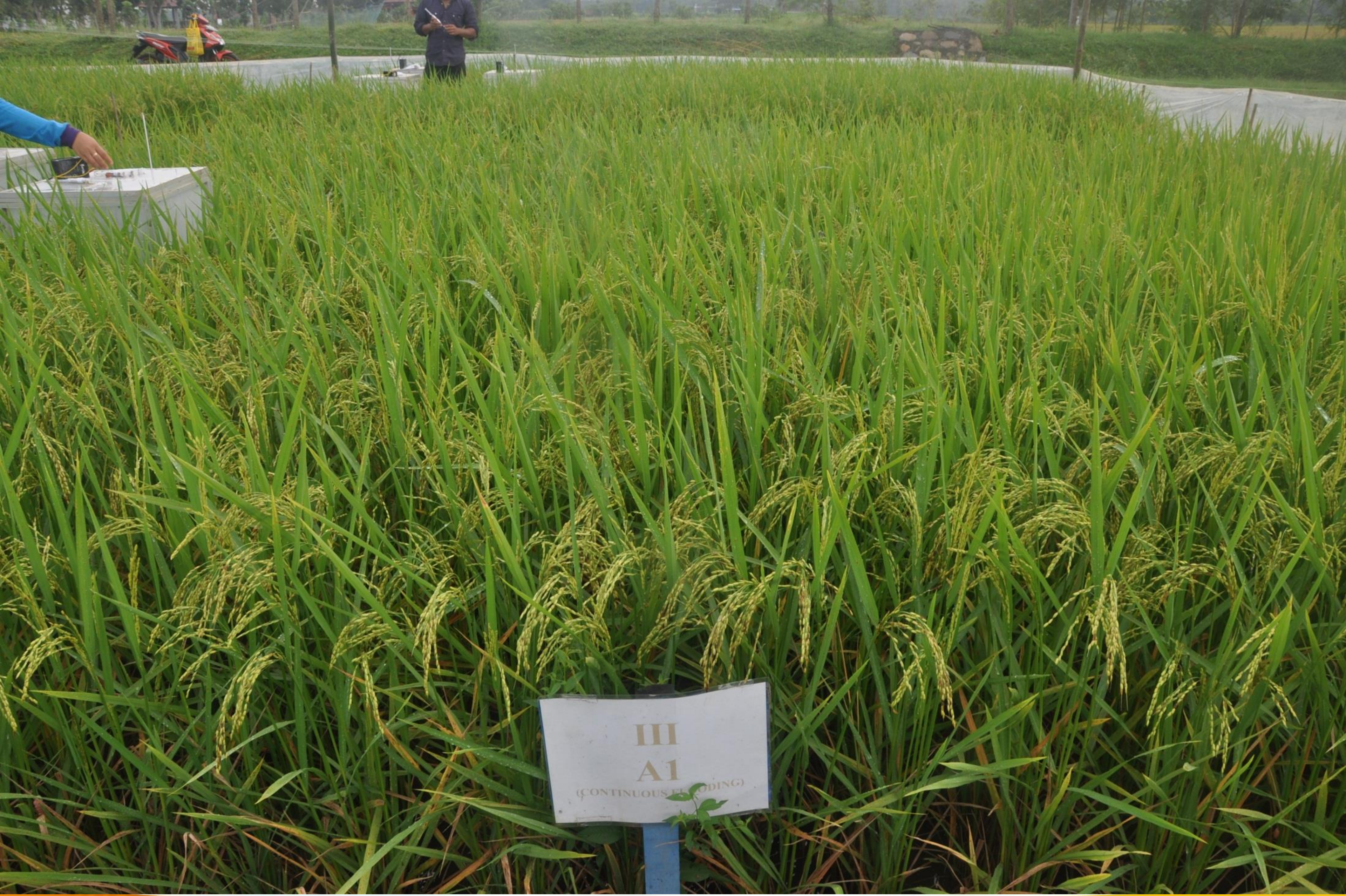
Parameters to be monitored

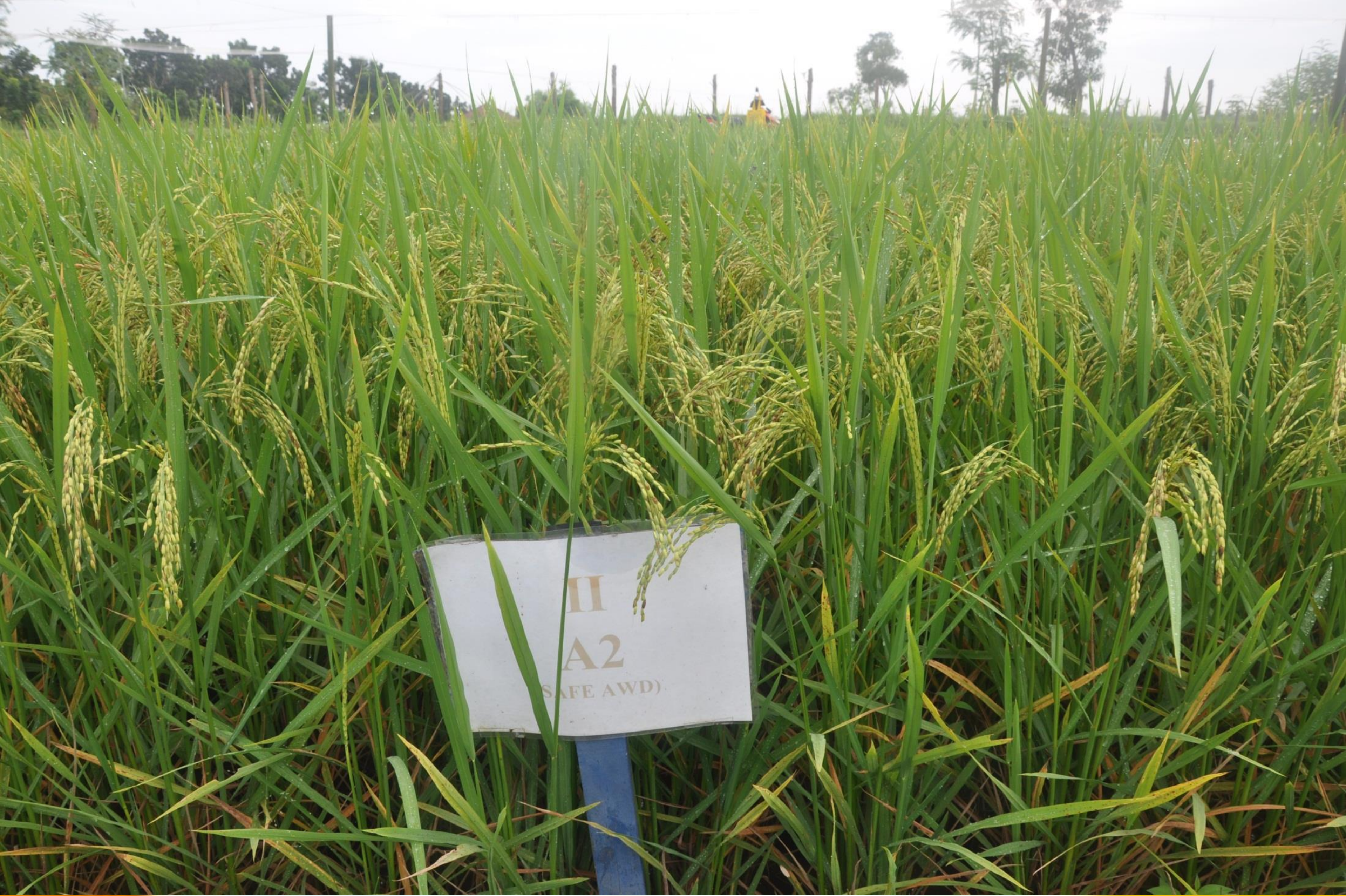
No	Parameters	Remarks
1	**GHG emissions**	CH_4 and N_2O, weekly and after fertilization
2	Plant height and tiller number	Weekly
3	**Yield** components	- Grain yield - Panicle/hill - Grain/panicle - Percentage of filled spikelet - Straw biomass - 1000 grain weigth
4	pH and Eh measurement	Weekly
5	Climate data	Rainfall, max-min temperature, solar radiation
6	Water table measurement	Daily
7	Soil physicochemical properties	Texture, BD, pH, N, P, K, CEC, C organic, exchangeable cation (before and after treatments)
8	Amount of water irrigation	Total volume of water (m^3)

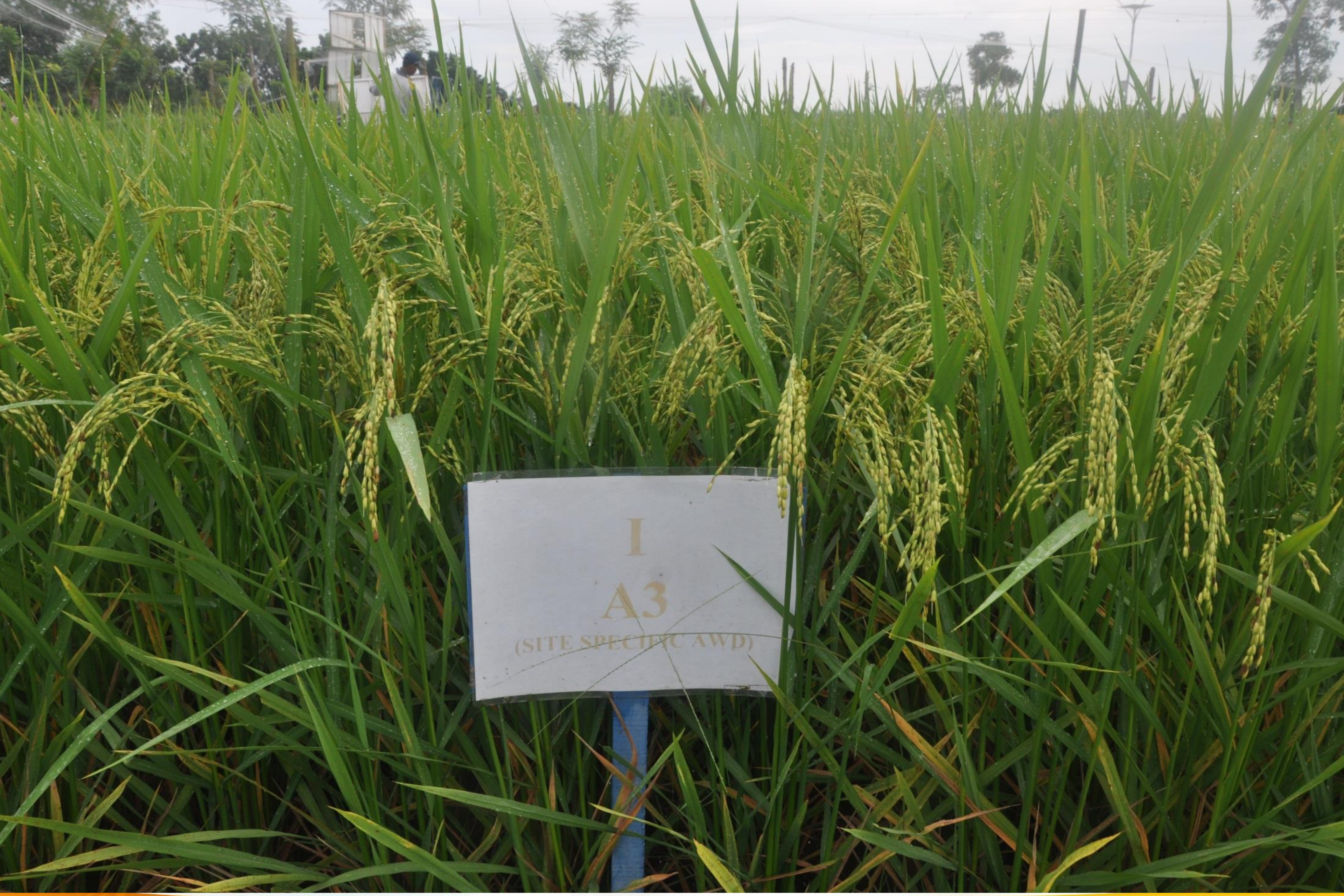








III
A1

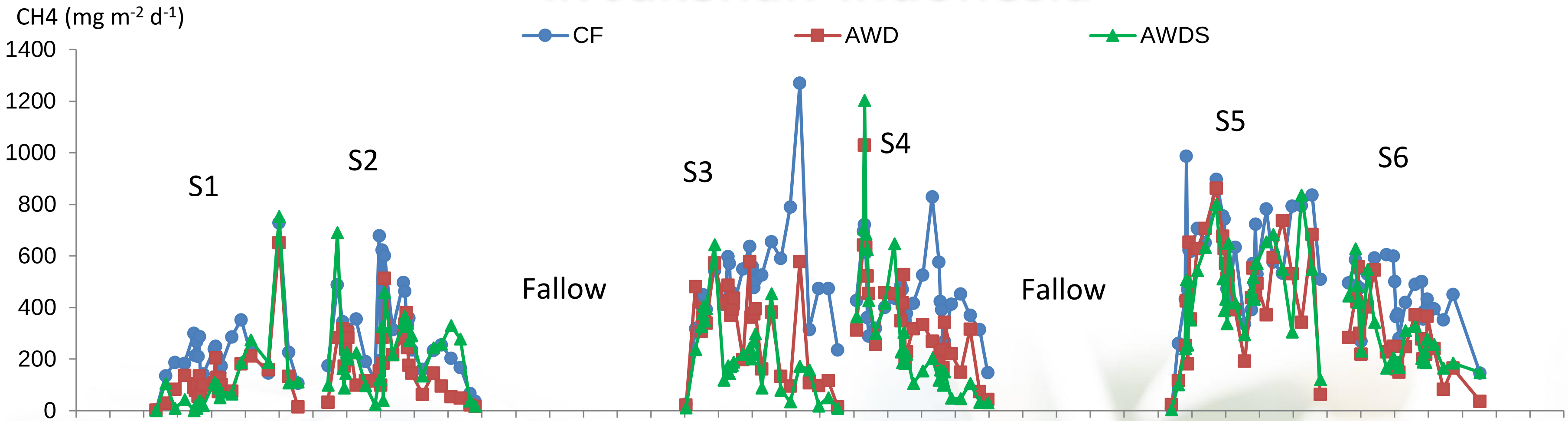

II
A2
SAFE AWD)


I
A3
(SITE SPECIFIC AWD)



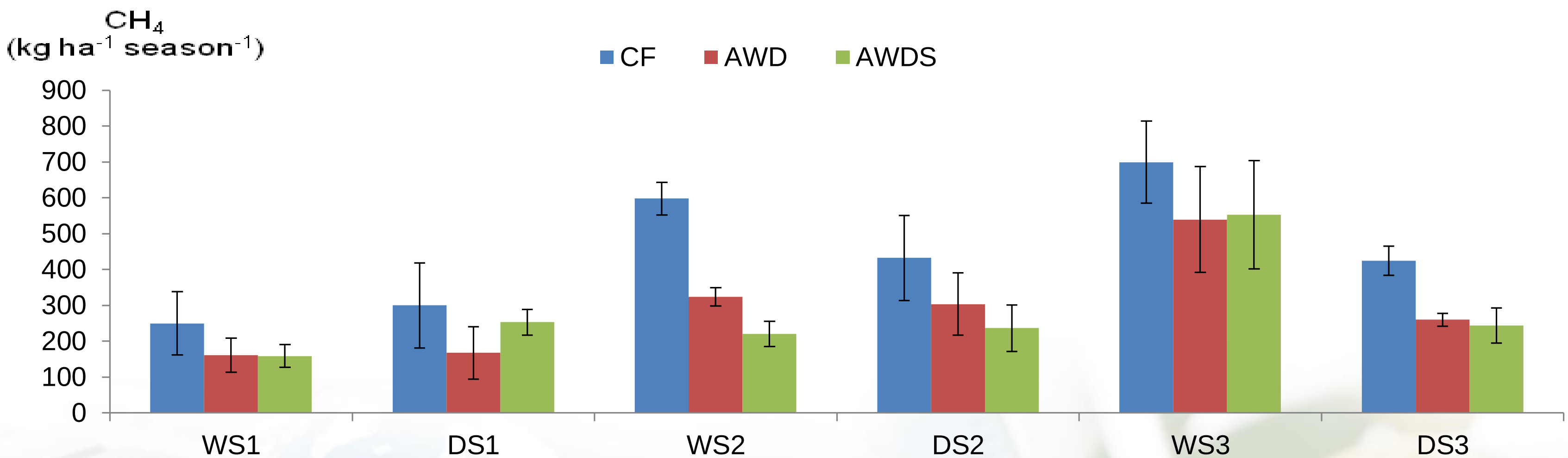

RESULTS

Methane emissions during rice cultivation in Jakenan-Indonesia



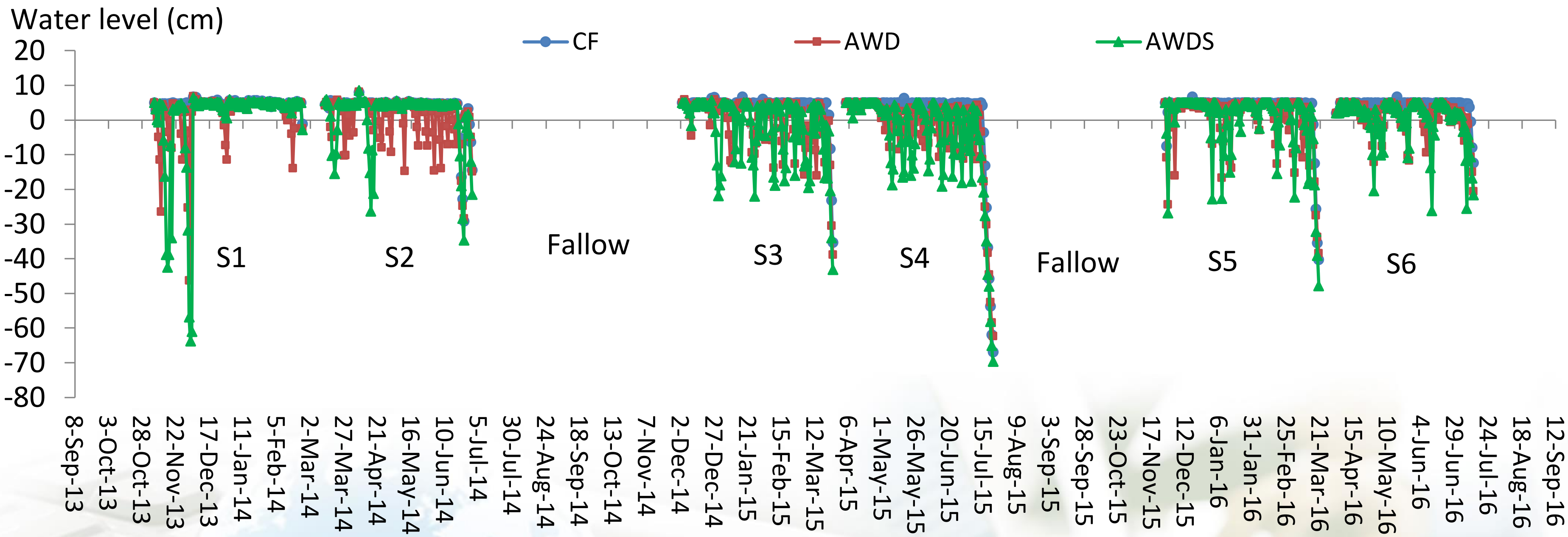
Average daily CH_4 emission rates mg m^{-2} d^{-1}			
Season	**CF**	**AWD**	**AWDS**
S1	218.41	127.70	106.19
S2	306.96	187.33	223.54
S3	497.04	321.43	215.29
S4	433.20	347.50	292.97
S5	590.46	462.86	455.93
S6	440.55	283.97	272.06
Means	**414.44**	**288.47**	**261.00**

Seasonal **methane emissions** during rice cultivation in Jakenan-Indonesia



Season	CH_4 kg ha^{-1}			
	CF	AWD	AWDS	Season Means
Wet Season 2013-14	249.7 a	160.3 a	158.5 a	189.5 d
Dry Season 2014	299.5 a	167.1 a	253.0 a	239.9 cd
Wet Season 2014-15	597.3 a	323.2 ab	220.6 b	380.4 b
Dry Season 2015	431.9 a	302.9 b	236.0 b	323.6 bc
Wet Season 2015-16	699.2 a	539.1 a	552.9 a	597.1 a
Dry Season 2016	424.6 a	259.8 b	243.8 b	340.0 bc
Trt means	450.4 a	292.0 b	277.5 b	
% CH_4 Reduction		34.5	37.6	

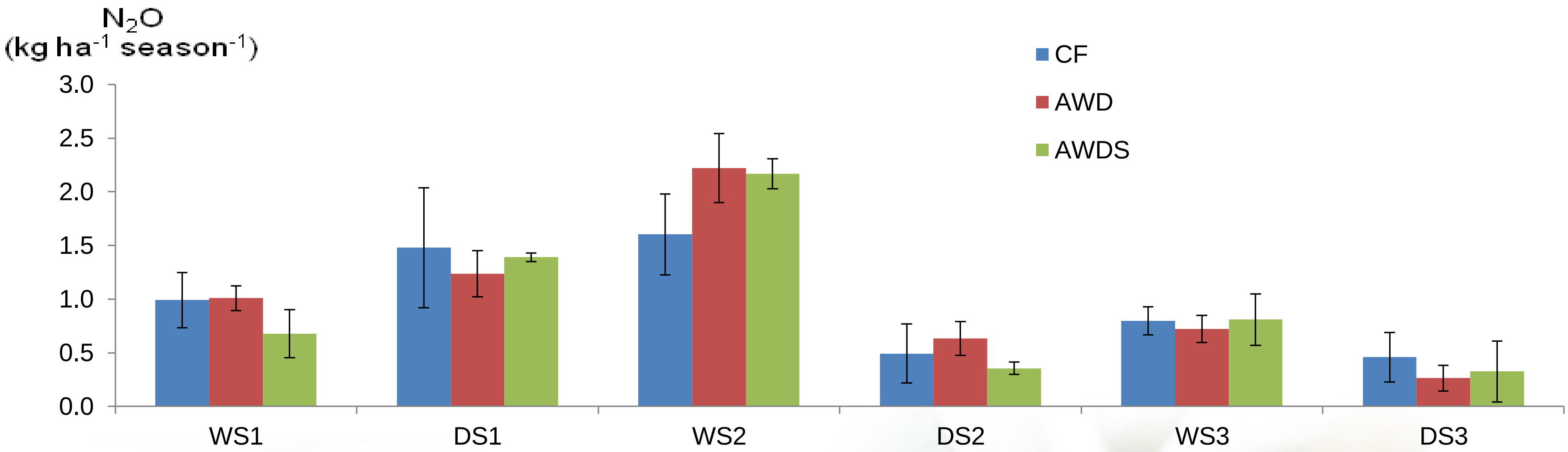
Measured **water levels** under AWD management in Jakenan-Indonesia



Parameter	Season 1			Season 2			Season 3			Season 4			Season 5			Season 6		
	CF	AWD	AWDS	CF	AWD	AWDS	CF	AWD	AWDS	CF	AWD	AWDS	CF	AWD	AWDS	CF	AWD	AWDS
No. of days drained (<0 cm)	0	20	14	0	31	16	0	38	44	0	41	38	1	25	27	0	29	24
% CH4 reduction		36	37		44	16		46	63		30	45		23	21		35	38

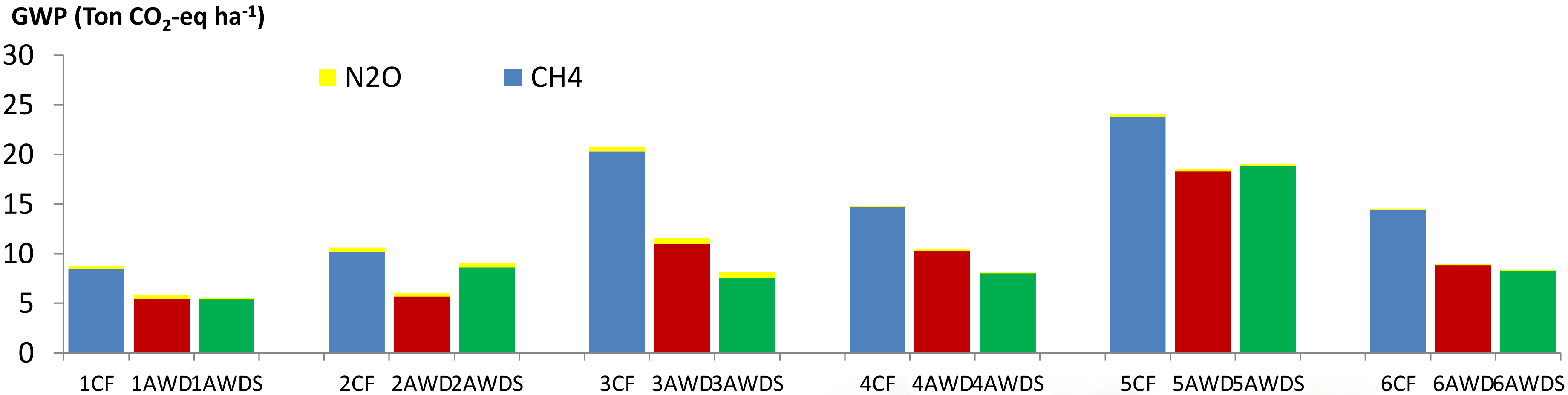
Water saving = 17-20%

Seasonal **nitrous oxide emissions** during rice cultivation in Jakenan-Indonesia



	N_2O kg ha^{-1}							
Season	**CF**		**AWD**		**AWDS**		**Season Means**	
Wet Season 2013-14	0.992	a	1.009	a	0.677	a	0.89	c
Dry Season 2014	1.479	a	1.237	a	1.390	a	1.37	b
Wet Season 2014-15	1.602	a	2.222	a	2.167	a	2.00	a
Dry Season 2015	0.493	a	0.633	a	0.356	a	0.49	cd
Wet Season 2015-16	0.799	a	0.722	a	0.810	a	0.78	c
Dry Season 2016	0.459	a	0.263	a	0.325	a	0.35	d
Trt means	0.971	a	1.014	a	0.954	a		

Seasonal **GWP from CH_4 and N_2O emissions** during rice cultivation in Jakenan-Indonesia



	GWP Mg CO_2 eq ha^{-1}							
Season	**CF**		**AWD**		**AWDS**		**Season Means**	
Wet Season 2013-14	8.78	a	5.75	a	5.59	a	6.71	d
Dry Season 2014	10.62	a	6.05	a	9.02	a	8.56	cd
Wet Season 2014-15	20.79	a	11.65	ab	8.15	b	13.53	b
Dry Season 2015	14.83	a	10.49	b	8.13	b	11.15	bc
Wet Season 2015-16	24.01	a	18.55	a	19.04	a	20.53	a
Dry Season 2016	14.57	a	8.91	b	8.39	b	10.62	bc
Trt means	**15.60**	**a**	**10.23**	**b**	**9.72**	**b**		
% GWP Reduction			34.4		37.7			

Variations in **grain yield** over 6 seasons as affected by water management in Jakenan-Indonesia

Season	Grain Yield Ton ha^{-1}							
	CF		AWD		AWDS		Season Means	
Wet Season 2013-14	6.847		6.363		6.807		6.672	a
Dry Season 2014	5.767		5.597		5.697		5.687	b
Wet Season 2014-15	6.944		6.820		7.263		7.009	a
Dry Season 2015	4.939		4.321		4.734		4.665	c
Wet Season 2015-16	6.827		6.814		6.528		6.723	a
Dry Season 2016	4.894		4.967		4.937		4.933	c
Trt means	**6.265**	a	**5.983**	a	**6.206**	a		

AWD IMPLEMENTATION

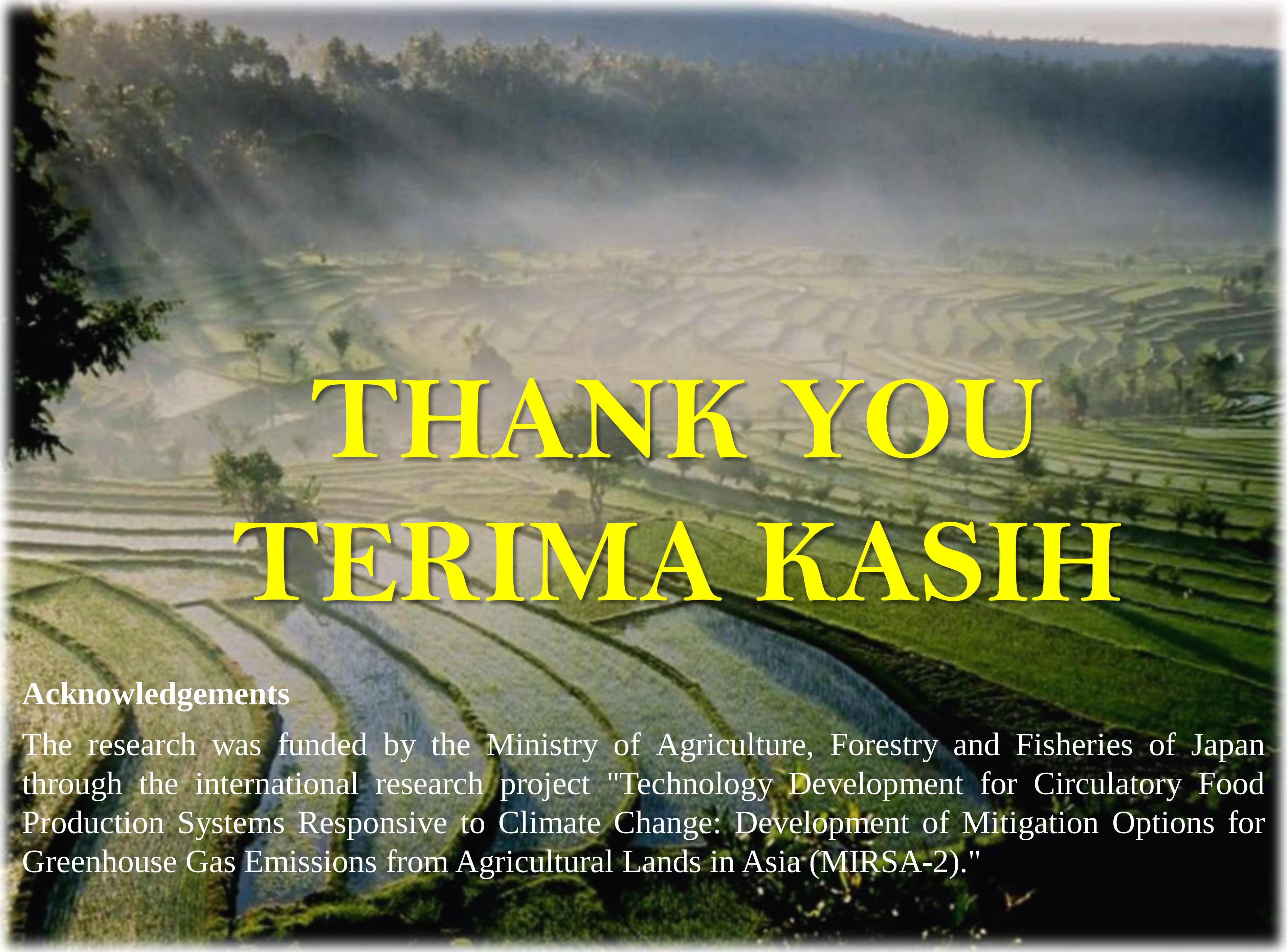
Intermittent Irrigation → ICM

CONCLUSION

- Compared to control, AWD and AWDS treatments significantly reduced the global warming potential of rice cropping systems by 35% and 38%, respectively compared to CF.
- The total water use was reduced by AWD (5%) and AWDS (6%) compared to CF.
- The adoption of AWD to rice cultivation in Indonesia will be feasible because AWD can reduce GHG emission and water use without rice yield loss.

FUTURE WORK

AWD practices can reduce GWP and water use while maintain rice yields. But, the farmer will be more interested to highest rice yield. So, it is important to know the effect of AWD treatment combined the organic manure and rice cultivars on GHGs emission and rice yield on Indonesian paddy field.

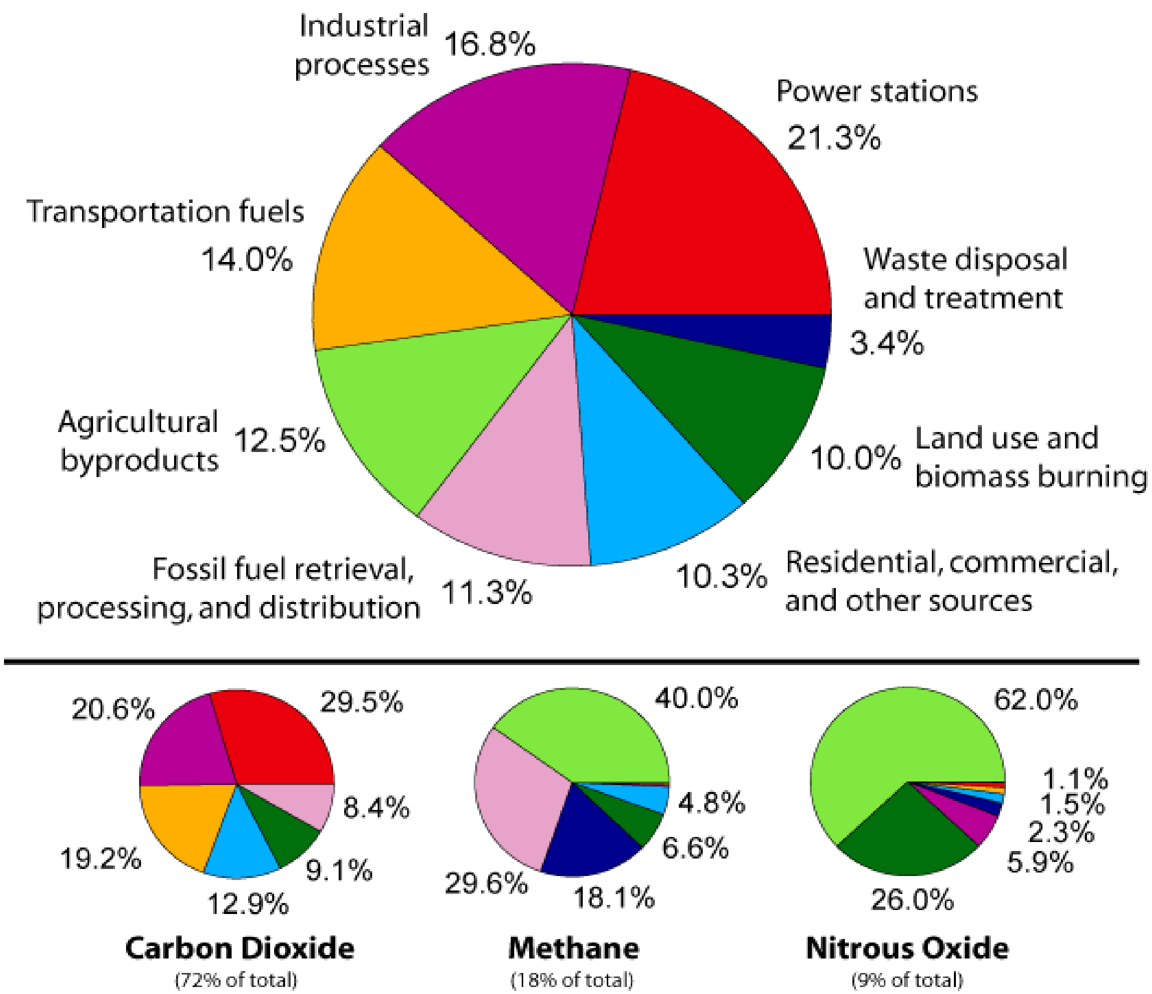

THANK YOU
TERIMA KASIH
Acknowledgements
The research was funded by the Ministry of Agriculture, Forestry and Fisheries of Japan through the international research project "Technology Development for Circulatory Food Production Systems Responsive to Climate Change: Development of Mitigation Options for Greenhouse Gas Emissions from Agricultural Lands in Asia (MIRSA-2)."

Assessing the feasibility of GHG mitigation through water saving techniques (AWD) in irrigated rice fields in Central Viet Nam

(FYs 2013-2017 funded by MAFF of Japan)

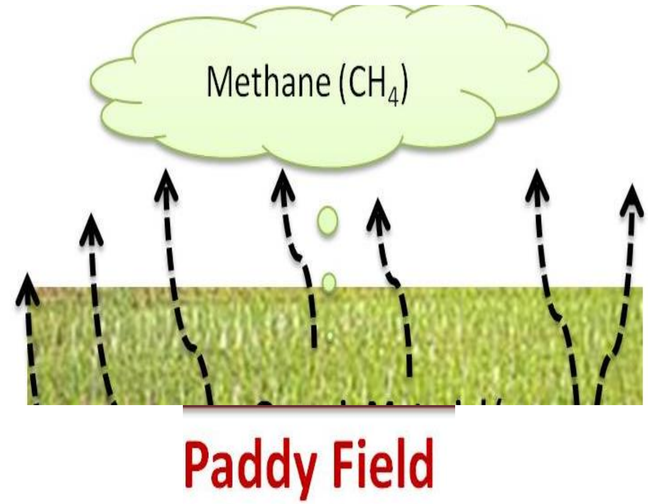
Hoang Trong Nghia
Hue University of Agriculture and Forestry (HUAF)

Introduction

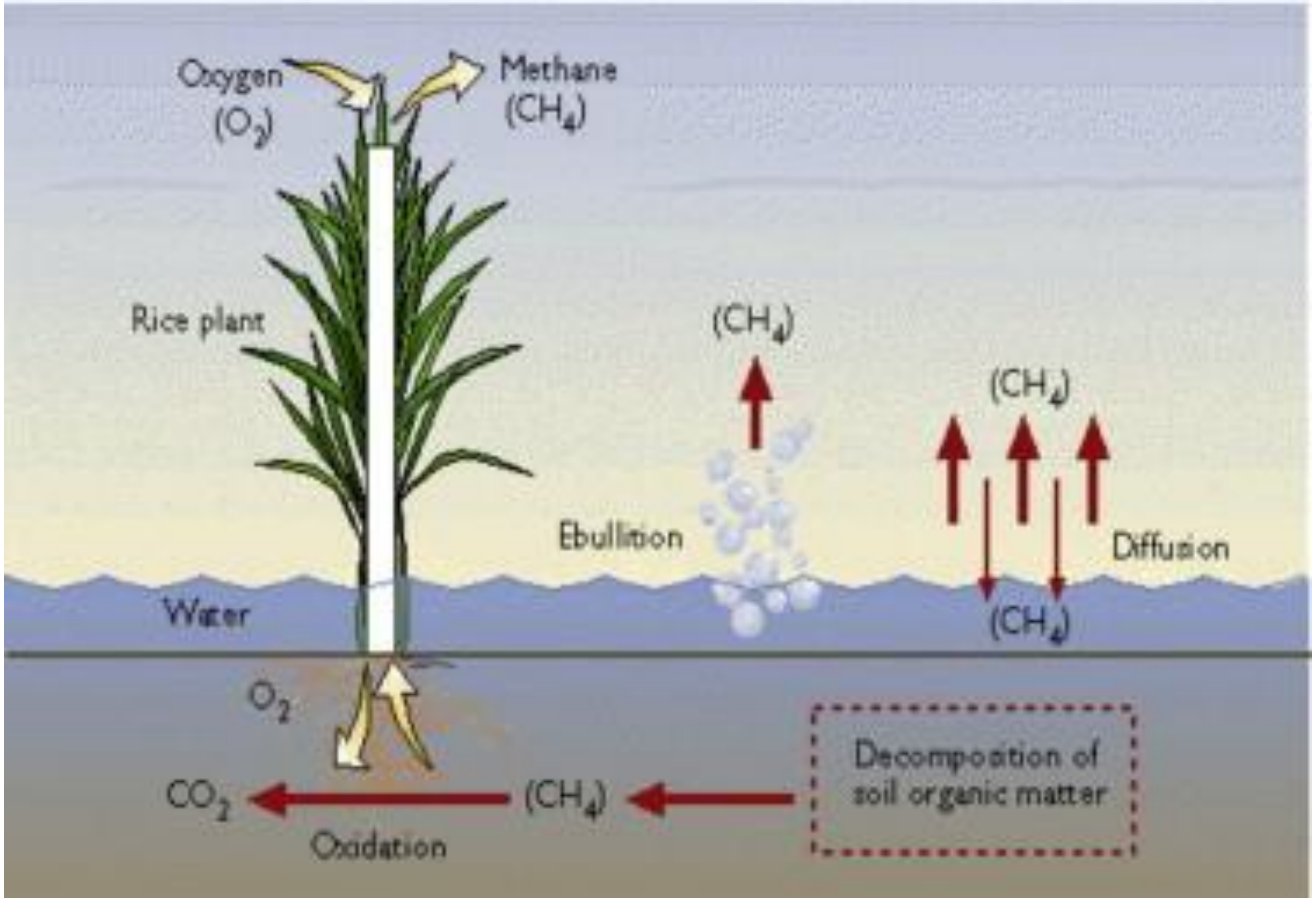


Annual greenhouse gas emission by sector

(Source: https://www.e-education.psu.edu/geog438w/node/364)



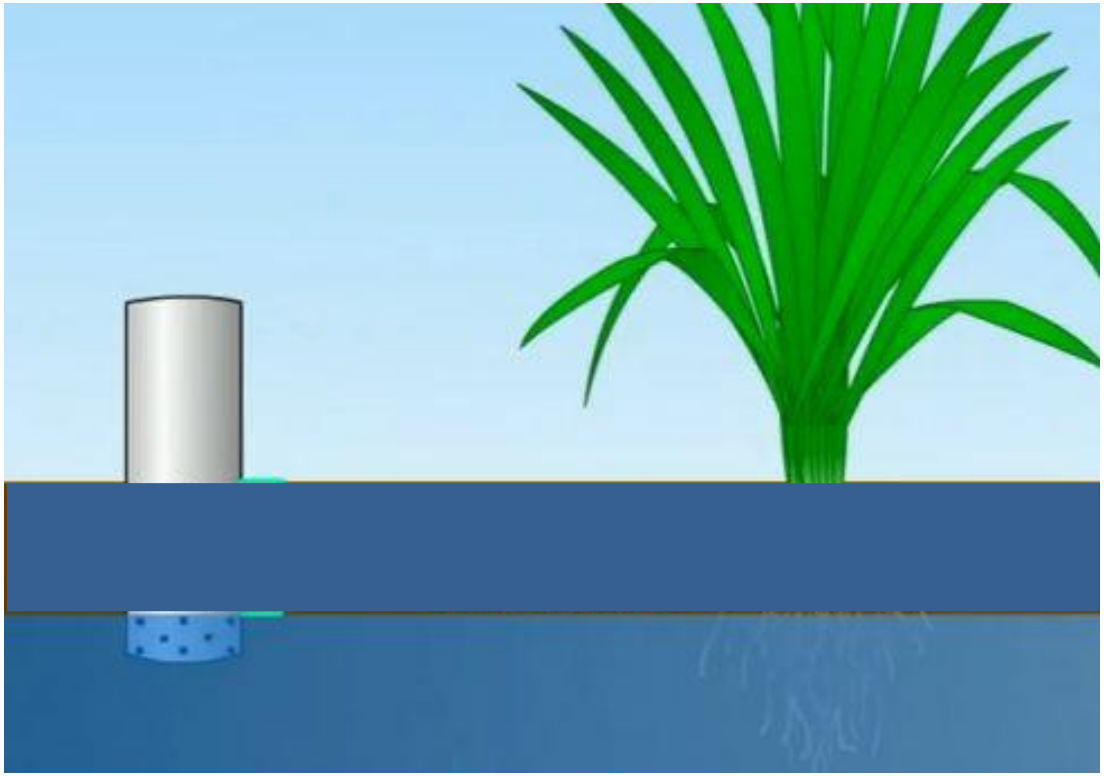
- Global warming is one of the most issue for the human
- CO_2, CH_4, N_2O are the top three GHGs, that's major attributor to emissions from land use including agriculture
- Rice cultivation is a major CH_4 source that accounts for the total anthropogenic emission



(Source: Hasan, 2013)

- In Asia, traditional rice cultivation uses CF as water regime, but CF enhances CH_4 emission.
- AWD reduced water input, kept grain yield, reduced CH_4 emission.

What is Safe AWD?

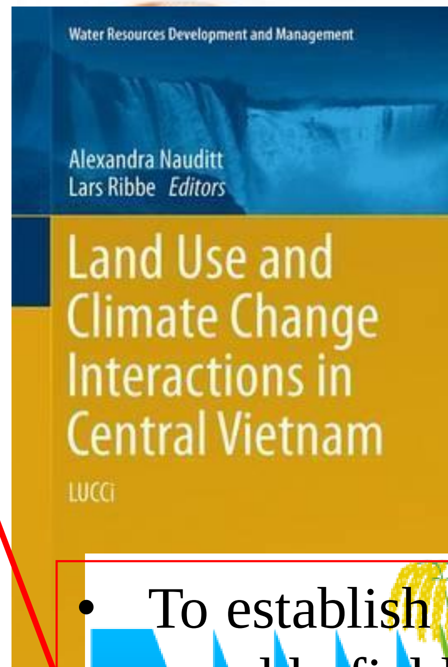


The threshold of 15 cm water depth (below the surface) before irrigation is called 'Safe AWD" as this will not cause any yield decline.

Long An (2015-2017)

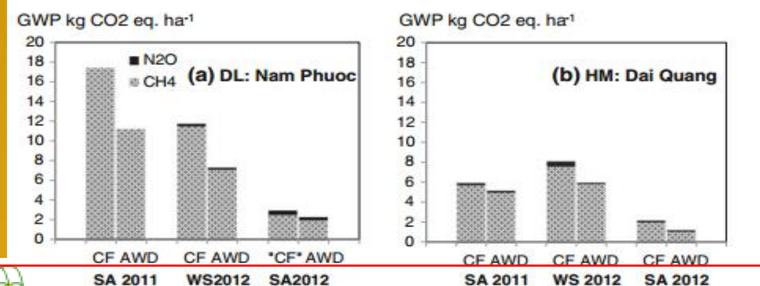
LUCCi Land Use and Climate Change Interactions in Central Vietnam

An output from LUCCi project



Measuring GHG Emissions from Rice Production in Quang Nam Province (Central Vietnam): Emission Factors for Different Landscapes and Water Management Practices

Agnes Tirol-Padre, Dang Hoa Tran, Trong Nghia Hoang, Duong Van Hau, Tran Thi Ngan, Le Van An, Ngo Duc Minh, Reiner Wassmann and Bjoern Ole Sander



Objectives

- To establish the baseline GHG emission from a paddy field in Central Vietnam
- To investigate the feasibility of AWD in term of GHG emission, rice productivity and water use.

MIRSA

(FYs 2013-2017 funded by MAFF of Japan)

VIỆN MÔI TRƯỜNG NÔNG NGHIỆP
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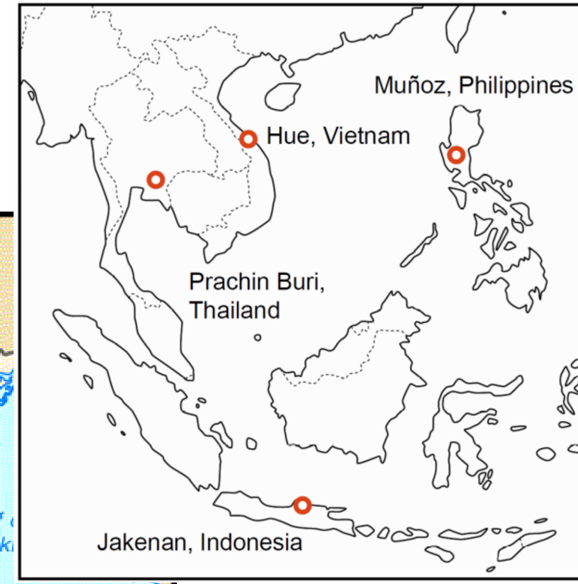
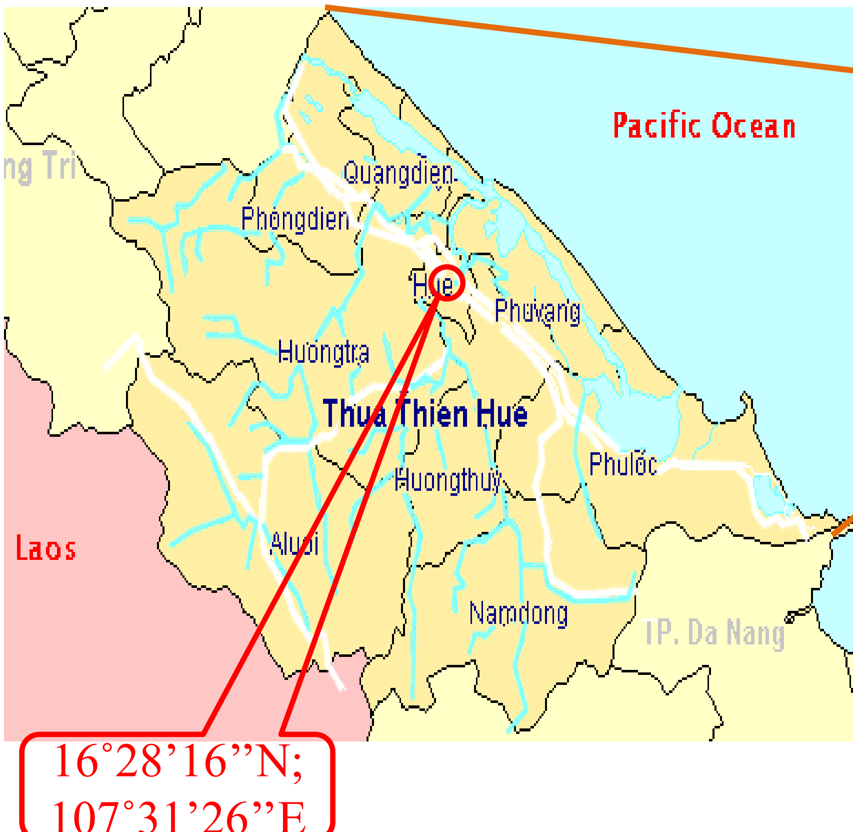
TRƯỜNG ĐẠI HỌC NÔNG LÂM
1955
THÀNH PHỐ HỒ CHÍ MINH

MIRSA 2 project outline

Experimental site

- Huong An commune, Huong Tra district, Thua Thien Hue Province, Central Viet Nam during six consecutive cropping seasons from 2013 to 2016

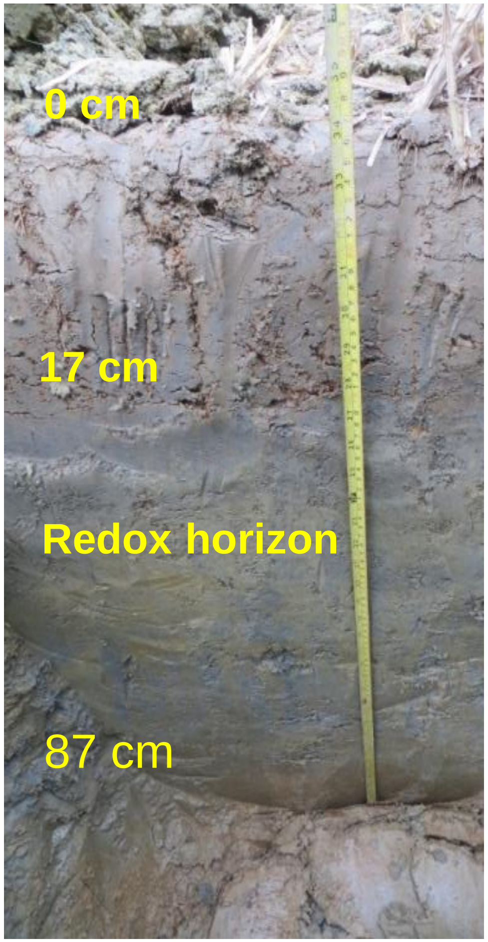




Experimental layout

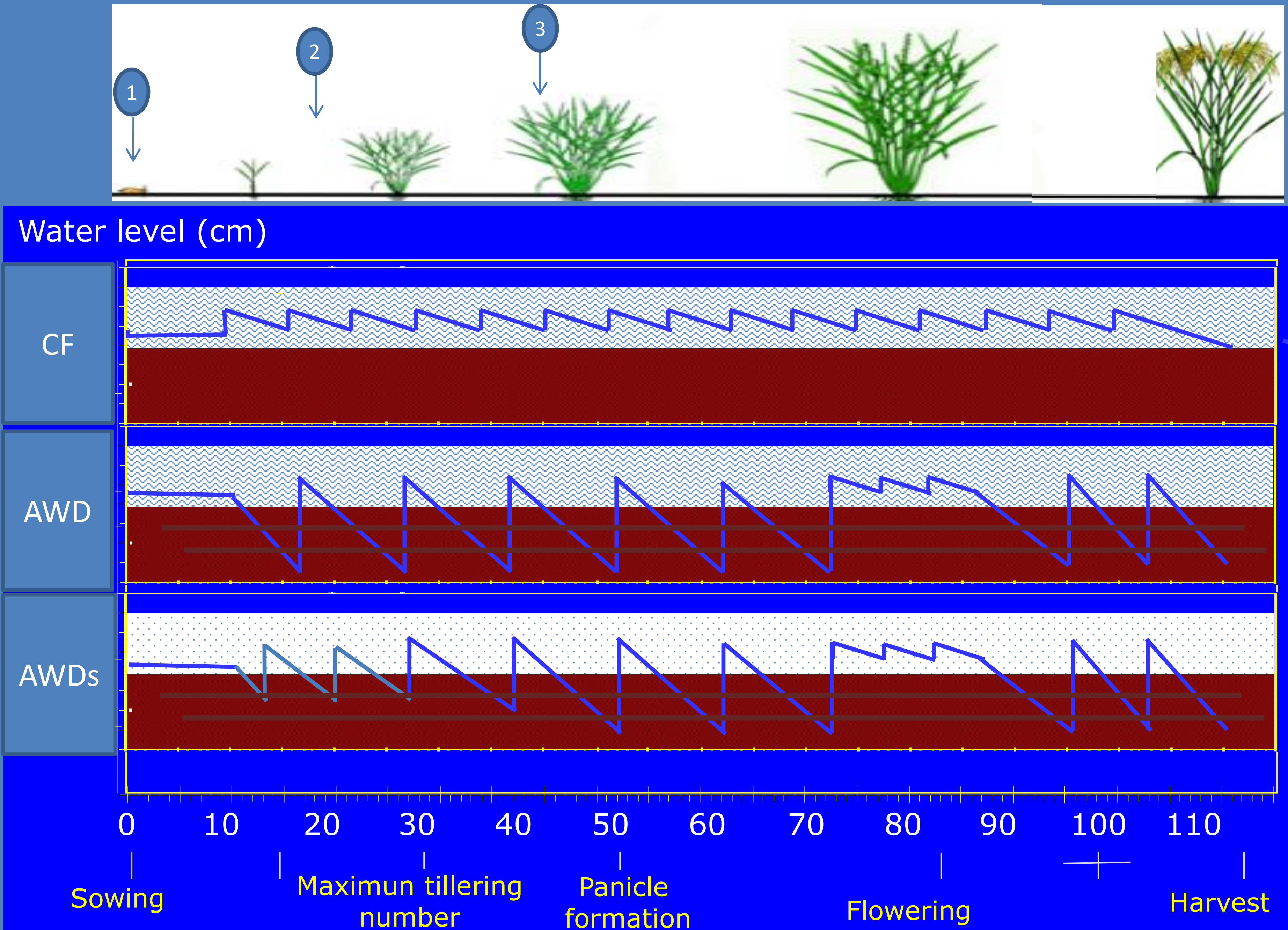
Area: 30 m^2 (5 m x 6 m)
Bank: 30 cm
Harvest area: 5 m^2

R1	R2	R3
CF	AWD	AWDS
AWDS	CF	AWD
AWD	AWDS	CF



FAO: Dystric Fluvisols,
USDA: Typic Endoaquepts

Treatments


1
2
3
Water level (cm)
CF
AWD
AWDs
0
10
20
30
40
50
60
70
80
90
100
110
Sowing
Maximun tillering number
Panicle formation
Flowering
Harvest

Measurements

Gas sampling:

- Weekly in mid-morning (8:00-10:00 AM).
- 1, 2, 3, 4, and 5 days after nitrogen (N) fertilizer application.
- The gas samples were collected using a 60-mL syringe fitted with a stopcock at 0, 6, 12, 20, and 30 min after chamber closure and used a 19-mL evacuated glass vials

Water level measurements

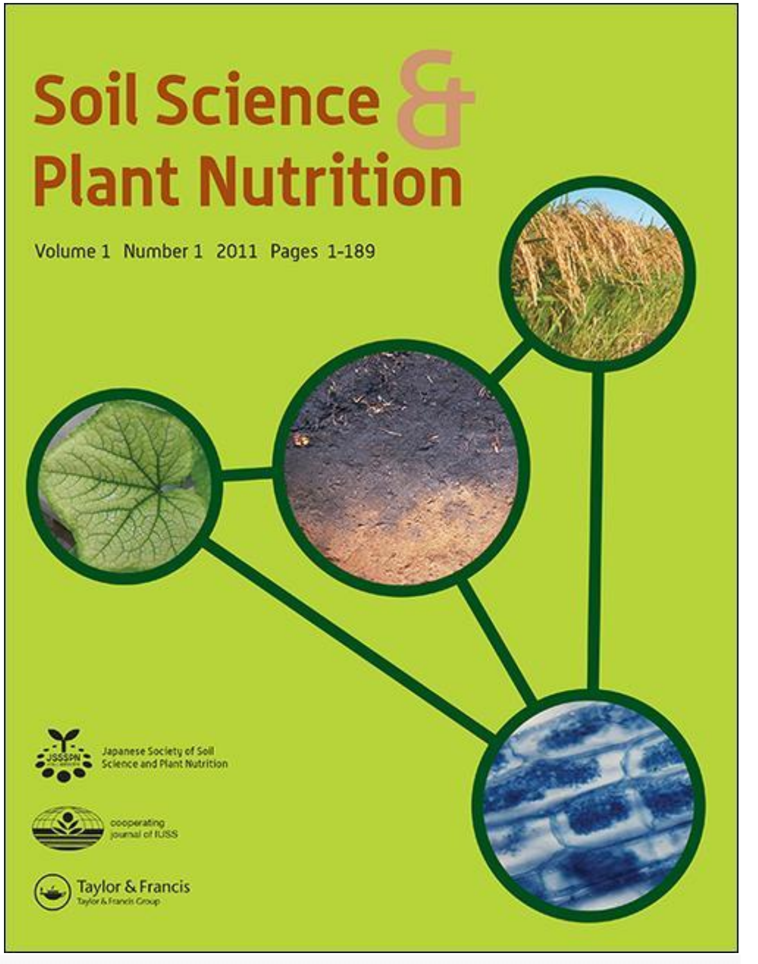
- Water Level Sensor was used
- Values were corrected based on manual measurements done daily using AWD tubes

Analysis gas sampling

- Gas chromatograph (8610C, SRI Instruments, CA, USA) equipped with a flame ionization detector (FID) for the analysis of CH_4 and an electron capture detector (ECD) for the analysis of N_2O.
- GWP (kg CO_2 ha^{-1}) = $28*CH_4 + 298*N_2O$ (IPCC, 2014)

An output from MIRSA-2 project

A paper published from *Soil Science and Plant Nutrition* in 2018.



Open access

Impacts of Alternate wetting and drying on greenhouse gas emission from paddy field in Central Vietnam

Dang Hoa Tran, Trong Nghia Hoang, Takeshi Tokida, Agnes Tirol-Padre & Kazunori Minamikawa

Pages 14-22 | Received 16 May 2017, Accepted 21 Nov 2017, Published online: 30 Nov 2017

Download citation https://doi.org/10.1080/00380768.2017.1409601 Check for updates

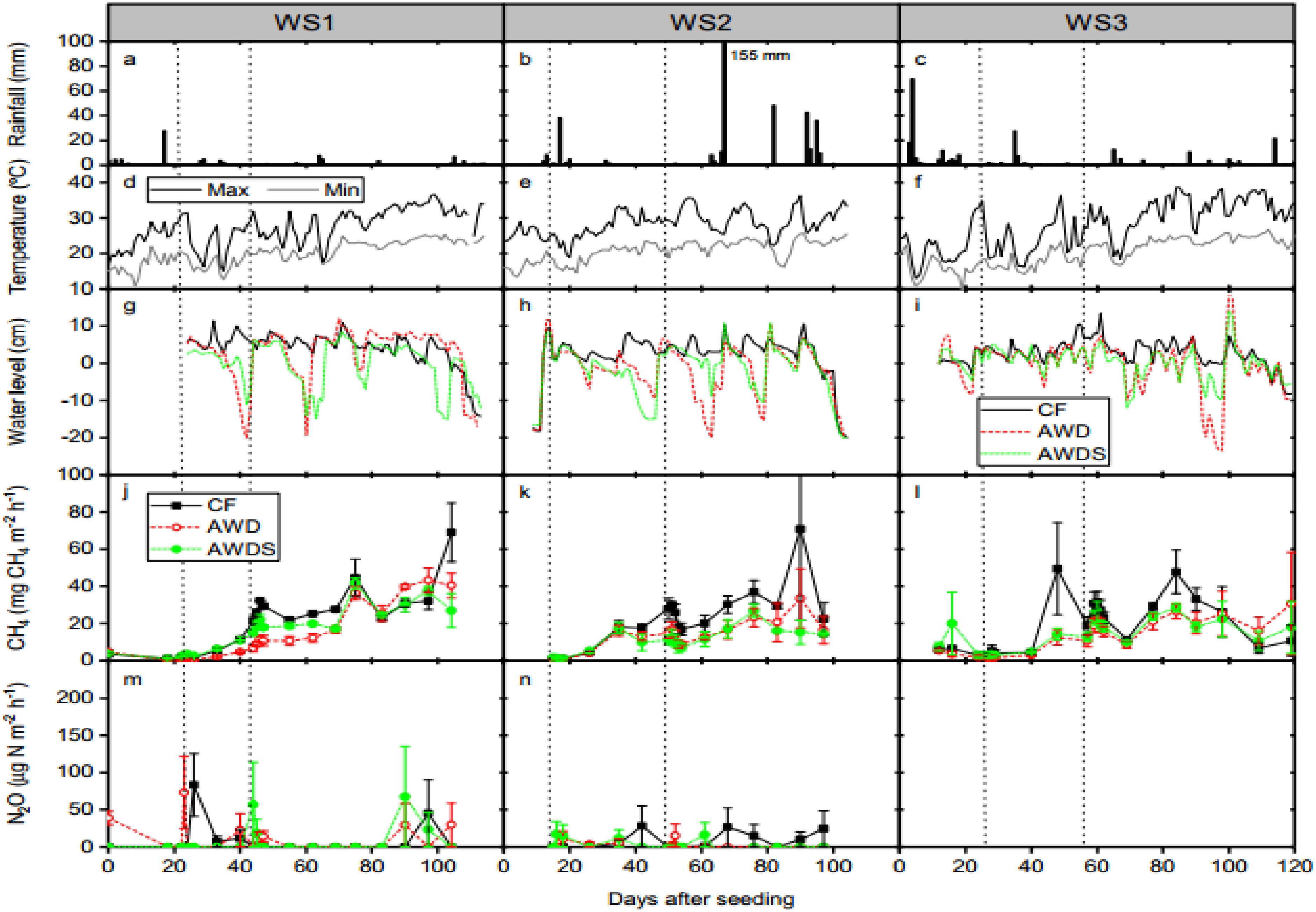


Fig 1. CH_4 and N_2O daily emission in Winter – Spring season

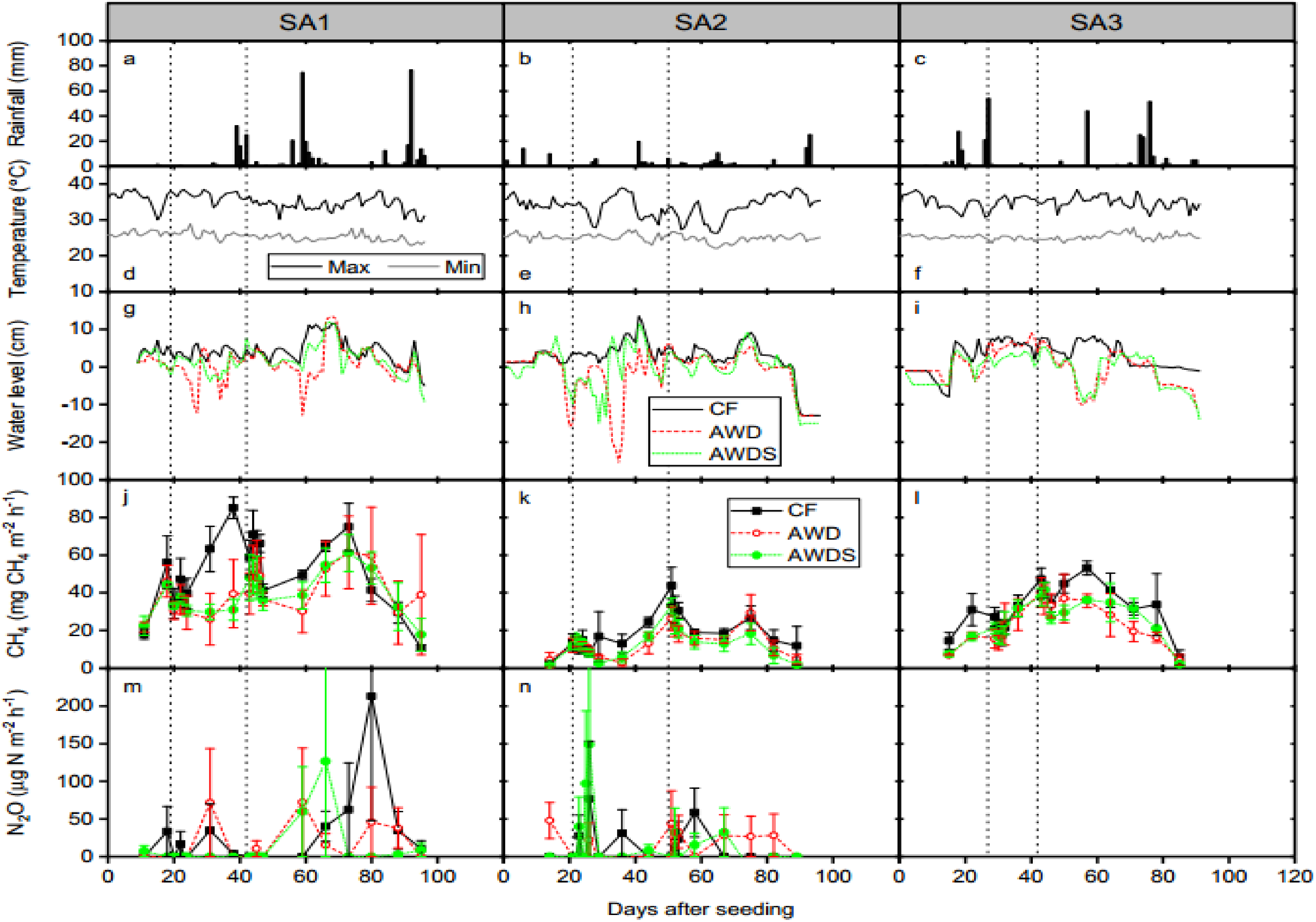


Fig 2. CH_4 and N_2O daily emission in Summer – Autumn season

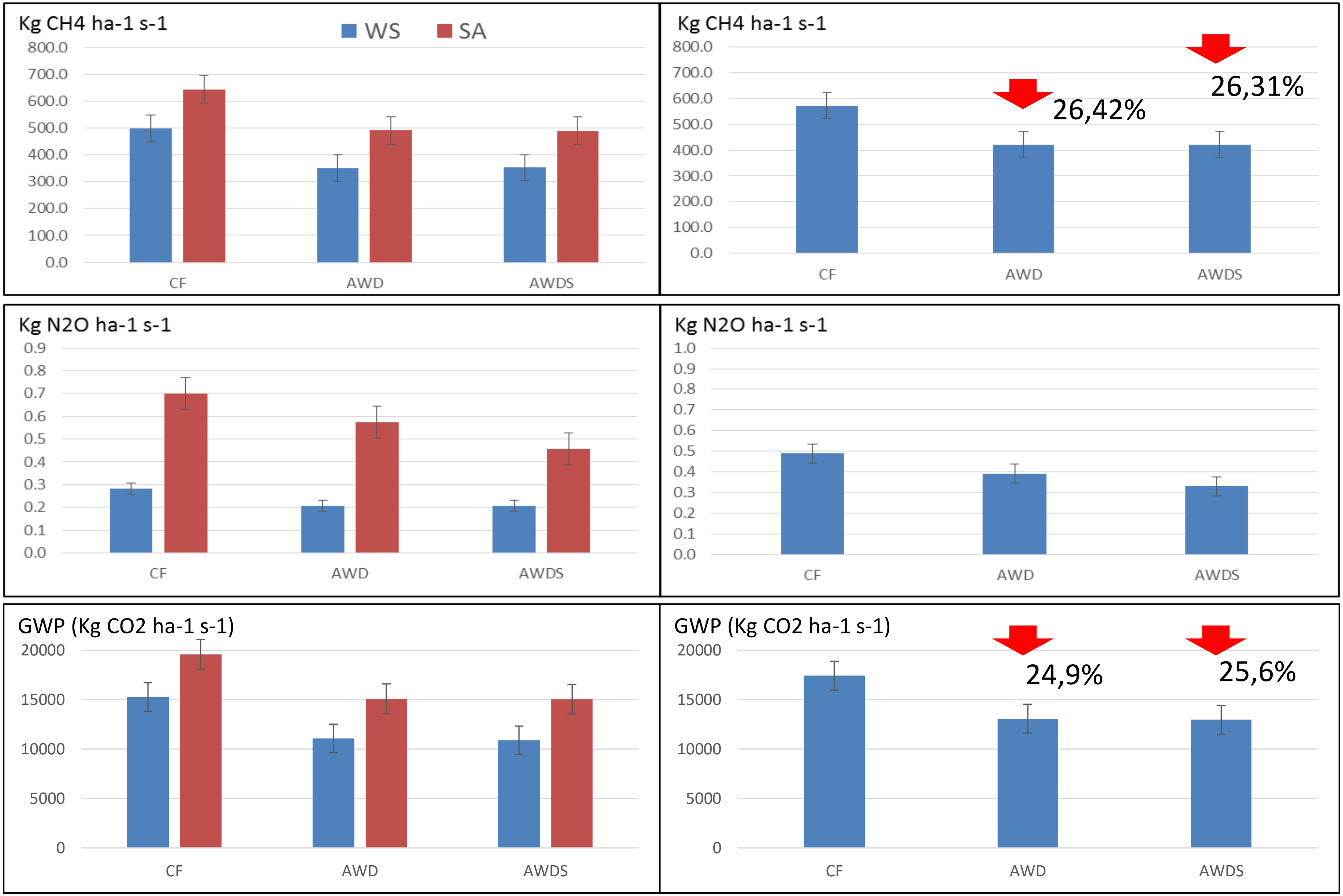


Fig 3. Seasonal CH_4, N_2O emission, and GWP (kg CO_2 ha^{-1}) as affected by cropping season and water management

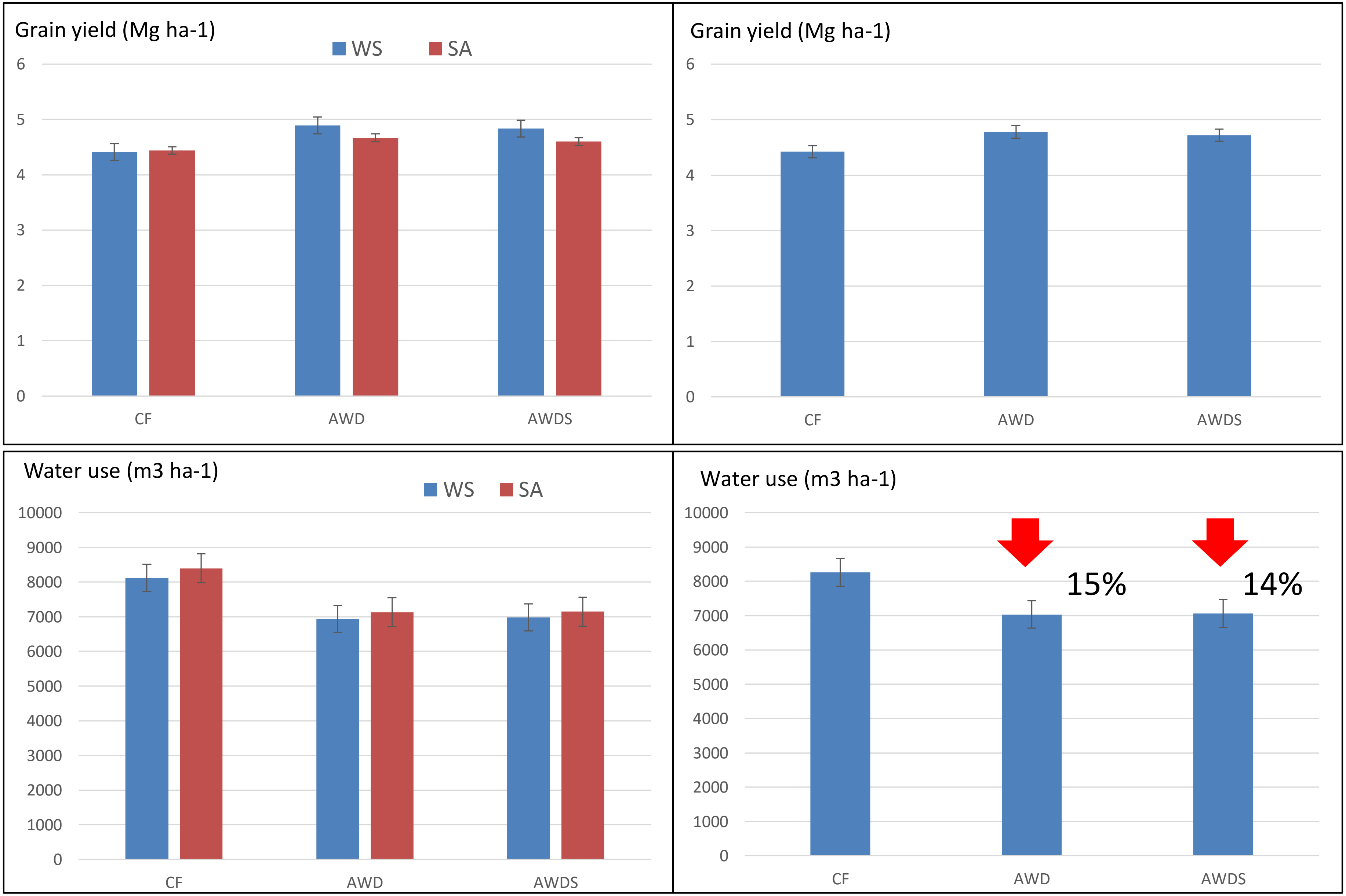


Fig 4. Rice grain yield (Mg ha^{-1}) and total water use (m^3 ha^{-1}) as affected by cropping season and water management

Conclusion

- CH_4 emission ranged from 500 kg CH_4 ha^{-1} in WS to 644 kg CH_4 ha^{-1} in SA. Rice paddy in Central Vietnam can contribute to the national GHG budget.

- The AWD with the current criteria reduced the GWP of CH_4 and N_2O by 26% compared to CF treatment.

- The AWD with the current criteria reduced the water use by 14-15% compared to CF treatment.

- A possibility of AWD's performance on increasing rice productivity. Thus, it will be key to spread AWD to local farmer.

Acknowledgements

- We would like to thank:
- The Ministry of Agriculture, Forestry, Fisheries (MAFF) of Japan through MIRSA 2 project.
- Prof. Kazuyuki Inubushi (Chiba University, Japan), Dr. Reiner Wassmann, Dr. Bjorn Ole Sander (IRRI, Philippines), and Dr. Kazuyuki Yagi (NIAES, Japan) for their valuable comments.

- Contact:

Hoang Trong Nghia
Hue University of Agriculture and Forestry (HUAF)
Email: hoangtrongnghia@huaf.edu.vn
Tell: +84 982 848 779

Thank you for your attention

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The Joint graduate School of Energy and Environment

Evaluating the effects of alternate wetting and drying (AWD) on methane and nitrous oxide emissions from a paddy field in Thailand

Amnat Chidthaisong[1*], Nittaya Cha-un[1], Benjamas Rossopa[2], Chitnucha Buddaboon[2], Choosak Kunuthai[1], Patikorn Sriphirom[1], Sirintornthep Towprayoon[1], Takeshi Tokida[3], Agnes T. Padre[4], Kazunori Minamikawa[3]

An acid sulfate soil profile with mottles at PRRC site, showing a highly compacted and heterogeneous nature of a soil at this site


10
30
50
70
1M
130


Soil Sampling Point of PRRC

Sampling area	: Prachinburi Rice Research Center
Coordinate	: Nakorn Nayok map, sheet 5237 III : 47P 739457E 1549947N
Elevation above sea level	: 3 meter
Area characteristic	: Smooth
Slope	: 0-1 %
Geomorphology	: Flooded by sea water in the past
Rainfall average	: 1,708 mm
Temperature average	: 28.0 ^{o}C
Climate classification	: Savanna grassland (Aw)
Sampling date	: June 6, 2016

Soil Data Summary of PRRC

Soil series	: Rangsit series (RS)
Soil characteristic	: Deep soil
Soil origins	: Deposition of sea water or brackish water sediment
Drainage	: Poor
Absorption of water	: Slow
Erosion	: None
The runoff of surface water	: Slow
Groundwater level	: Less than 1.0 meter
Soil classification	: Very-fine, mixed, active, acid, isohyperthermic Sulfic Endoaquepts

➔ To evaluate the potential of AWD for GHG mitigation, and its effects on rice productivity and water saving in an acid sulphate paddy field soil in Thailand.

Field Layout

Experimental design: RCB

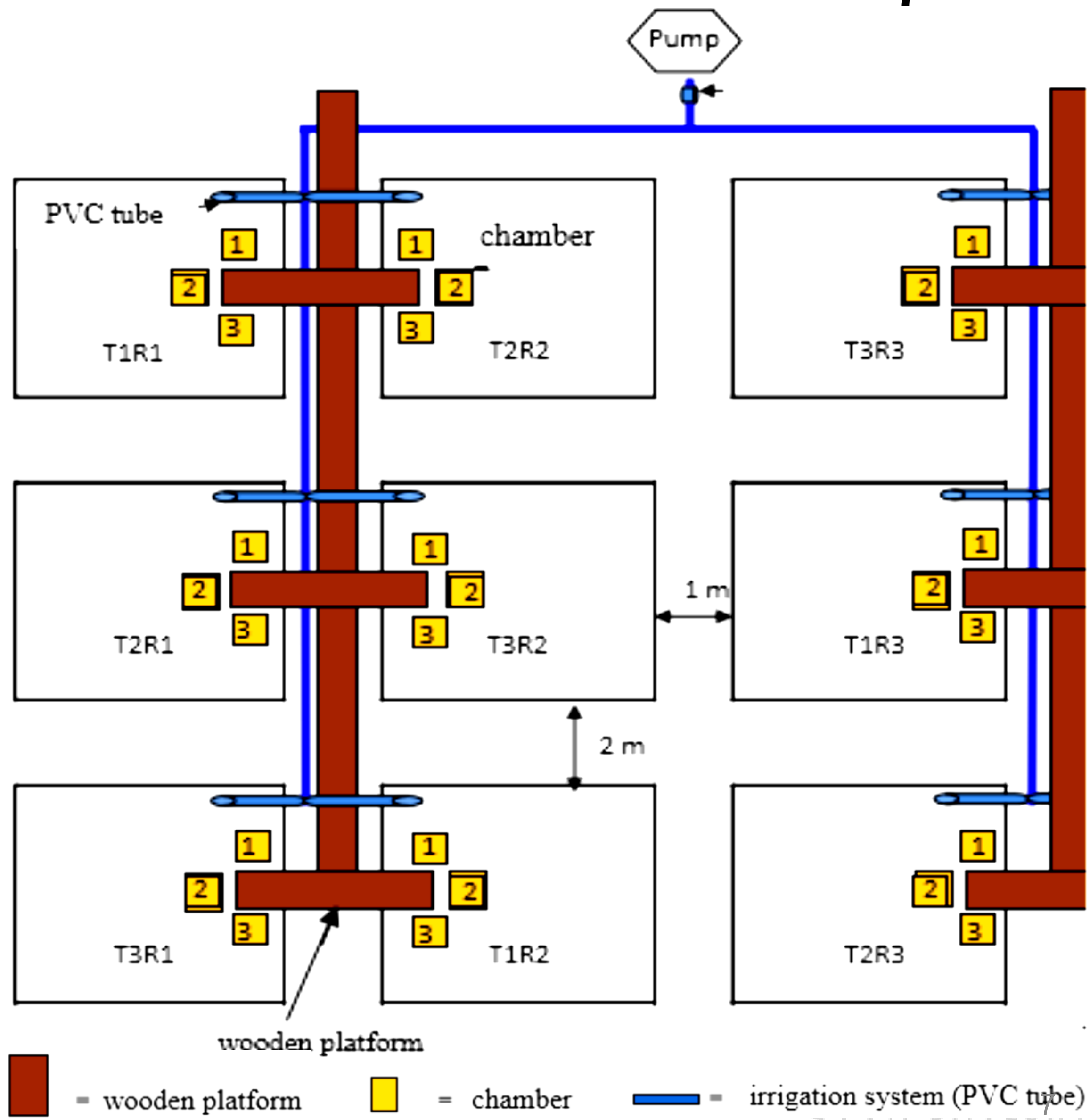
No. of replicates: 3

No. of chambers per rep: 3

Plot size: 5m x 7m

Harvest area: 2m x 3m

Irrigation: Pumping



Gas sampling procedure

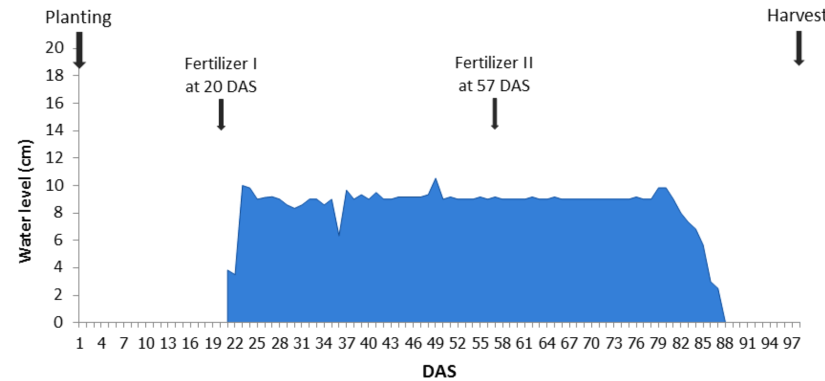
Sampling frequency : Start at 7 DAS then once a week and 1,2,3,4,5 days after fertilizer application

Gas sampling during chamber deployment : Sampling intervals 0,6,12,20 and 30 mins

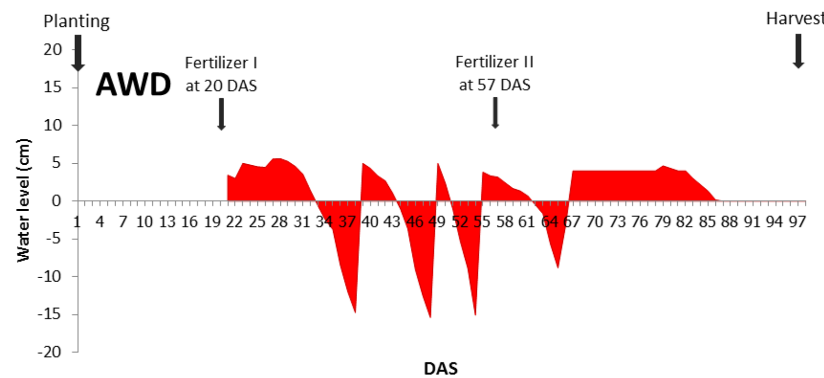
Gas sampling start time : 9.00 AM

Treatments

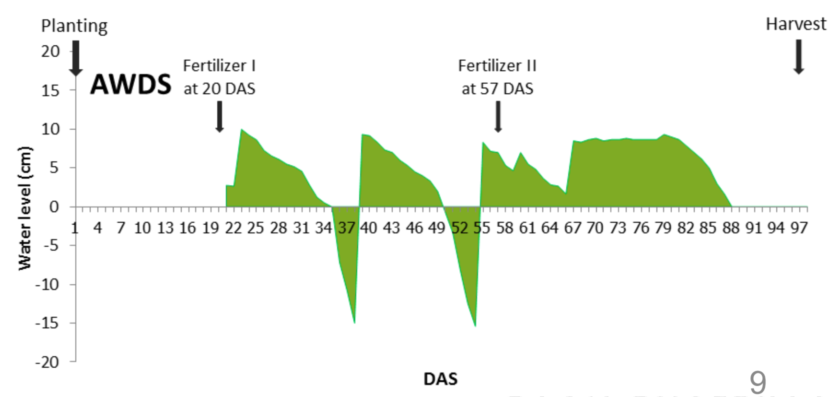
T1 (CF): Conventional flooding, floodwater depth 5 - 6 cm, flooded from 15 to 90 DAS



T2 (AWD): Safe AWD (Irrigate when water level is at 15 cm below soil surface) start at 37 DAS



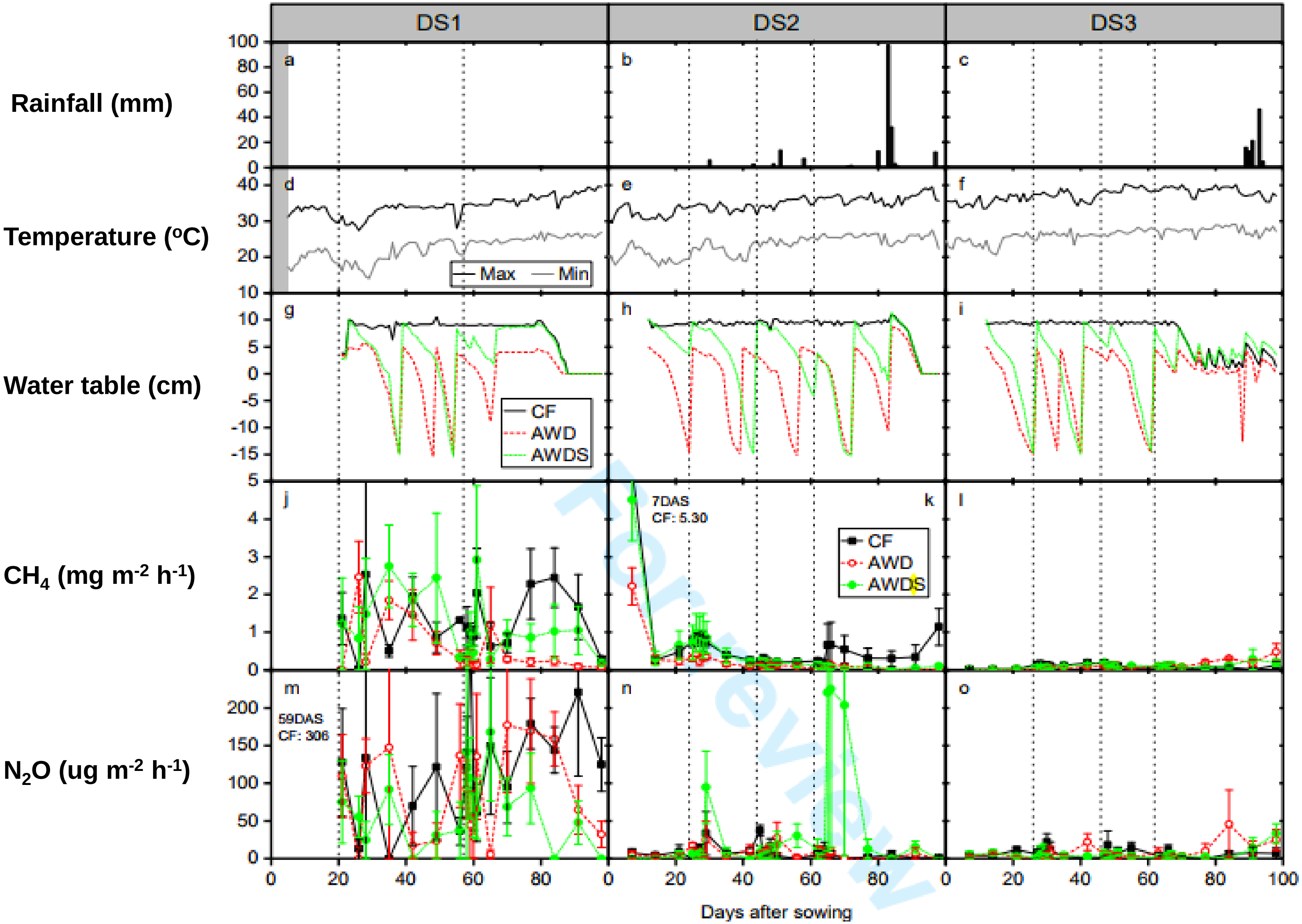
T3 (AWDS): Site specific AWD (flexible, AWD that is more adapted to specific site)



Field Management

Management	1st season	2nd season	3rd season	5th season		6th season
				1st planting	2nd planting	
Plowing Date	30 Nov. 2013	30 Apr. 2014	15 Dec. 2014	01 Dec. 2015	01 Feb. 2016	20 Jun. 2016
Plowing Depth	20 cm	20 cm	20 cm	20 cm	20 cm	20 cm
Planting Method	Pre-germinated seed broadcasting					
Planting Date	27 Dec. 2013	19 Jun. 2016	1 Jan. 2015	22 Dec. 2015	17 Feb. 2016	30 Jun. 2016
Rice variety	RD41	RD41	RD41	RD41	RD41	RD41
Seeding rate	125 kg/ha	125 kg/ha	125 kg/ha	125 kg/ha	125 kg/ha	125 kg/ha
Harvest date	4 Apr. 2014	15 Sep. 2016	9 Apr. 2015	Rice blast disease	25 May 2016	26 Sep. 2016

Summary of 1st to 6th season of PRRC



Summary of 1st to 6th season of PRRC

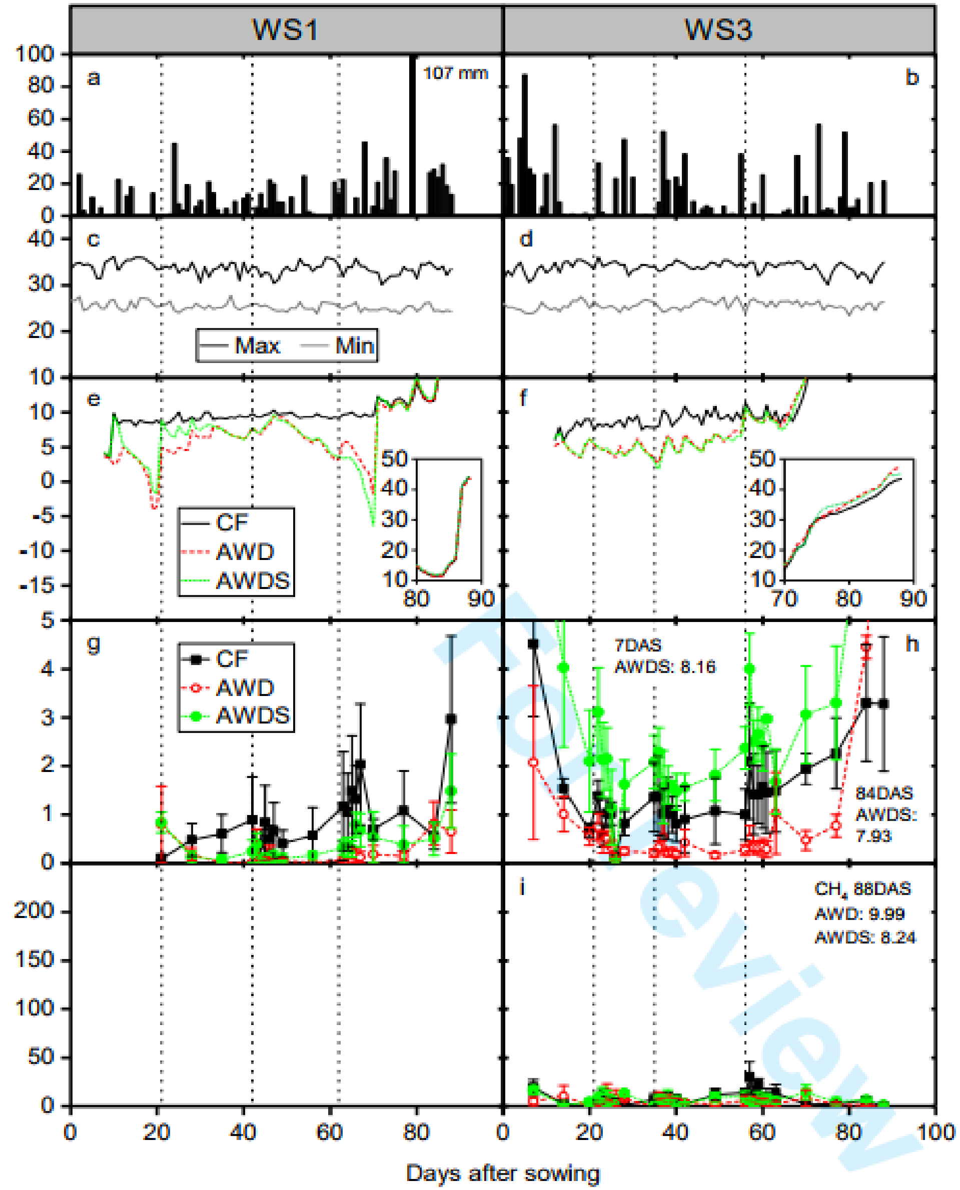
Rainfall (mm)

Temperature (°C)

Water table (cm)

CH_4 (mg m^{-2} h^{-1})

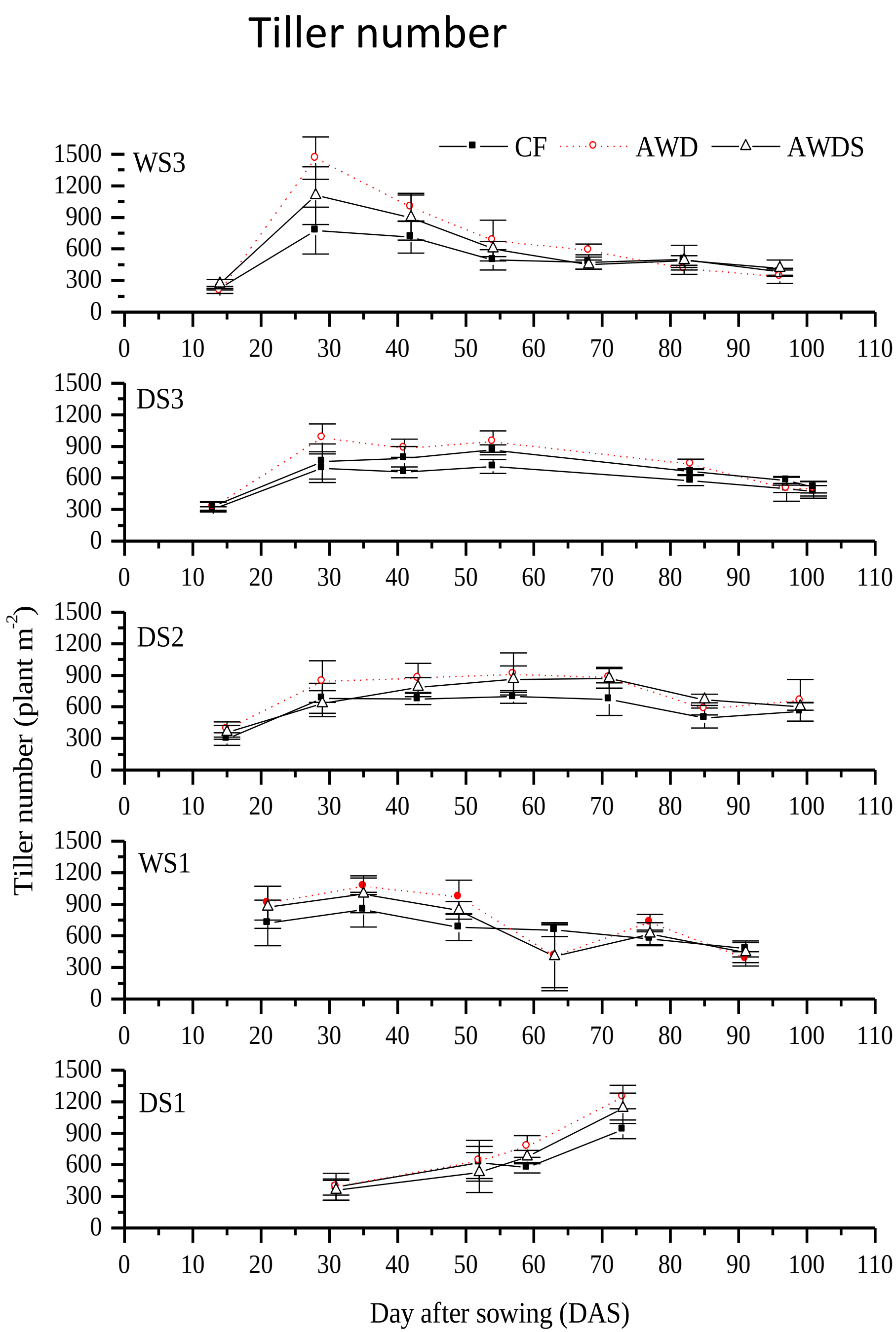
N_2O (ug m^{-2} h^{-1})



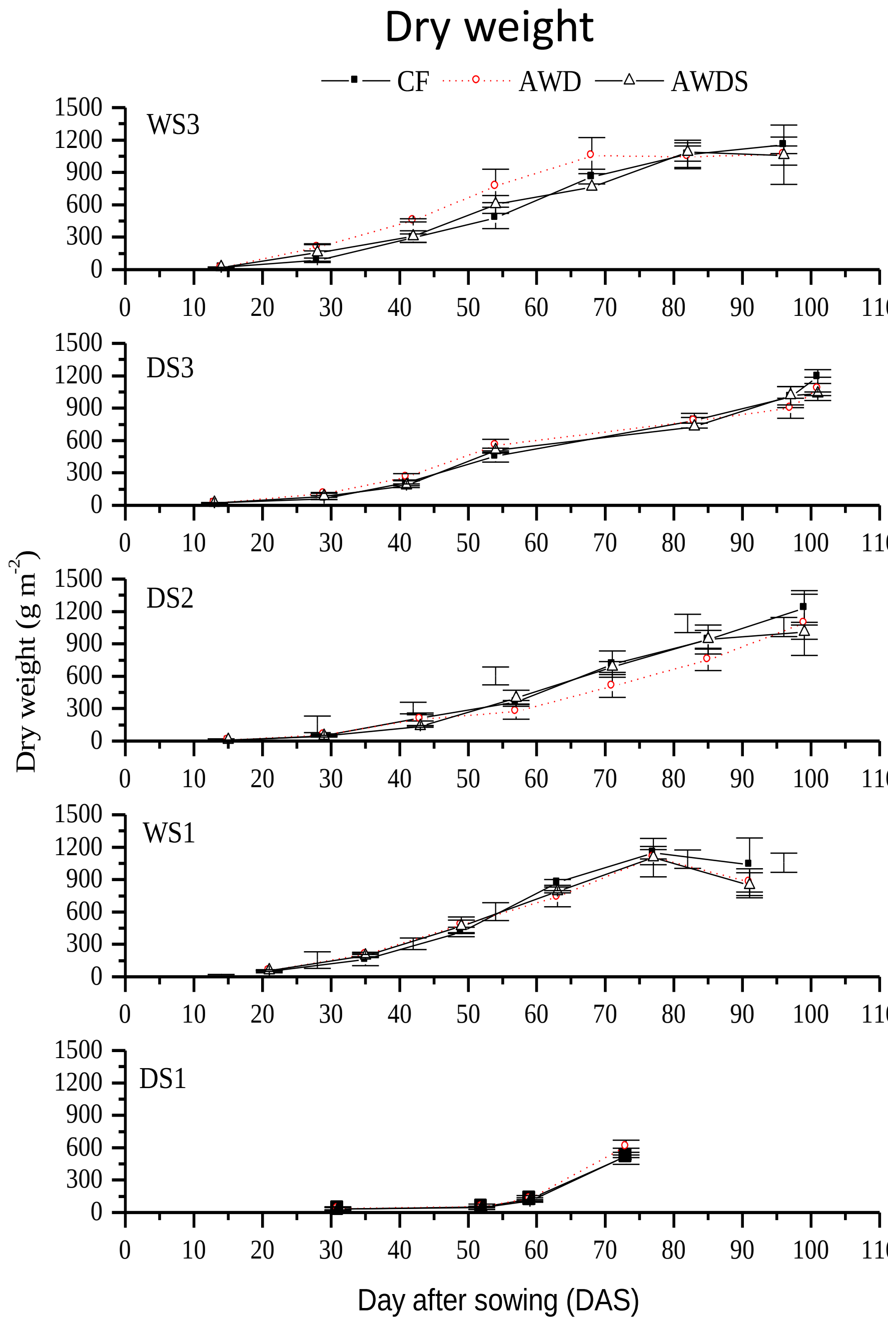
Statistical analysis results of combined seasonal means of CH_4, N_2O, grain yield and water use, with the effects of both treatment (Trt), growing season (s), and a combination of treatment and season (S × Trt) .

Treatment	CH_4‡ (kg ha^{-1})	N_2O (kg ha^{-1})	GWP‡ (kgCO_2e ha^{-1})	Grain Yield (t ha^{-1})	Yield scaled GWP (kgCO_2e ton^{-1})	Water use‡ (m^3 ha^{-1})	Water Productivity‡ (ton m^{-3})
CF	17.3 A	0.785	857 B	4.50	0.17	8805 a	0.609 b
AWD	8.8 B	0.979	637 B	4.19	0.14	5108 c	1.086 a
AWDS	21.0 A	0.851	1097 A	4.44	0.22	5811 b	1.023 a
Source of Variation	p value						
Trt	*	0.554	†	0.398	0.140	***	**
S	***	*	***	***	***	***	***
S × Trt	0.502	*	0.129	*	0.221	***	**

‡Means with different letters indicate significant difference at the 5% level for lower-case letter and at the 10% level for capital one. The asterisks †, *, ** and *** indicate the p value of <0.10, <0.05, <0.01, <0.001, respectively.



Tiller number
CF
AWD
AWDS
WS3
DS3
DS2
WS1
DS1
Tiller number (plant m-2)
Day after sowing (DAS)



Dry weight
CF
AWD
AWDS
WS3
DS3
DS2
WS1
DS1
Dry weight (g m-2)
Day after sowing (DAS)

Key findings

- 50% reduction in methane but no significant effect on nitrous oxide emissions (AWD vs. cont. flooding)
- Effects on greenhouse gas emission are more obvious in dry than wet season
- 42% reduction in water consumption
- No significant effect on rice growth and grain yields


Greenhouse Gas Mitigation in Irrigated Rice
Paddies in Southeast Asia (MIRSA-2 project)
Crop season: Dry season, 2015
Rice variety: RD41
Planting method: pre-germinated seed broadcasting
Seed rate: 125 kg/ha
Treatments: 1. Continuous flooding
2. Save AWD 5/-15
3. AWD 10/-15
2014/02/24 13:59

Thank you


2014/02/24 13:53


2014/02/24 14:45

PHILIPPINES

Assessing the feasibility of GHG mitigation through water saving techniques (AWD) in irrigated rice fields in the Philippines

Kristine S. Pascual
Philippine Rice Research Institute

October 10, 2018
Bangkok, Thailand

Project Site

Central Luzon, Philippines

- Contributes 20% of the national rice production

- Two distinct season
  - Dry and Wet

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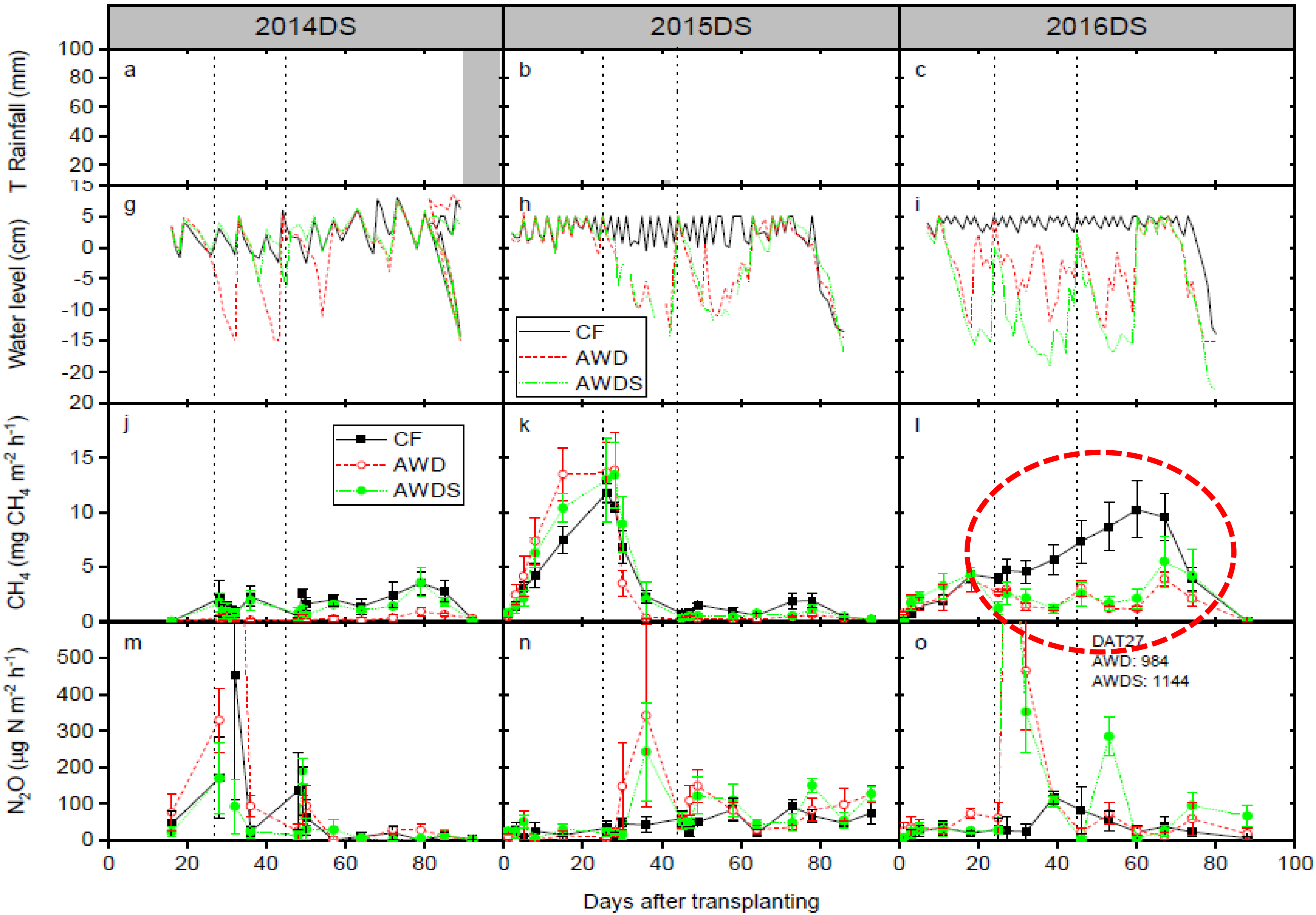
Water Management

1. Continuous Flooding (CF)
2. Safe AWD
3. **Site Specific AWD (AWDS)**
   - Mid-season drainage
   - AWD at -25 cm

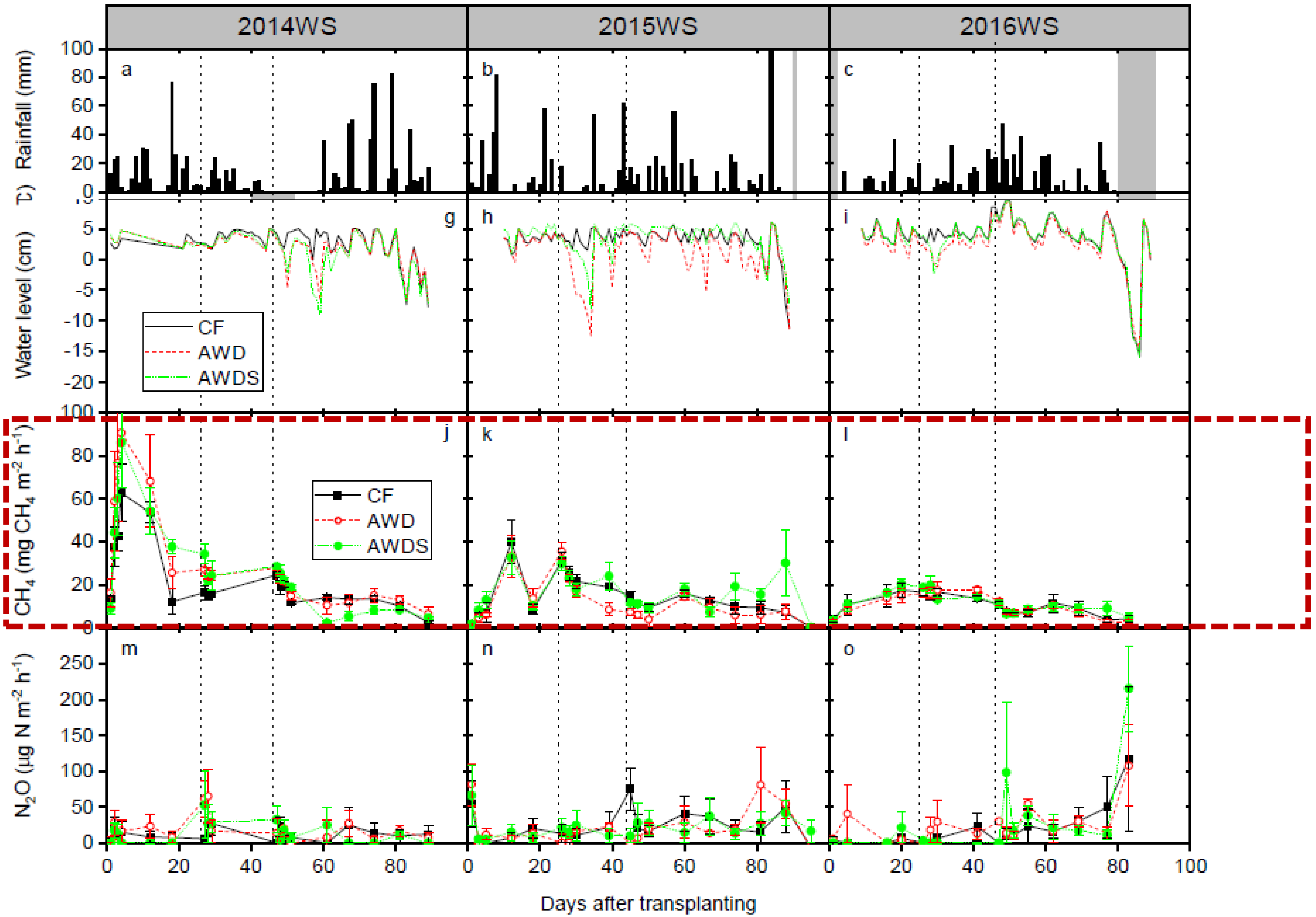
Crop Management

- Similar in all 6 cropping seasons
- In 2016 DS and WS:
  1. AWD was implemented 10 DAT
  2. Rice stubble incorporated during dry fallow tillage

Seasonal variations in daily rainfall, mean surface water level, CH_4 and N_2O flux during **Dry season**



Seasonal variations in daily rainfall, mean surface water level, CH_4 and N_2O flux during **Wet season**



Results

Treatment	CH_4 (kg CH_4 ha^{-1})		N_2O (kg N_2O ha^{-1})		GWP (kg CO_2 eq ha^{-1})		Grain yield (Mg ha^{-1})		Water use (m^{-3} ha^{-1})	
	DS	WS	DS	WS	DS	WS	DS	WS	DS	WS
CF	69.9	328.9	1.6	0.509	2853	11333	6.9	5.41	10336	10944
AWD	42.2	350.1	3.5	0.633	2476	12093	6.88	5.83	5913	9215
AWDS	52.8	374.0	2.63	0.528	2578	12874	6.90	5.42	5012	8949
Season mean	54.9	351.5	2.58	0.556	2636	12100	6.89	5.55	7087	9702
Treatment Means										
CF	199.4 A		1.05 B		7093 A		6.16 A		10640 A	
AWD	196.1 B		2.07 A		7284 A		6.35 A		7564 B	
AWDS	213.4 A		1.58 B		7725 A		6.16 A		6980 B	

1.7% reduction

Conclusions

- Implementation of AWD is feasible in **DS** in Central Luzon
- The AWD with the current settings significantly reduced the seasonal total CH_4 emission, but the reduction rate against CF was very limited (1.7%)
- N_2O emission was enhanced by the AWD, and the resultant GWP of CH_4 and N_2O did not significantly differ among water management.

NARO IRRI PHILRICE Rice-secure PHILIPPINES

Feasible options that enhance the ability of AWD in reducing GHG emissions in Central Luzon, Philippines:

(1) An earlier rice residue incorporation under dry soil conditions

(2) An earlier implementation of AWD;

(3) A proper maintenance of flooded soil condition during/after N fertilizer topdressing.

NARO IRRI PHILRICE PHILIPPINE RICE RESEARCH INSTITUTE

Rice-secure PHILIPPINES

Thank you

RICE LANDSCAPES AND CLIMATE CHANGE
11 OCOTBER 2018 - BANGKOK

ANALYSIS OF SUITABLE ENVIRONMENTS FOR THE IMPLEMENTATION OF LOW-EMISSIONS TECHNOLOGIES IN RICE PRODUCTION

BJOERN OLE SANDER[1], VU DUONG QUYNH[2], NGUYEN THI HUE[2], MAI VAN TRINH[2], JORREL AUNARIO[1], VO THI BACH THUONG[3], REINER WASSMANN[1]

[1] International Rice Research Institute, Los Baños, Philippines
[2] Institute for Agricultural Environment, Hanoi, Vietnam
[3] Nong Lam University, Ho Chi Minh City, Vietnam

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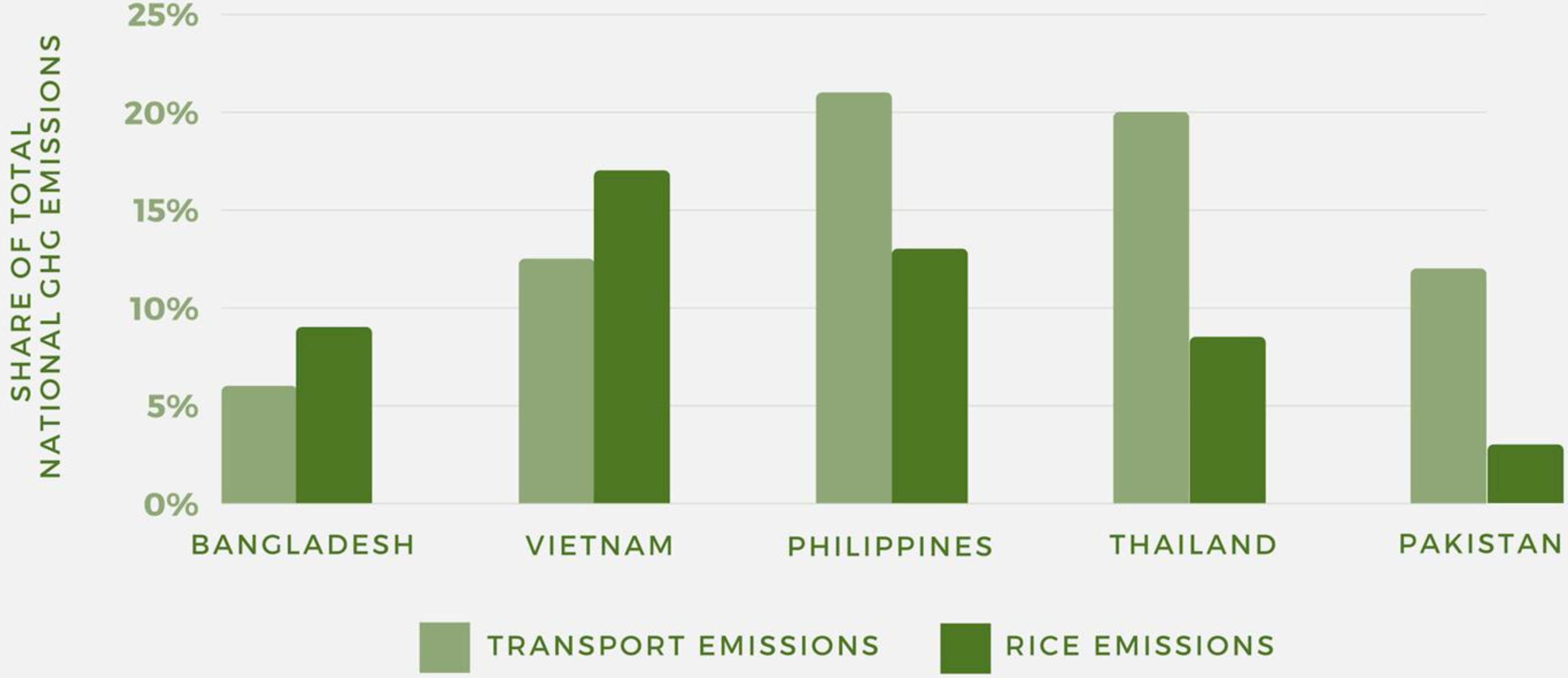
GHG EMISSIONS FROM RICE PRODUCTION

[BASED ON LATEST NATIONAL COMMUNICATIONS]



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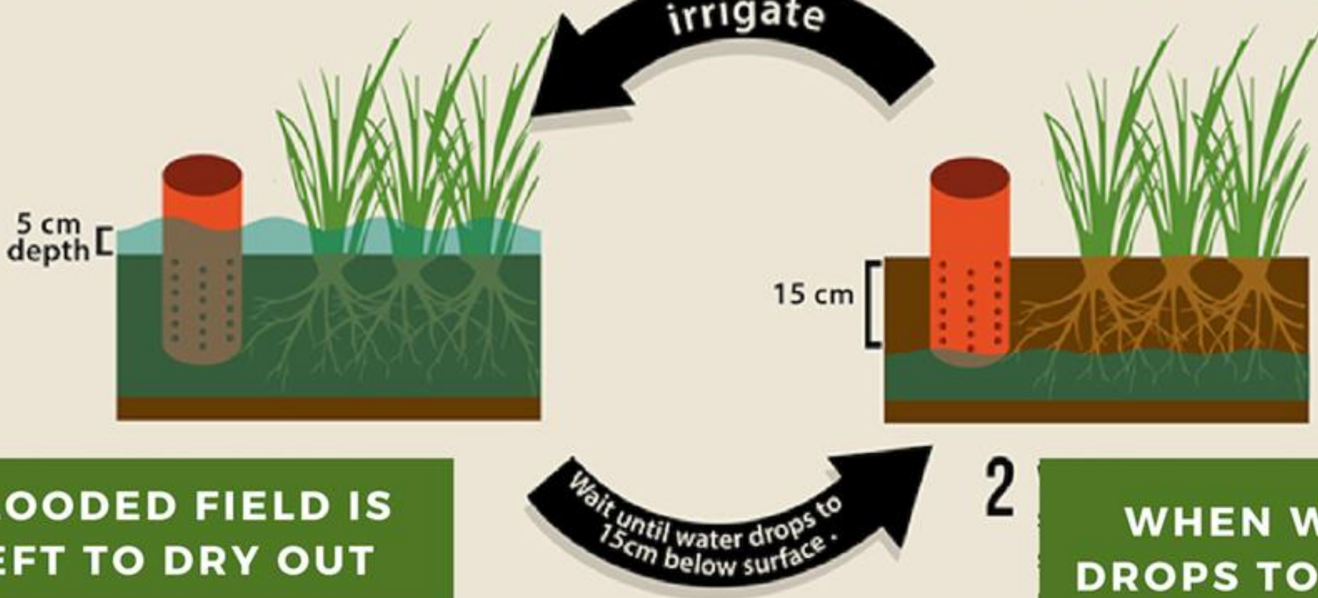
HOW DOES AWD WORK?

PERFORATED TUBE FOR OBSERVING WATER LEVEL IN THE SOIL



1 **FLOODED FIELD IS LEFT TO DRY OUT**

2 **WHEN WATER LEVEL DROPS TO A THRESHOLD (15CM BELOW SOIL SURFACE), THE FIELD IS IRRIGATED AGAIN**

AWD SAVES UP TO 30% OF IRRIGATION WATER AND REDUCES GHG EMISSIONS BY ~50%

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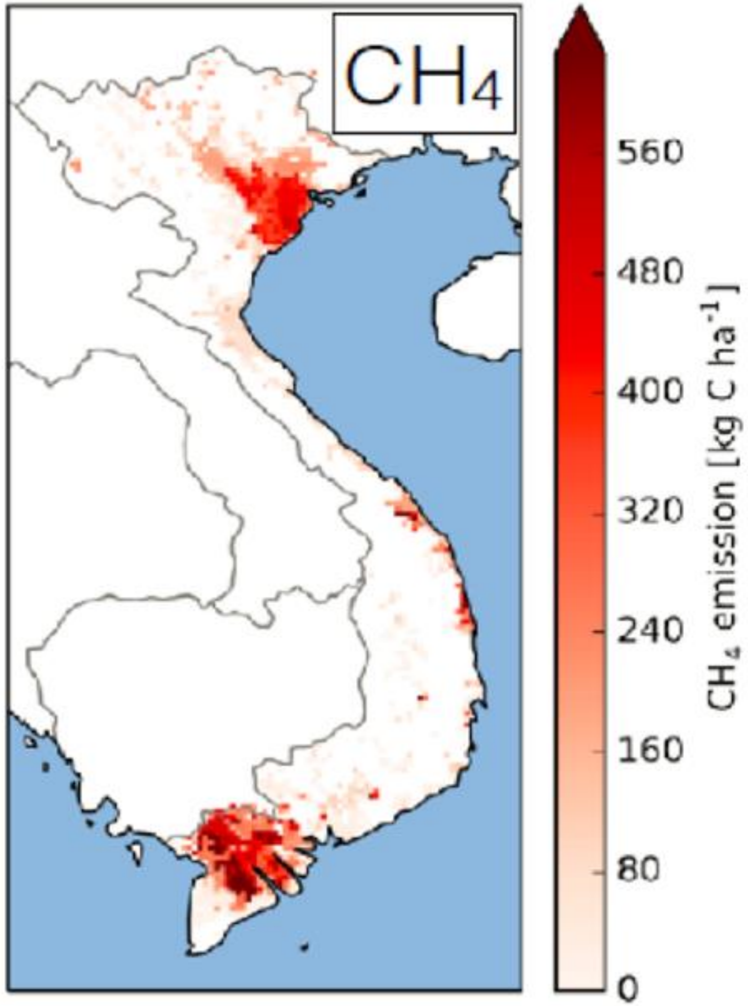
EMISSION HOTSPOTS IN VIETNAM

- Using advanced GHG model (landscape-DNDC) to identify emission hotspots
- Target mitigation actions
- Use as monitoring tool and to improve national inventory

Karlsruher Institut für Technologie



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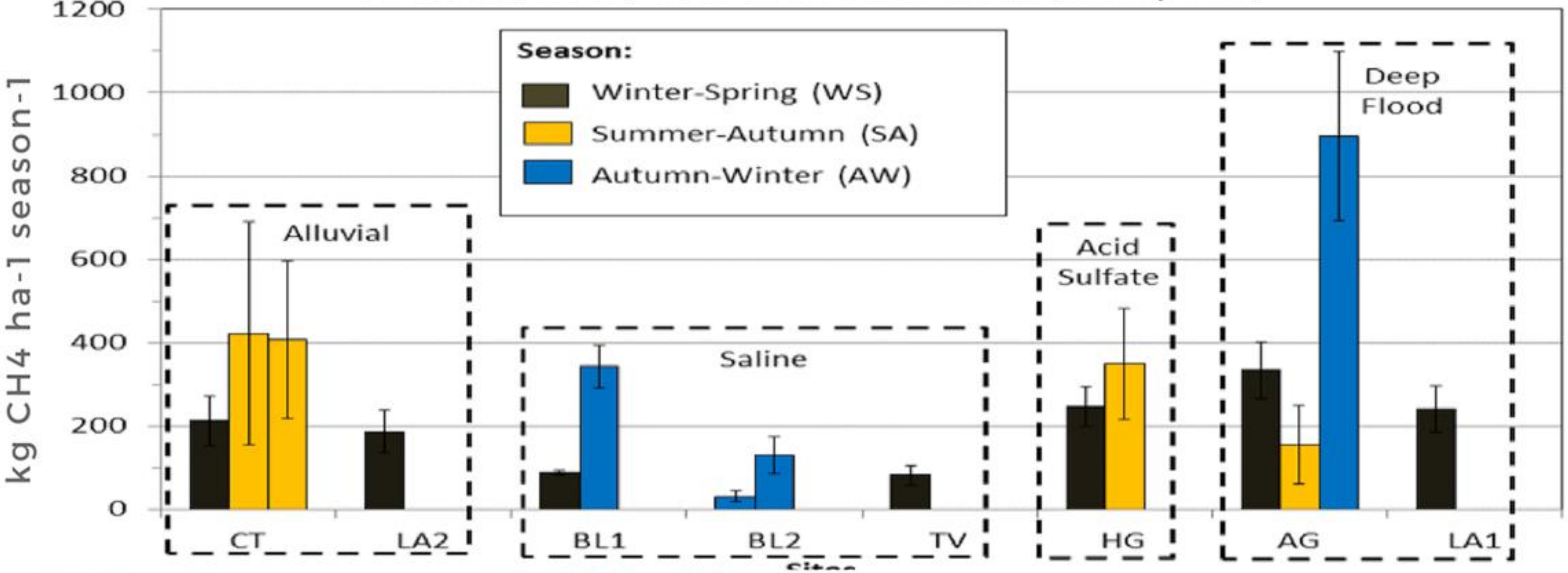
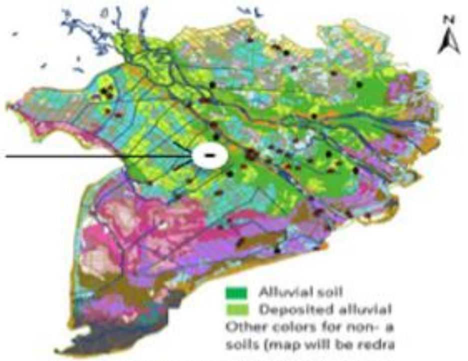
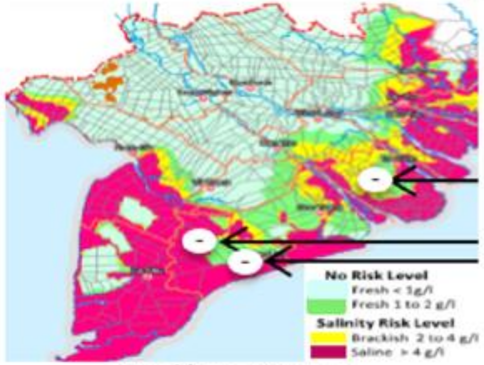
EF [AL] = **2.39** EF [SA] = **1.14** EF [AS] = **2.78** EF [DF] = **3.20**

Vo et al., 2017, Soil Sci. Plant Nutr. (accepted)

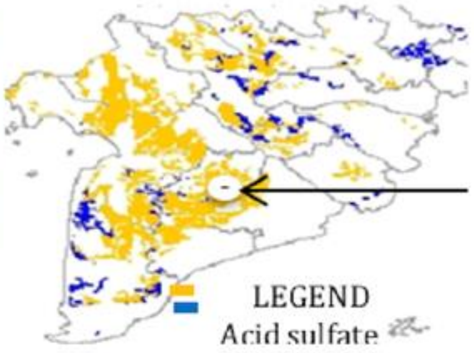




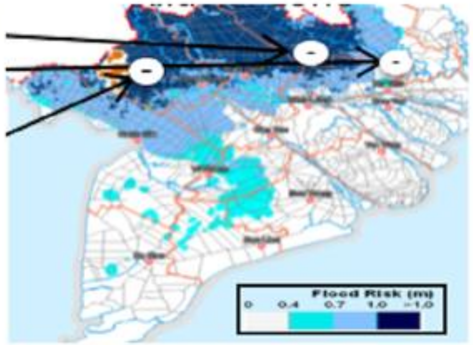
Alluvial Zone



Saline Zone



Acid Sulfate Zone



Deep Flood Zone

GHG EMISSION ASSESSMENT IN MRD

- Evaluation of GHG data sets of 8 locations in MRD (CLUES project)
- Incl. different biophysical characteristics
  - detailed regional GHG emission assessment

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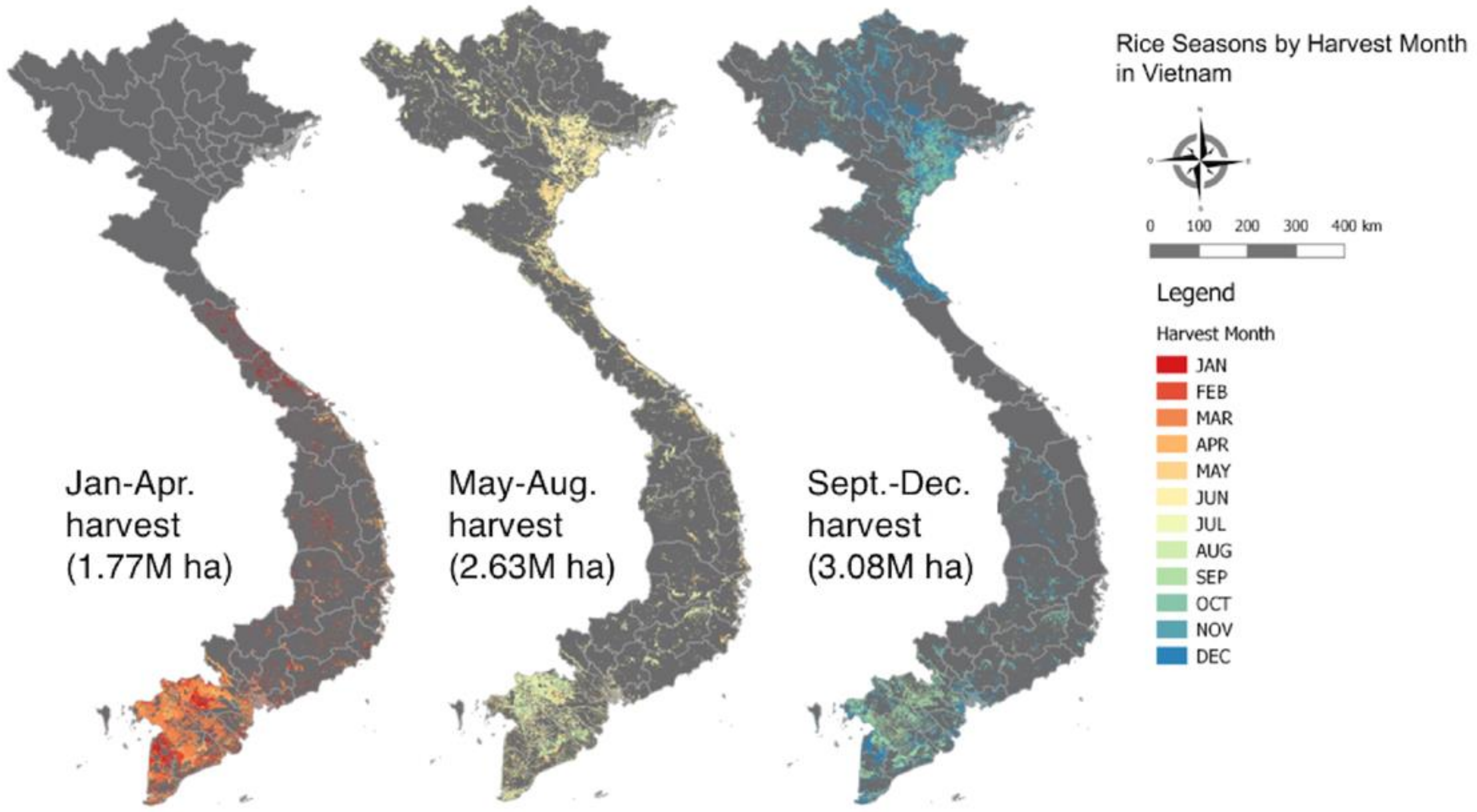
PHENORICE VIETNAM: WHEN AND WHERE?



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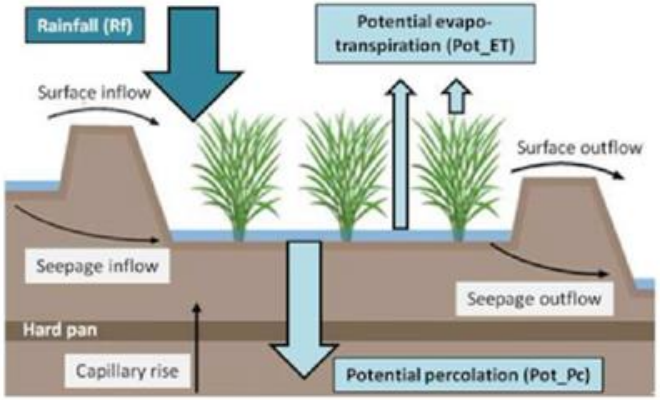
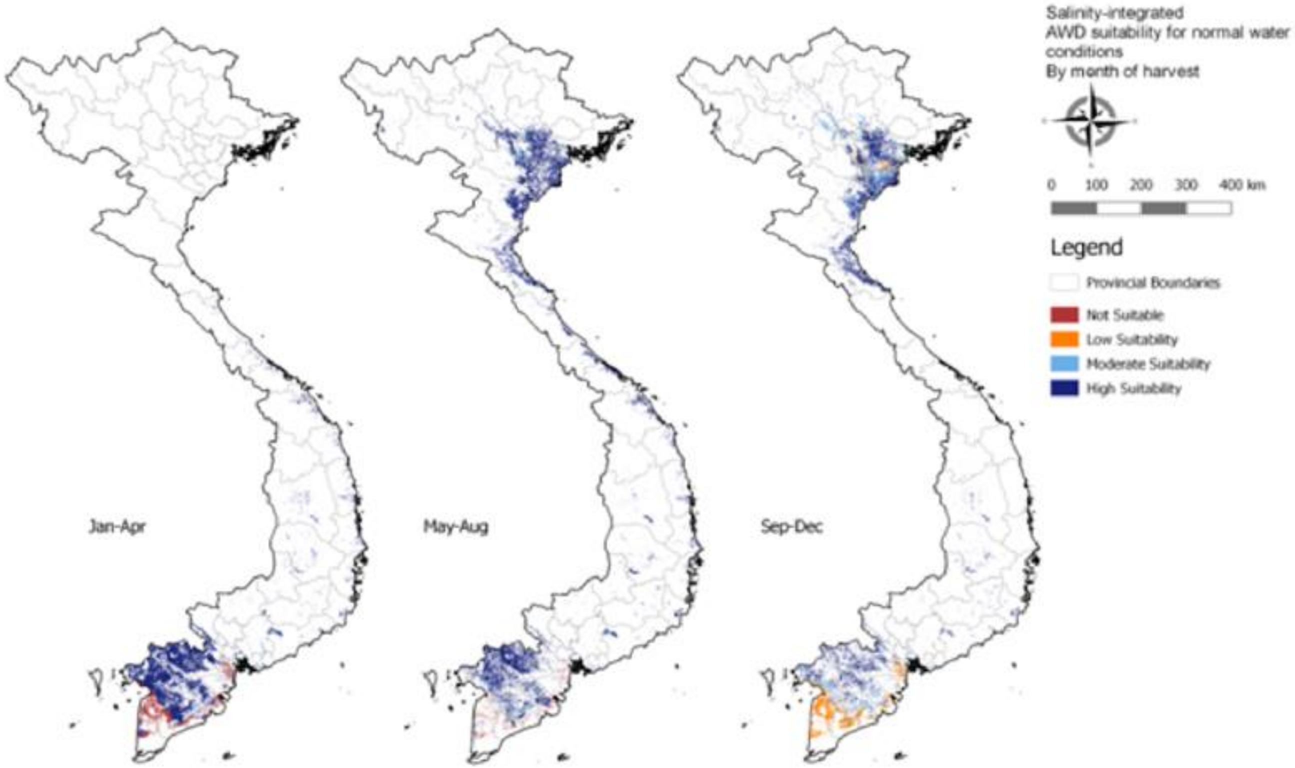
CLIMATIC AWD SUITABILITY MAPS - VIETNAM



Methodology: Nelson et al., 2015

- Based on cropping calendar, rice extent and water balance
- Considering biophysical factors only (soil texture / percolation, rainfall, temperature, solar radiation)



Sander et al., manuscript in preparation

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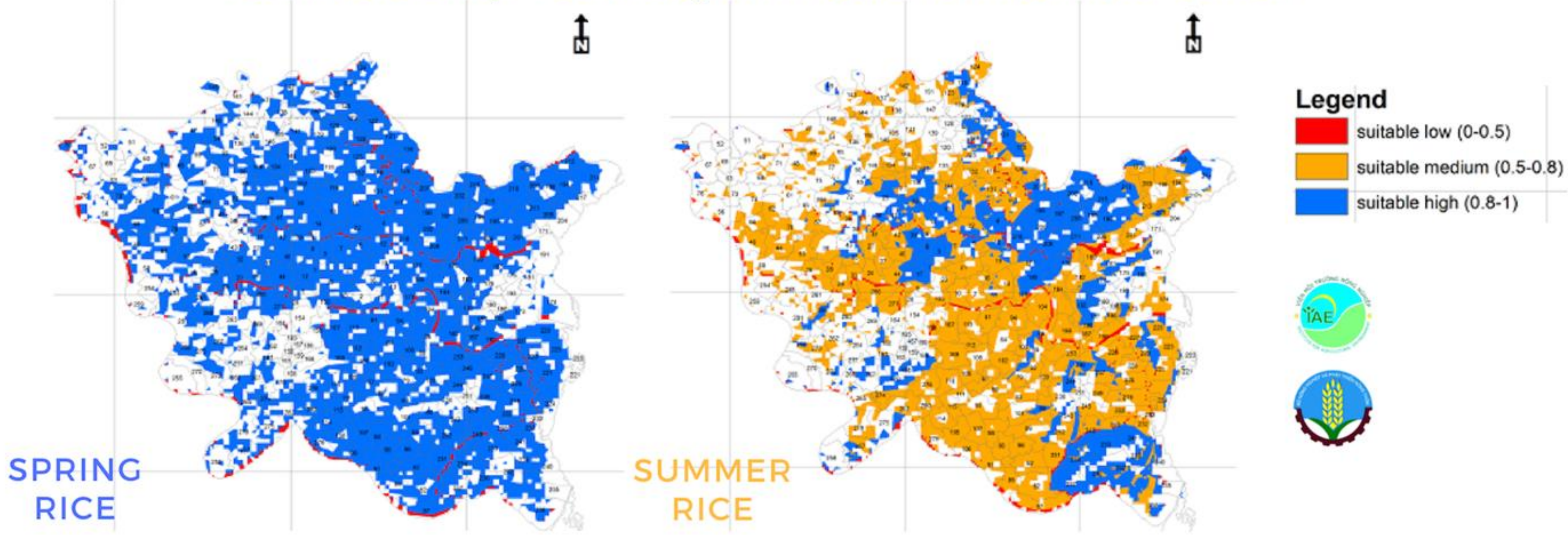
CLIMATIC AWD SUITABILITY ANALYSIS IN THAI BINH PROVINCE

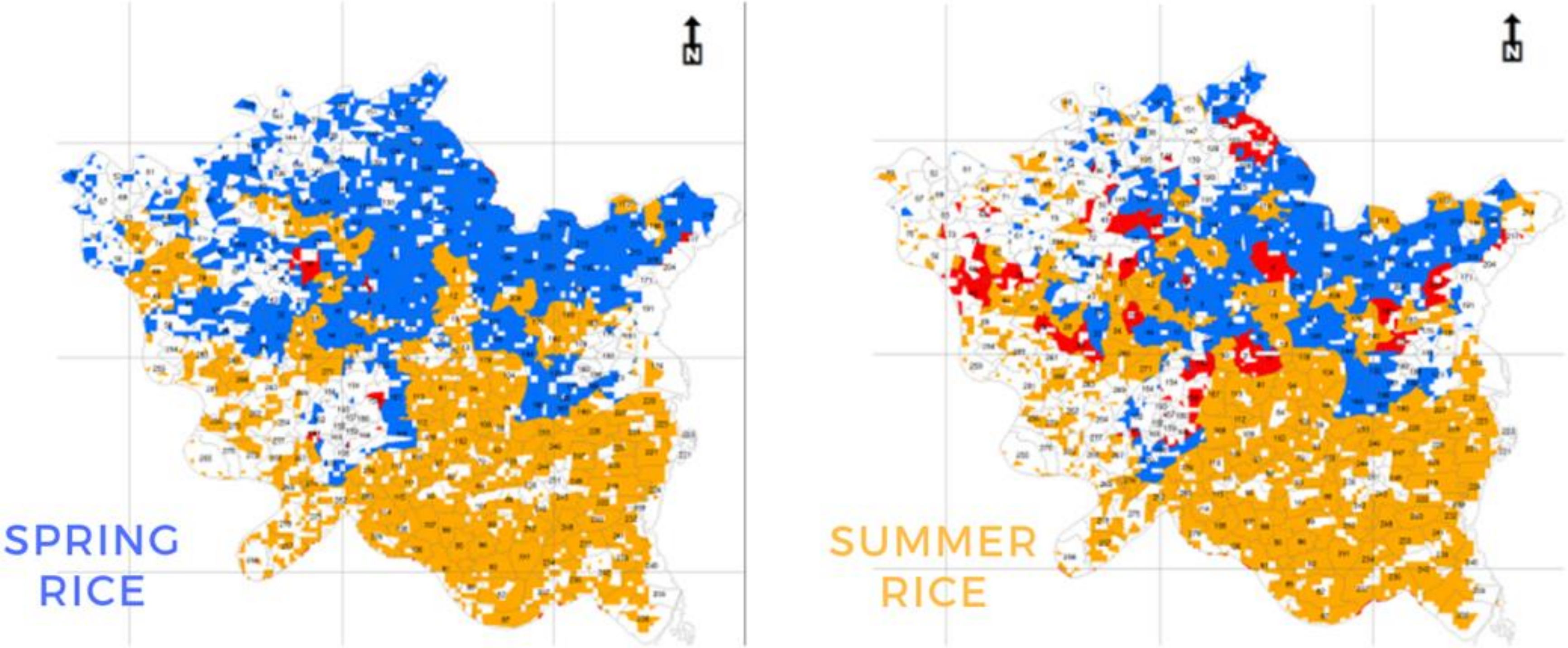
- Based on provincial soil map 1:50,000
- High suitability: > 80% of growth duration has water deficit
- Low suitability: < 50% of growth duration has water deficit



Sander et al., manuscript in preparation

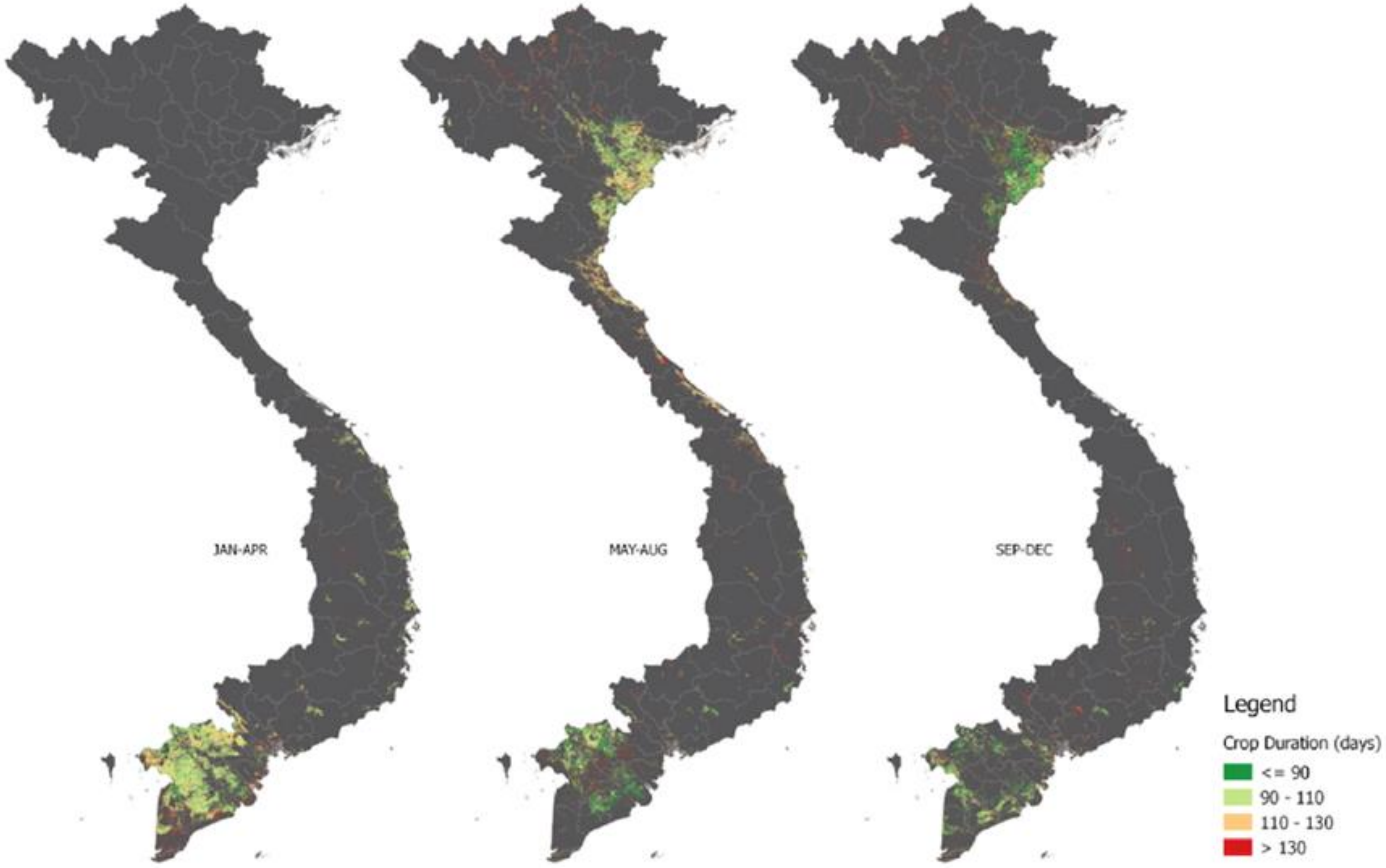
SOCIO-ECONOMIC AWD SUITABILITY ASSESSMENT

- Local experts from DARD and extension services rate various factors, e.g. elevation, farmer awareness, irrigation facilities from 1-10
- High suitability: average rating > 8
- Low suitability: average rating < 5



Sander et al., manuscript in preparation

RICE GROWTH DURATION IN VIETNAM



- Shortening the time rice is in the field reduces CH4 emissions
- Analysis of rice growth duration using PhenoRice

✓ In deltas mostly short duration varieties used

✓ Some long duration traditional varieties

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OTHER GHG MITIGATION OPTIONS IN RICE PRODUCTION

- Alternate wetting and drying
- Mid-season drainage
- Fertilizer deep placement
- Coated urea
- Minimum / zero tillage
- Short-duration varieties
- Low-emissions straw management
- Site-specific nutrient management
- Biochar
- Laser land leveling
- Solar bubble dryer
- . . .

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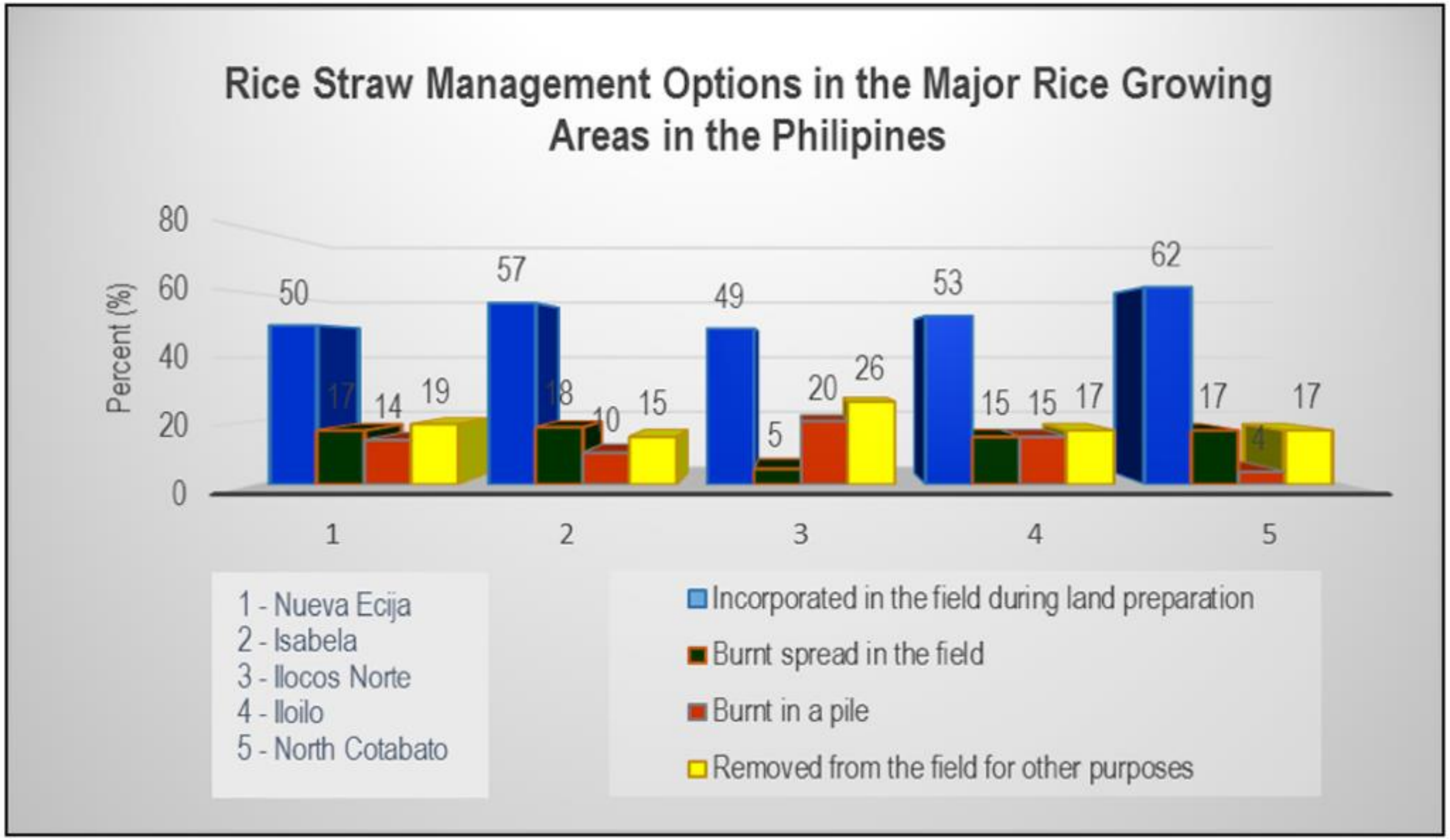
RICE STRAW MANAGEMENT - PHILIPPINES

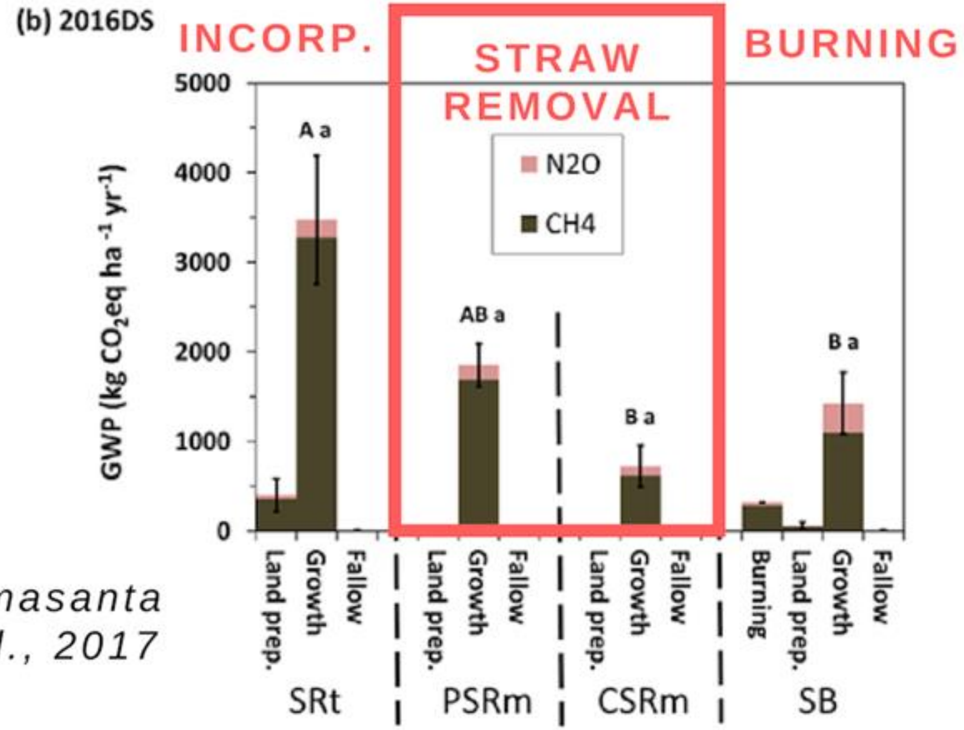


- Early 2000s: 90% of straw was burnt
- 2017: Only ~20-30% of straw is burnt and ~50-60% is incorporated

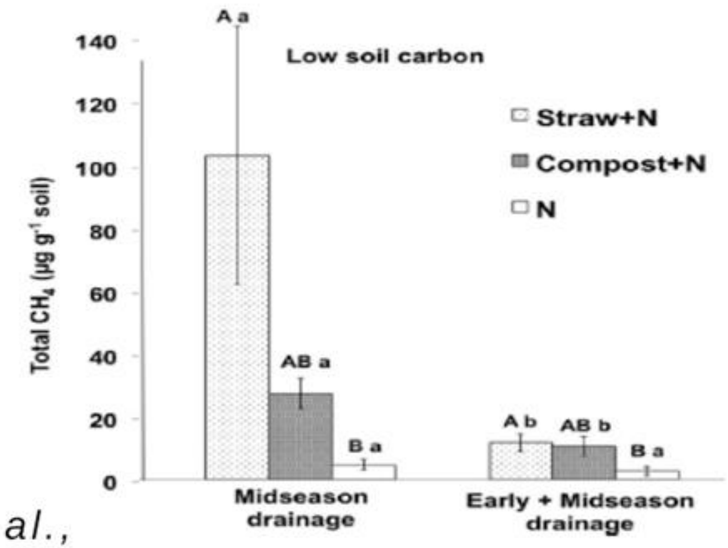
STRAW MANAGEMENT FOR GHG MITIGATION

Partial straw removal provides multiple benefits:
1) retain soil health by restoring C and K
2) create profit through straw sales
3) reduce GHG compared to incorporation

Coordinated water management can minimize GHG emissions even with straw being incorporated



Romasanta et al., 2017



Tariq et al., 2016

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GALAN
STAR

RICE LANDSCAPES AND CLIMATE CHANGE
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THANK YOU VERY MUCH.

MORE INFORMATION:

ClimateChange.irri.org
GHGmitigation.irri.org
B.Sander@irri.org

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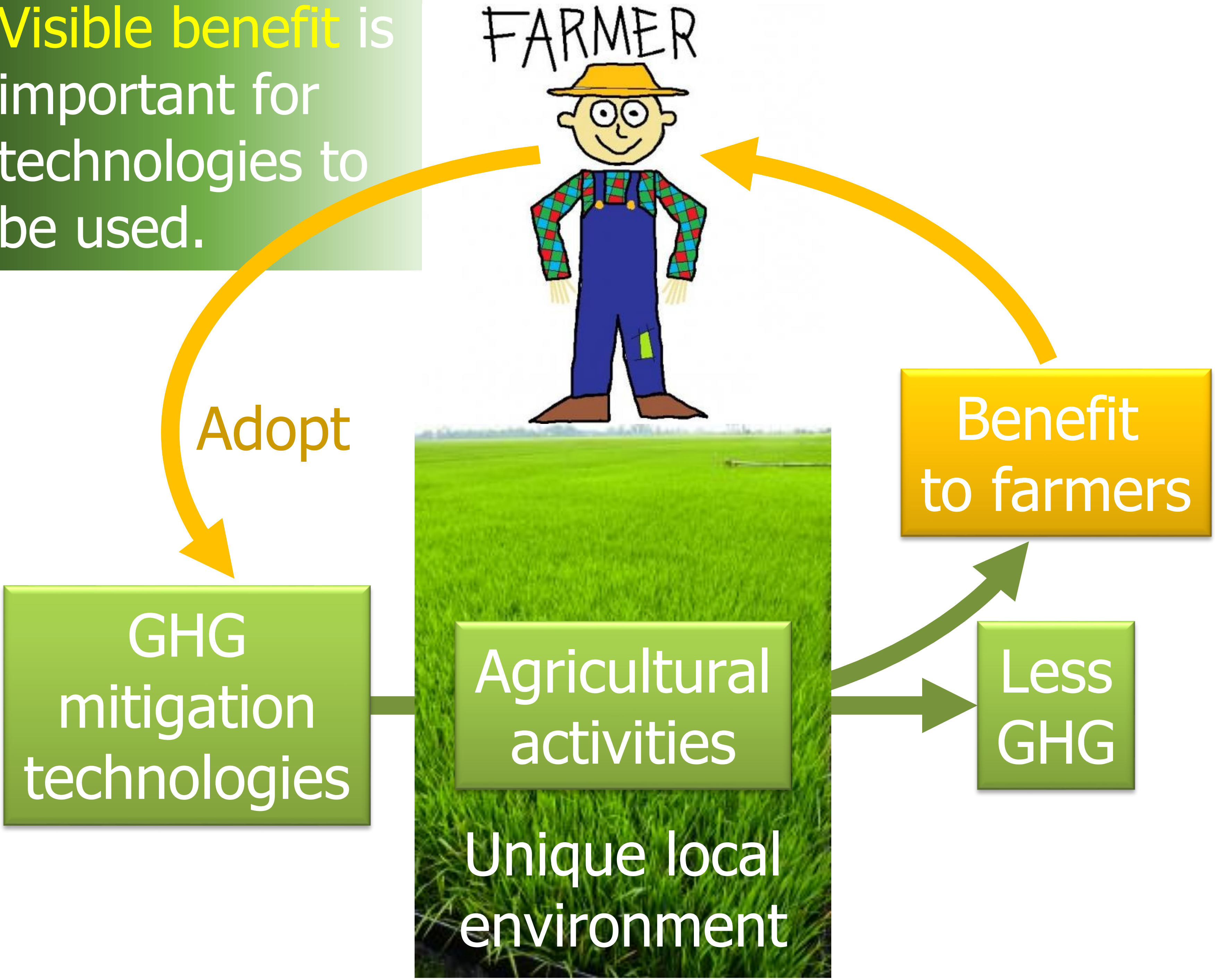
What kind of environment should be targeted for AWD introduction?

- Through the experience in the Mekong Delta -

Yasukazu Hosen Ph.D.

Unit leader
Soil Biogeochemistry and Modeling Unit
Division of Climate Change
Institute for Agro-Environmental Sciences (NIAES)
National Agriculture and Food Research Organization (NARO)

Visible benefit is important for technologies to be used.



Options for reducing CH_4 emissions

Water

AWD

Field management	Mitigation efficiency	Problem for application: Applicability		Economy		Effects on		Other effects
		Irrigated	Rainfed	Cost	Labor	Yield	Fertility	
Water management								
Midseason drainage	□	○	●	~	↑	+	~	May promote N_2O
Short flooding	□	○	●	~	~	−	−	May promote N_2O
High percolation	□	○	●	↑	↑	+	~	May promote nitrate leaching
Soil amendments								
Sulfate fertilizer	□	○	○	↑	~	△	−	May cause H_2S injury
Oxidants	□	○	○	↑	↑	△	−	
Soil dressing	○	○	○	↑	↑	−	−	
Organic matter								
Composting	□	○	○	↑	↑	+	+	
Aerobic decomp.	□	○	○	~	↑	~	~	
Burning	○	○	○	~	↑	~	~	Atmospheric pollution
Others								
Deep tillage	○	○	○	↑	↑	−	−	
No tillage	?	○	○	~	↓	−	~	
Rotation	○	○	△	~	↑	−	−	
Cultivar	○	○	○	~	~	~	~	Require long time

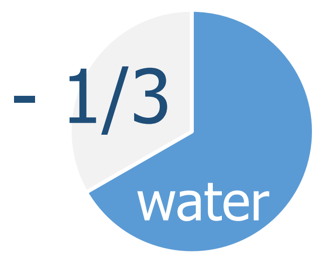
Modified from Yagi, K 2002. Methane emissions in rice, mitigation options for, p. 814-818. In Encyclopedia of soil science, Marcel Dekker, New York.

□: very effective, ○: Effective/applicable, △: case by case, ●: not applicable, ?: no information, ↑: increase, ↓: decrease, ~: about equal to previous situation, +: positive, −: negative.

From: Minamikawa, K., Sakai, N., Yagi, K 2006. Methane emission from paddy fields and its mitigation options on a field scale. *Microbes Environ.* **21**(3), 135-147.

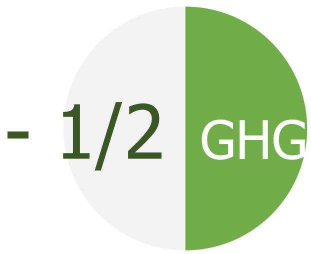
A good example obtained in the Mekong Delta

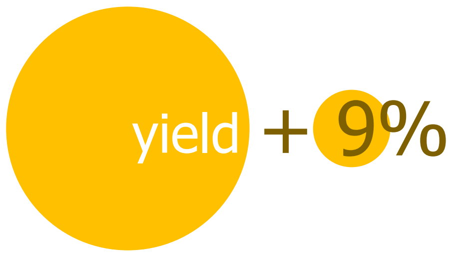
AWD 1/3 less irrigation water use

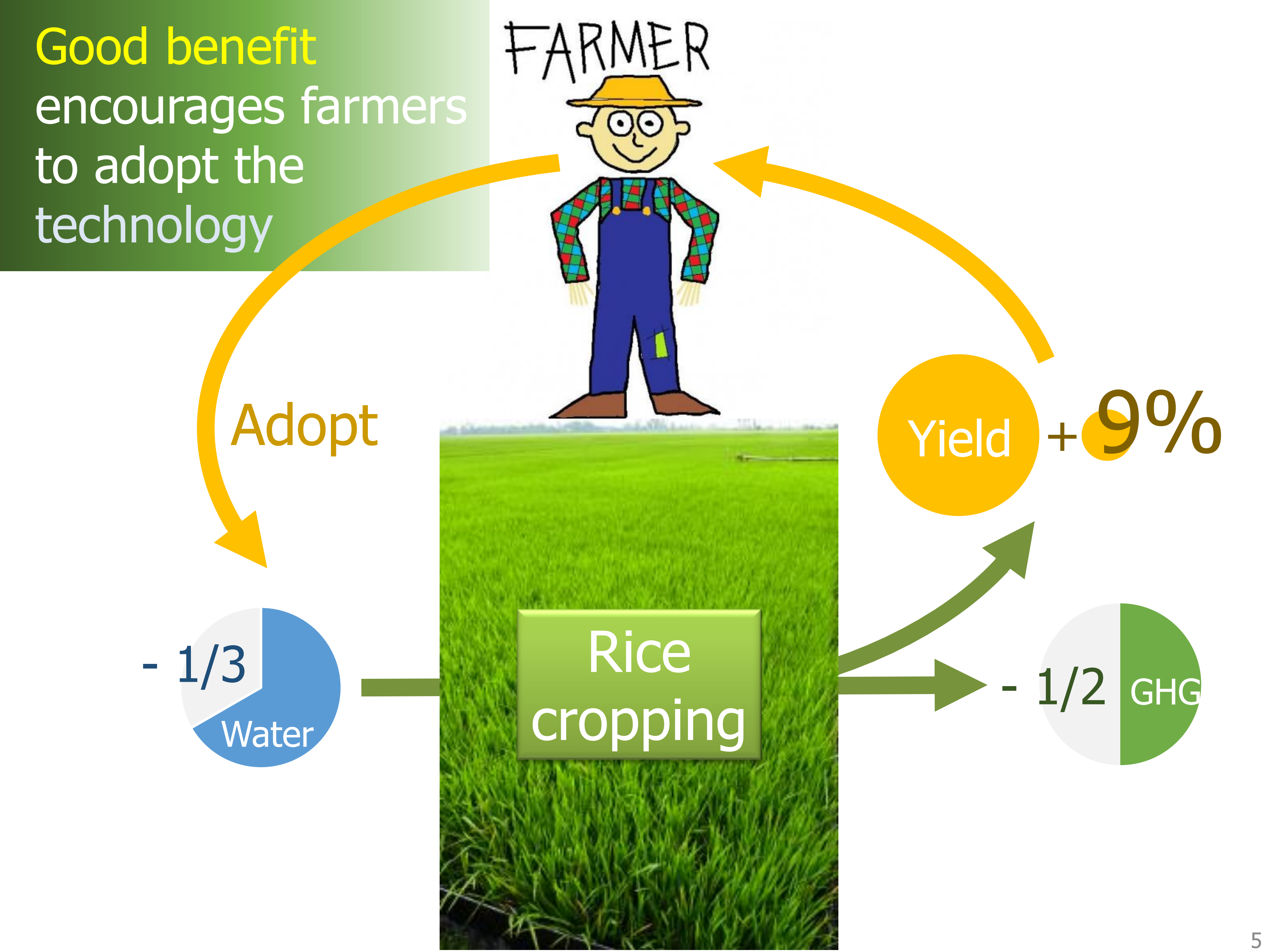


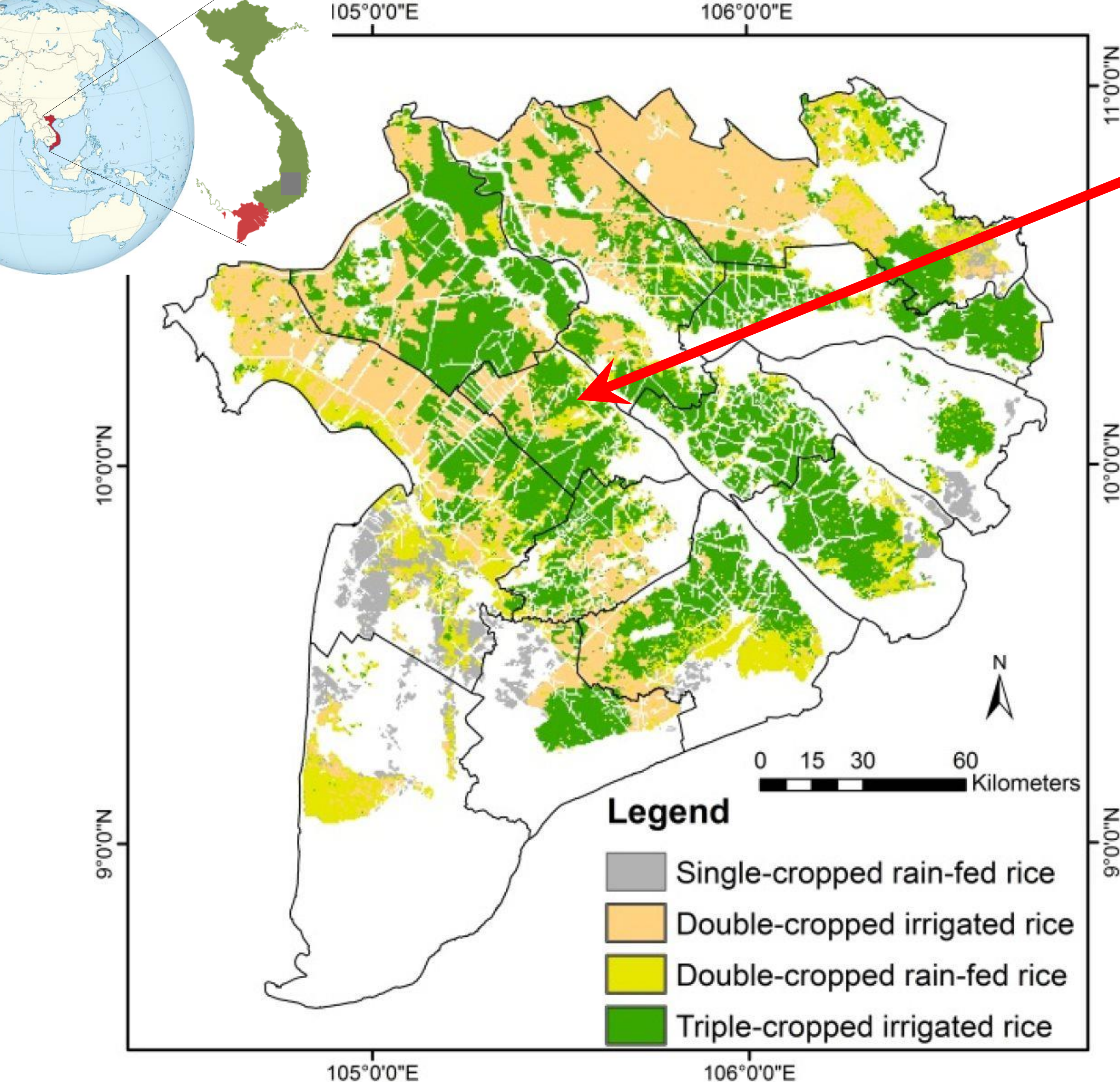
50% less GHG emission

9% higher grain yield






Good benefit encourages farmers to adopt the technology
FARMER
Adopt
Yield
+9%
- 1/3
Water
Rice cropping
- 1/2
GHG



Location at which JIRCAS conducted a field experiment for over 5 years, a farmer's triple-rice-cropping alluvial paddy, Tan Loi 2 Hamlet, Can Tho City.

Spatial distributions of rice cropping systems in 2012, estimated with remote sensing techniques by Nguyen-Thanh Son, et al. (2014).

Characteristics of the Mekong Delta: Abundant in water and submerged nearly throughout the year

Winter-Spring Cropping	Spring-Summer Cropping	Summer-Autumn Cropping	Flooding

Nov. Feb. May. Sep.

Less water treatment during cropping seasons may become **GOOD AERATION** for rice.

POSITIVE effects of Less water may be greater than NEGATIVE ones in the case of the Mekong Delta?

Under water-SCARCE environments

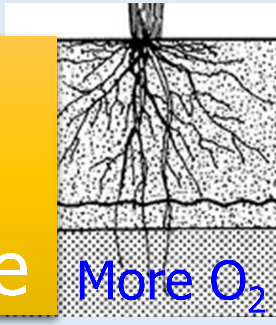
e.g. most places where AWD has been applied for water-saving

NEGATIVE
Gives water stress to rice

>

<

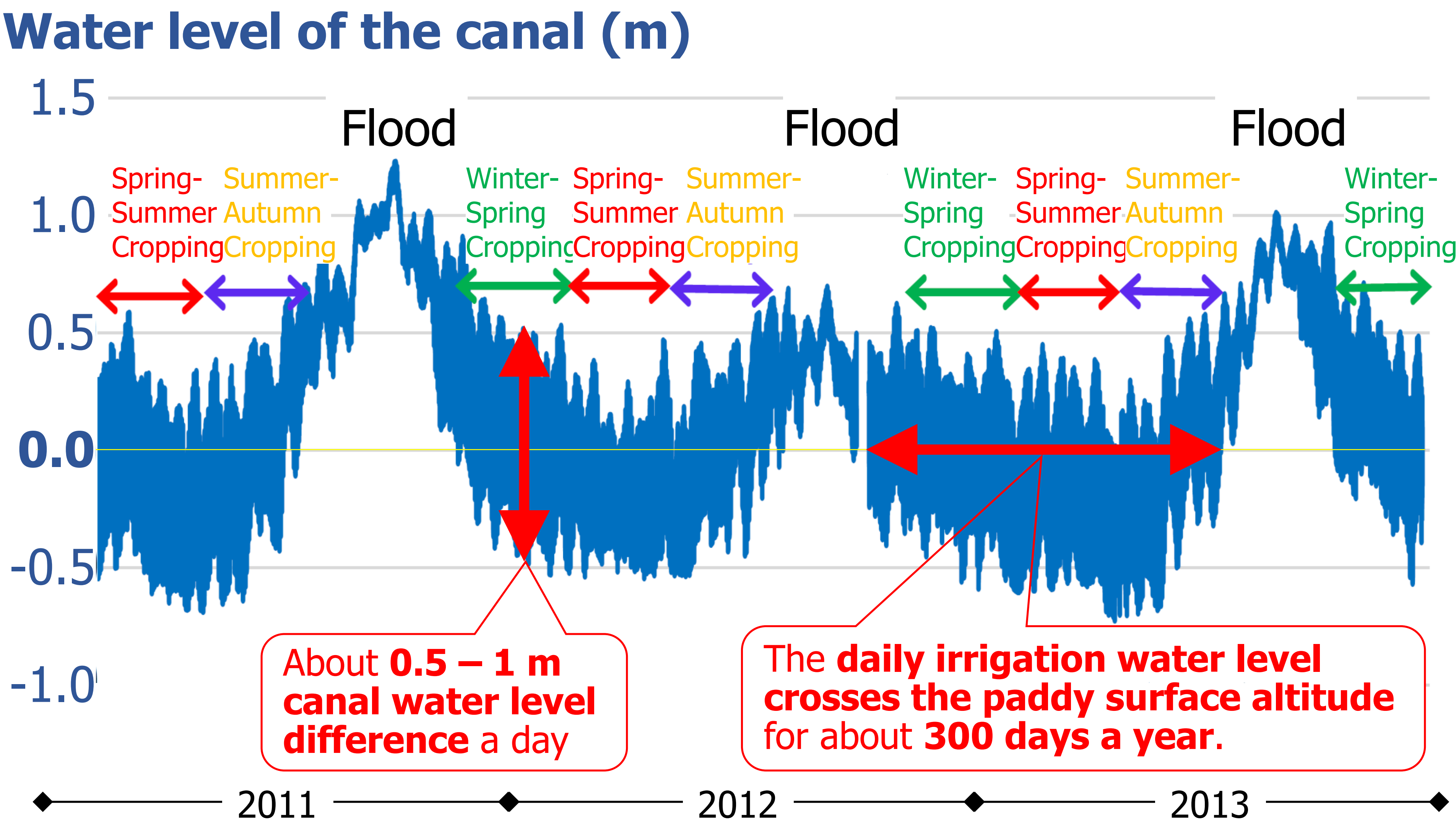
POSITIVE
Gives more O_2 to paddy soil and rice

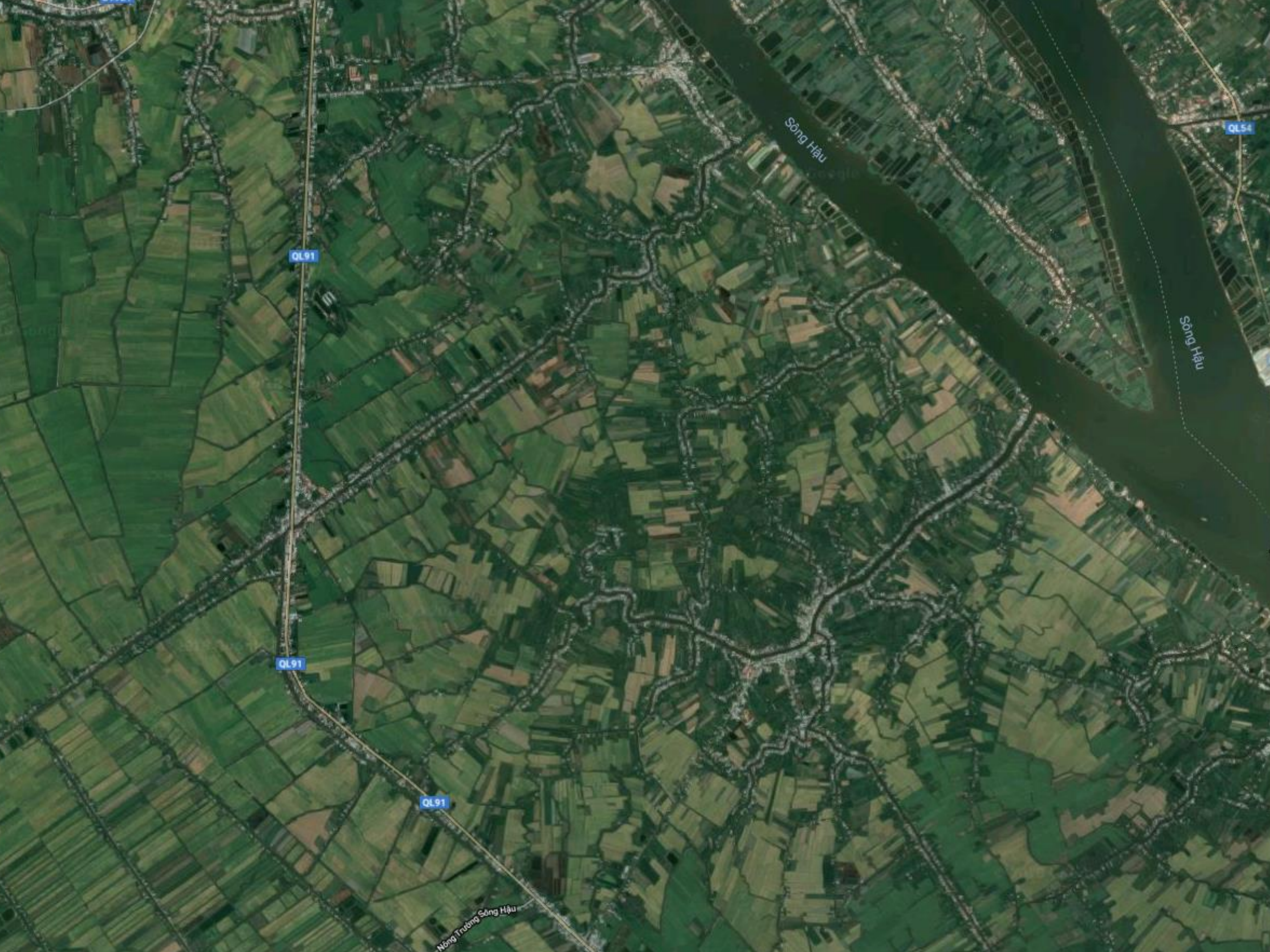


Under water-ABUNDANT environments

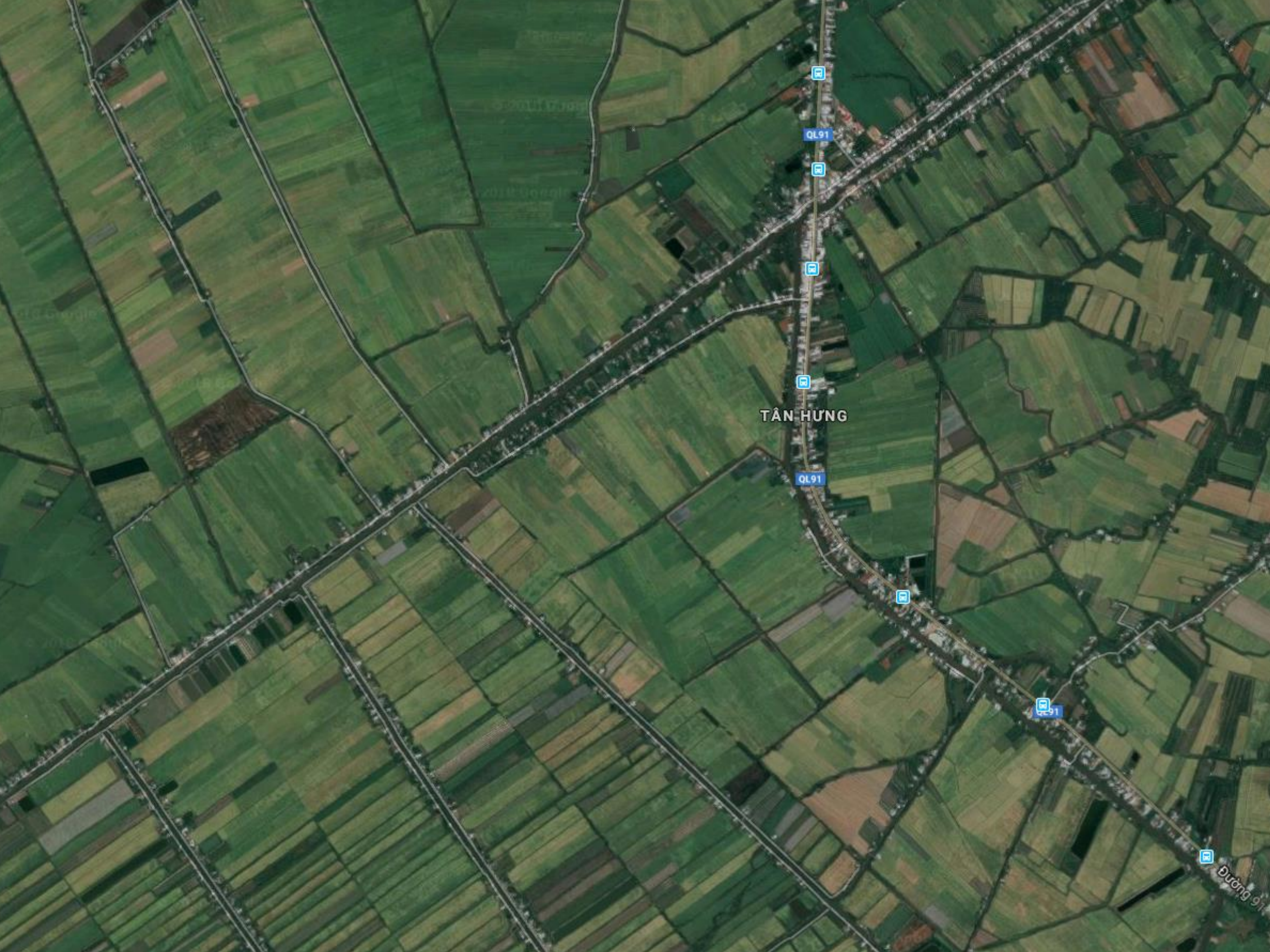
e.g. triple-rice cropping paddies in the Mekong Delta

Characteristics of the Mekong Delta: Tidal irrigation available





Sông Hậu
QL54
Sông Hậu
QL91
QL91
QL91
Nông Trường Sông Hậu


QL91
TÂN HƯNG
QL91
QL91

Environment favorable for introducing a less-water environment to rice paddies

- **Water**
  - **Submerged long periods** a year
    → Possibility of **yield increase**
  - **Abundant** and **controllable**
    → Farmers are **not afraid** of saving water
  - **Tidal irrigation** available
    → **Favorable** in terms of water management **costs**

Environment favorable for introducing a less-water environment to rice paddies

- **Soil**
  - **Low sulfide** conc. (e.g. FeS_2)

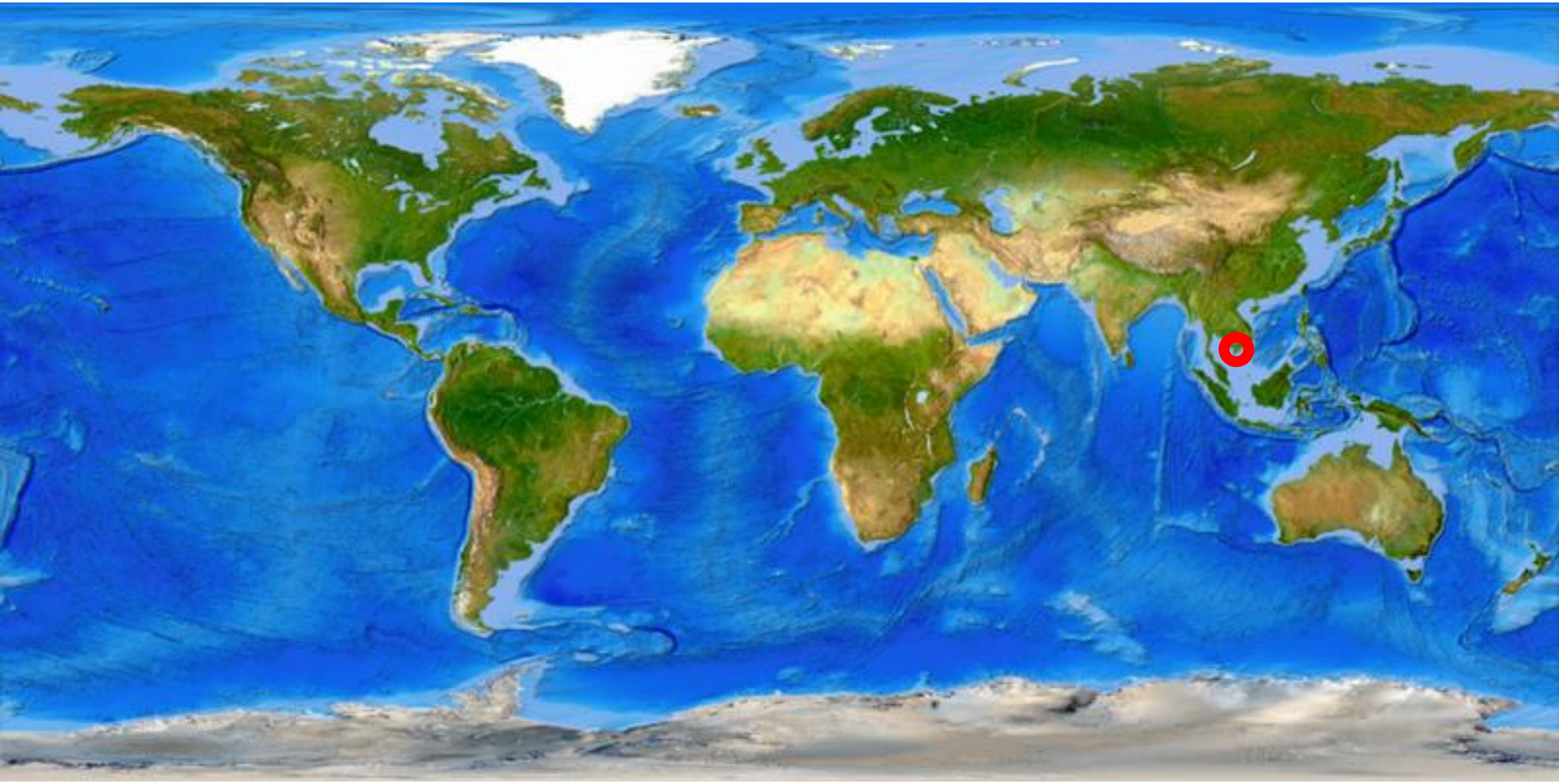
    $2FeS_2 + 7O_2 + H_2O \rightarrow 2FeSO_4 + H_2SO_4$

    $4FeSO_4 + O_2 + 10H_2O \rightarrow 4Fe(OH)_3 + 4H_2SO_4$

  - **Low Cd** conc. (e.g. CdS)

    $CdS + 2O_2 \rightarrow Cd^{2+} + SO_4^{2-}$

    $\hookrightarrow$ Rice → Humans



Environment favorable for introducing a less-water environment to rice paddies

- **Water**
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  - **Abundant** and **controllable**
  - **Tidal irrigation** available
- **Soil**
  - **Low sulfide** conc. (e.g. FeS_2)
  - **Low Cd** conc. (e.g. CdS)

Knowledge 2a

Capacity Building for Climate Smart Rice Cultivation in Asia

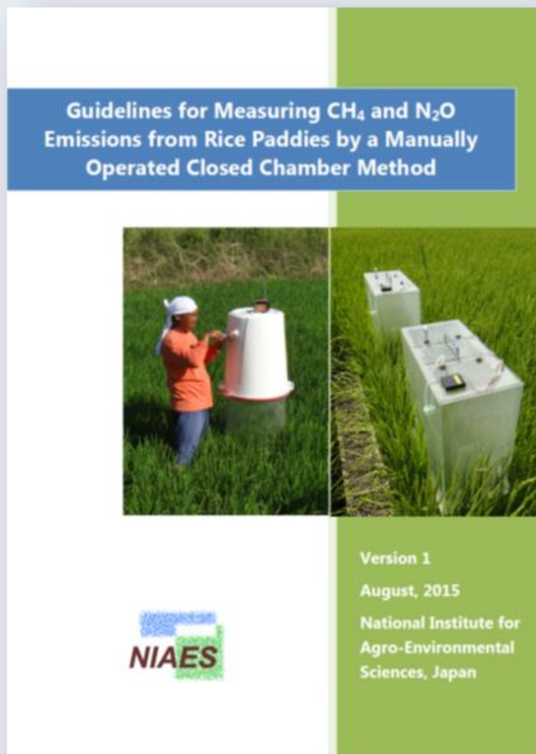
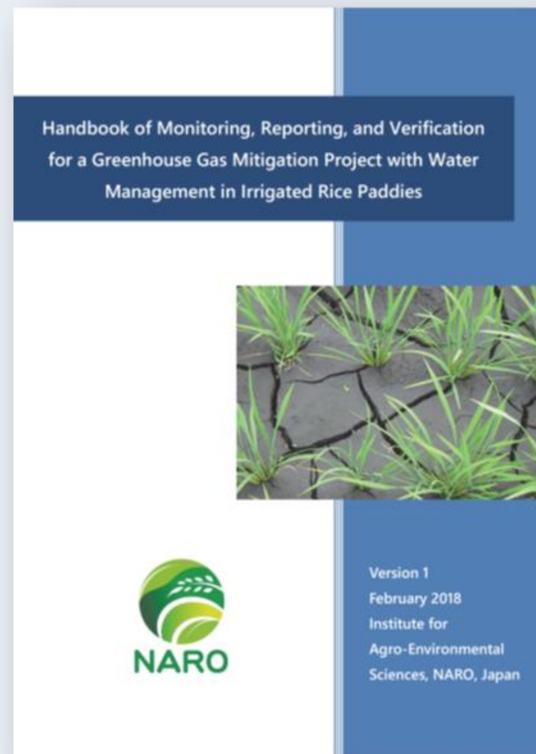
MRV for a GHG mitigation project with water management in irrigated rice paddies

Kazunori Minamikawa (JIRCAS, Japan)

MIRSA

This study was funded by the Ministry of Agriculture, Forestry and Fisheries of Japan through the 5-year International Research Project (MIRSA-2).

Guidebooks for GHG measurement and MRV

Target	Chamber paddy GHG meas. (EF & SF)	MRV for paddy water management
Published year	2015 (ver. 1)	2018 (ver. 1)
Authors	Minamikawa et al.	Minamikawa et al.
Cover NARO MIRSA-2 Or visit the website of this workshop		

Reviewers

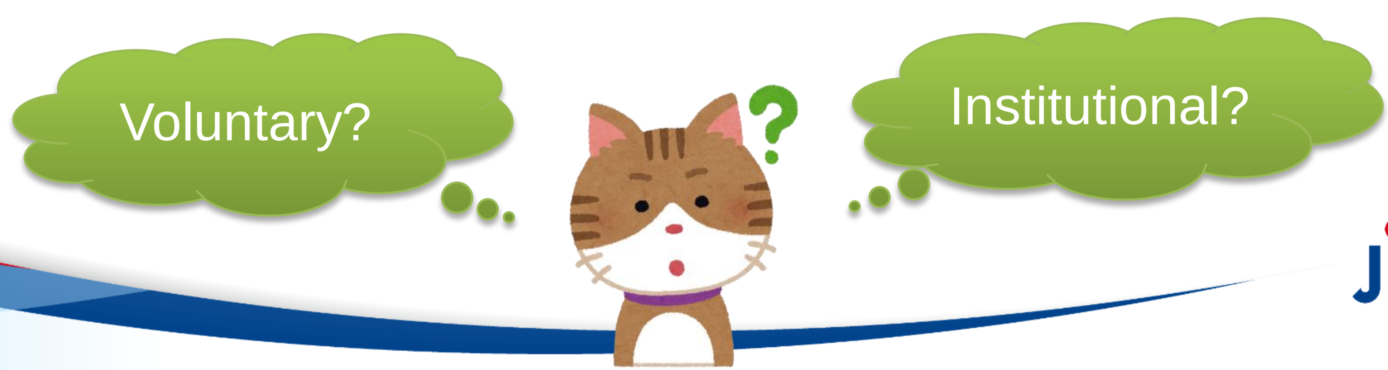
- Mr. Kenjiro Suzuki (UNFCCC Secretariat, Germany)
- Ms. Carolyn Ching (Verified Carbon Standard, US)
- Mr. Sandro Federici (FAO, Italy)
- Dr. Andreas Wilkes (UNIQUE forestry and land use GmbH, Germany)
- Mr. Kentaro Takahashi (IGES, Japan)

JIRCAS

Benefits of water management

- Sound rice growth and water saving for farmers
- CH_4 emission reduction for global environment
- Arsenic pollution control for local environment
- Negative possibilities: water stress, Cadmium pollution, N loss (N_2O), soil fertility, labor, etc.

➔Because there is a limit to the dependence on the voluntary dissemination, the institutional dissemination will be a crucial key.



Three dissemination approaches

	Voluntary	Semi-institutional	Institutional
Explanation	Get help from benefits/synergies of climate change adaptation, etc.	Domestic subsidy or certification systems	International or domestic carbon pricing and NAMA
Advantage	• No additional cost • Indirect financial incentive from improved products	• Financial incentive • Relatively easy documentation	• Financial incentive • Accountable to national GHG inventory
Drawback	• Limited mitigation capacity • Limited number of options	• Limited amount of subsidy • Limited purchasers of certificated prod.	• Complicated documentation • (Current) low carbon price
Example	• Soil C sequestration • Early maturing variety	• GAP • Eco-labelling	• CDM • Thai Rice NAMA

MRV required for the institutional approach

Necessary to develop MRV methodology for ensuring the accuracy and reliability of asserted CH_4 emission reduction by water management.

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

Monitoring

Reporting

⇄

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

Validation/Verification

Challenges for MRV in agricultural sector

1. Impact of environmental factors on GHG emissions, which complicates the separation of anthropogenic contributions from natural variability.
2. Spatial variability in GHG emissions due to varying environmental conditions across landscapes.
3. Temporal variability in background GHG emissions, which complicates setting and tracking progress toward emission reduction goals.
4. Carbon sequestration and accounting for changes in the management and ownership of different carbon pools.
5. Delayed effects of agricultural activities on GHG emissions.
6. Organizational structures and management practices specific to agricultural sector.

World Resources Institute (2014)

Typical procedure for M and R processes

Procedure
1. Distinguishing project boundary
2. Identifying emission sources, sinks, and reservoirs
3. Determining how to monitor emissions and activities
4. Establishing monitoring system
5. Monitoring and calculating emissions and activities
6. Reporting emissions and activities

Baseline vs. project

- Baseline water management shall be accurately identified from the past record in the project area, the fields currently surrounding the project, and the crop calendar.
- Project water management shall consider not only GHG emissions but also rice physiology to achieve the same rice productivity as the baseline scenario.

Distinguishing project boundary

Recommendations

- Responsible party shall select the project area candidate where paddy water management is feasible in respect of natural and artificial conditions for irrigation and drainage.
- Project area should follow administrative boundaries as well as natural boundaries to facilitate collection of necessary information about agricultural activities.

Considerations

- Infrastructure may overcome the lack and/or surplus of water.

➔ Expanding the opportunity and area for a project.

- Water management during fallow season can also be a target.

← Wet/flooded soil conditions can cause substantial CH_4 emissions.

- There should be an economy of scale for a project area.

← Dilution of fixed MRV costs, etc.

Identifying GHG sources/sinks/reservoirs

Recommendation

- Responsible party shall identify all GHG sources, sinks, and reservoirs and select target GHGs and their sources, sinks, and reservoirs after taking "materiality" into consideration.

	Source	Sink	Reservoir
CH_4	Wet/flooded soil	Dry soil	None
N_2O	Wet/drained soil, "leakage" (atmospheric N deposition, N leaching and runoff)	None	None
CO_2	Soil, fuel	Plants, soil†	Soil†

† Soil can be a CO_2 sink when SOC storage is not saturated, whereas soil is just a CO_2 reservoir when SOC storage is saturated.

Determining how to monitor emis/activities

Recommendations

- Items that shall be monitored and reported include basic information on agricultural activities, such as water management and rice productivity.
- Criteria for appropriately implementing project water management shall be determined based on the definition of project water management, the required level of assurance, the spatial scale of project area, and the limitations imposed by MRV costs.

Information candidate	Item examples
Weather	Precipitation, air temperature, extreme events
Water use	Irrigation volume, pump fuel usage
Agricultural practices	Event date, fertilizer, agrochemicals
Water management	Surface water level, dates of irrigation and drainage
Rice productivity	Growth stage, disease and pests, grain yield
Soil properties	Moisture conditions, C concentration

Establishing monitoring system

Considerations

- Items and their collection methods may depend on the spatial scale of project and the required level of assurance.
- Video and photographs can be used to monitor (qualitative) items.

Table. Candidate criteria for water management and the characteristics

Criteria	Monitoring method	Advantage/drawback
Surface water level	• Automated sensor/logger • Manual reading with gauge	• Direct evidence to demonstrate • Heterogeneity of soil surface level
Irrigation volume	• Water gauge • Estimation from pump fuel/time	• Applicable from field to tract • Need precip. data for correction
Soil moisture status	• Automated sensor/logger • Manual sampling	• Most scientific evidence • Need scientific background • Heterogeneity of soil surface level
Precipitation	• Nearby weather station • Rain gauge	• Applicable from field to tract • Need irrigation volume data

Monitoring and calculating emis/activities

Recommendations

- Data essential for CH_4 emission calculation are (1) EF and SF, (2) the area of project, and (3) the duration of project period.
- Uncertainties associated with the calculated results should be quantified to meet the principle of "conservativeness."

Considerations

- EF, SF, area size, and duration need to be determined in advance.
- Model simulation is a sophisticated approach for GHG calculations in a wide area, but it requires many input parameters.

$$E = EF \times SFw \times SFp \times SFo \times SFs,r \times A \times Y \times GWP$$

Three currently available techniques for V

	Technique 1 Reviewing reported materials	Technique 2 Comparison with other independent datasets	Technique 3 On-site direct monitoring
GHG emissions	• Calculation equations and errors • Auxiliary data • Uncertainty range	• National inventory rep. • National communication • Published papers	• Chamber measurement
Area of cultivation	• Calculation errors • Lack of data • Uncertainty range	• Statistics • GIS-derived data • Published papers	• Location survey
Volume of irrigation and drainage	• Logbook (water gauge and pump) • Uncertainty range	• Precipitation data • Data related to irrigation	• Performance of water gauge and pump
Surface water level	• Logbook (water level gauge) • Uncertainty range	• Precipitation data	• Performance of water level gauge • Spatial variability
Straw management	• Logbook • Photos	• GIS-derived data (after harvest)	• Inspection (after harvest)

The Overview and Plan of The Thai Rice NAMA Project

Chitnucha Buddhaboon

Ubon Ratchathani Rice Research Center, Rice Department,
Ministry of Agriculture and Cooperatives, Thailand

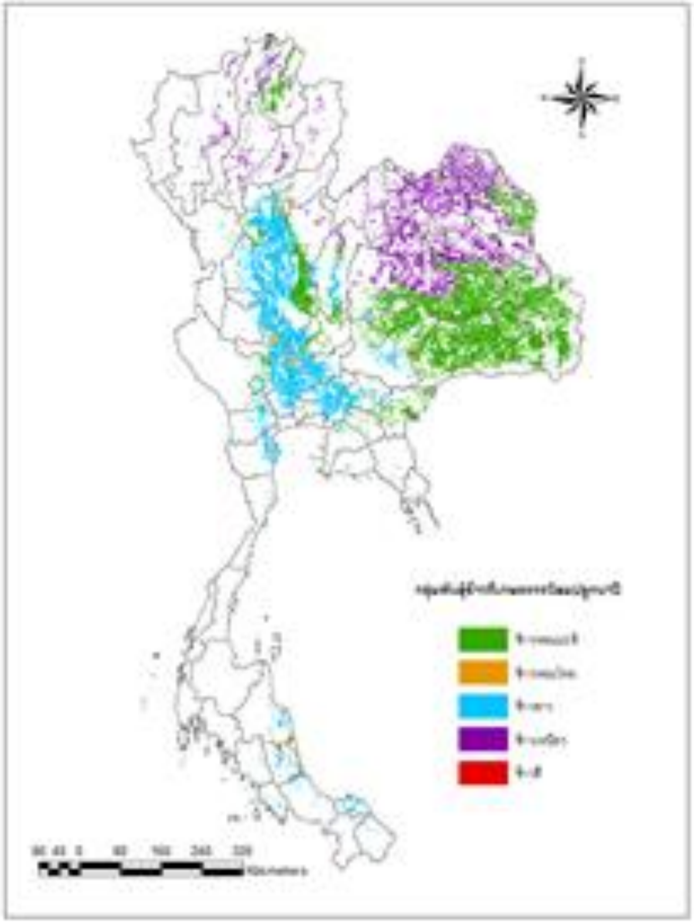
The Project Partners

Contents

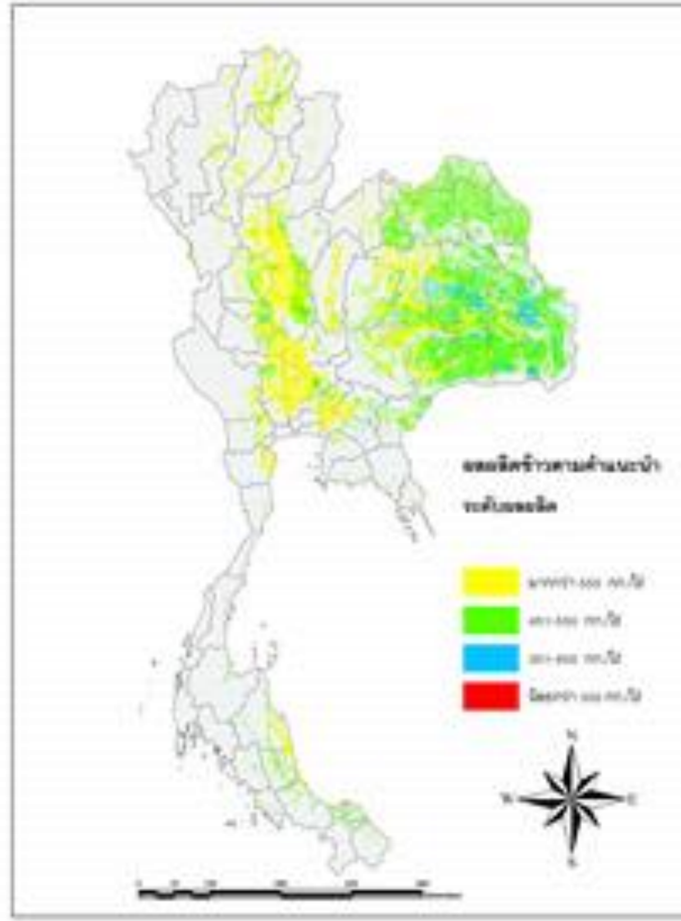
- Introduction
- The Project Overview
- The project plan

Introduction

Introduction

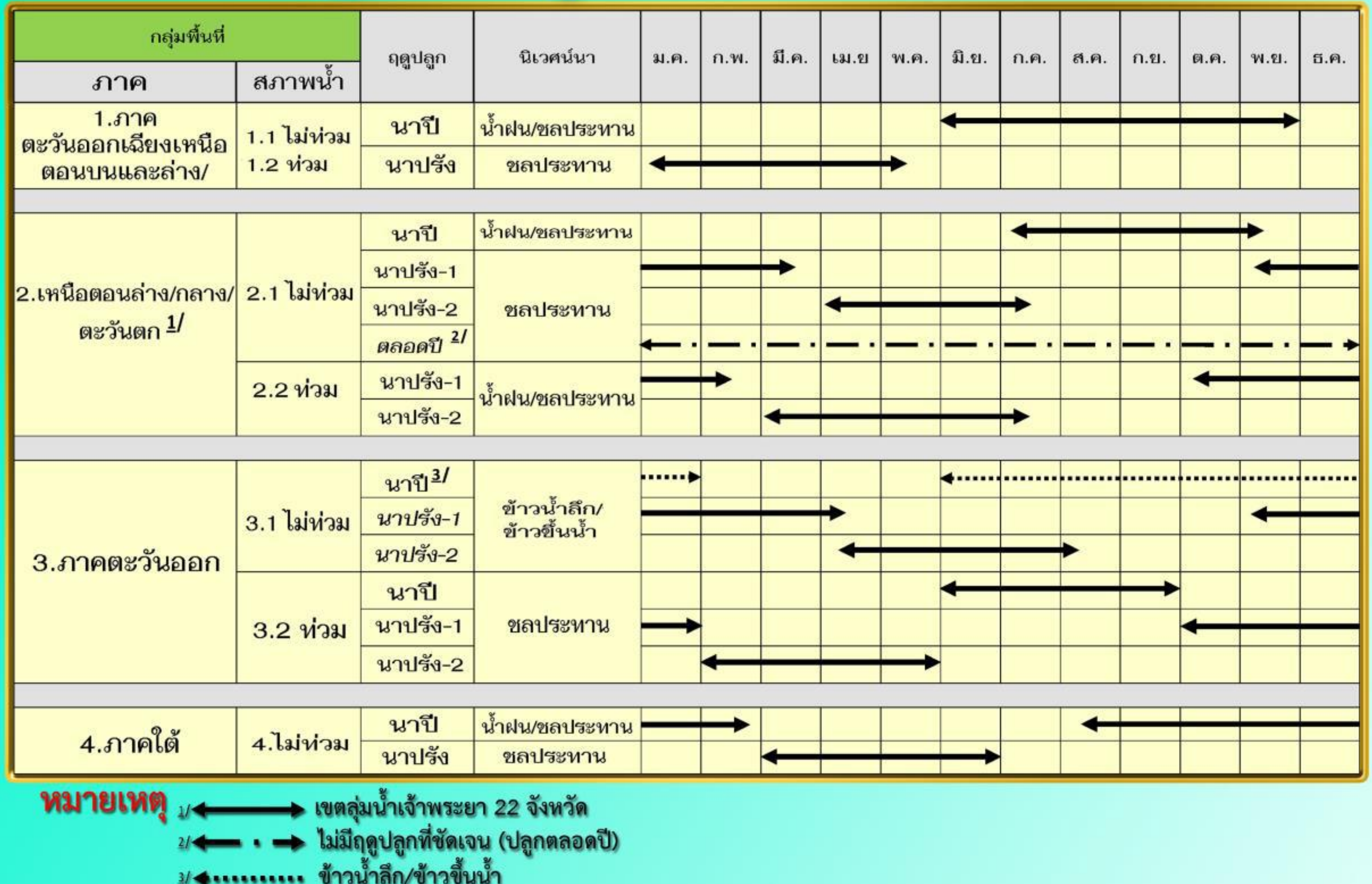


Rice Variety Groups



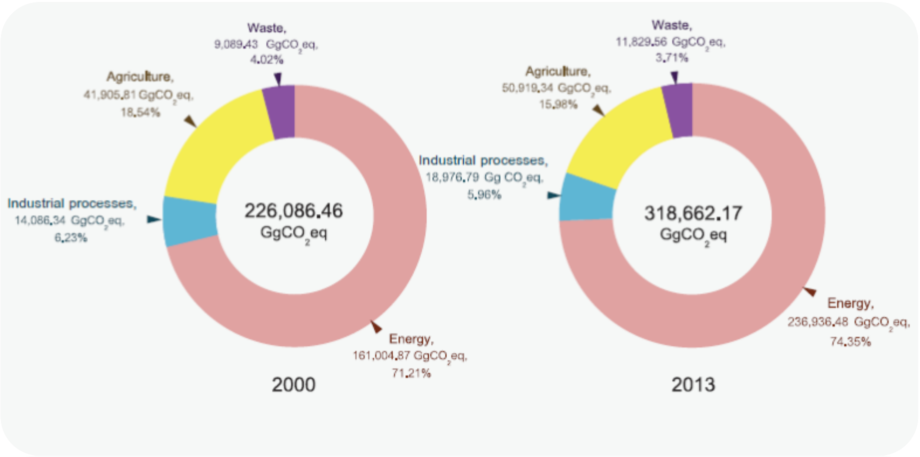
Rice Yield

ปฏิทินการปลูกข้าวของไทย ปี 2559

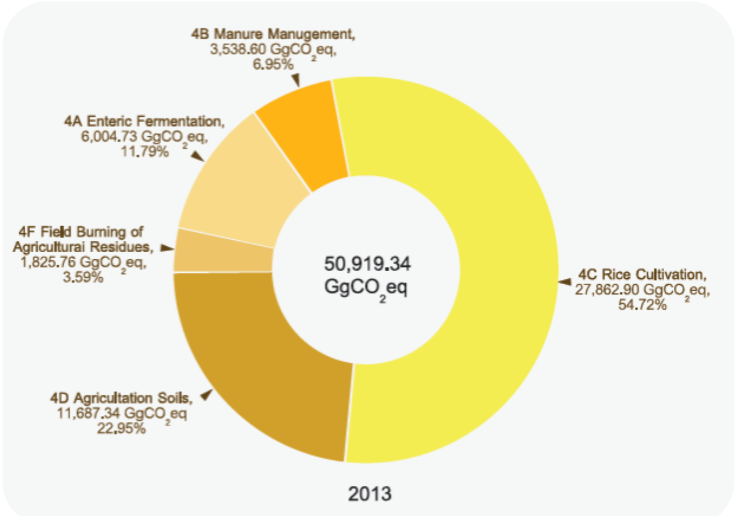


Source: Rice Departments

GHG emission and rice cultivation



Total GHG emissions by sector: 2000–2013



GHG emissions in the agriculture sector: 2013

(ONEP, 2017)

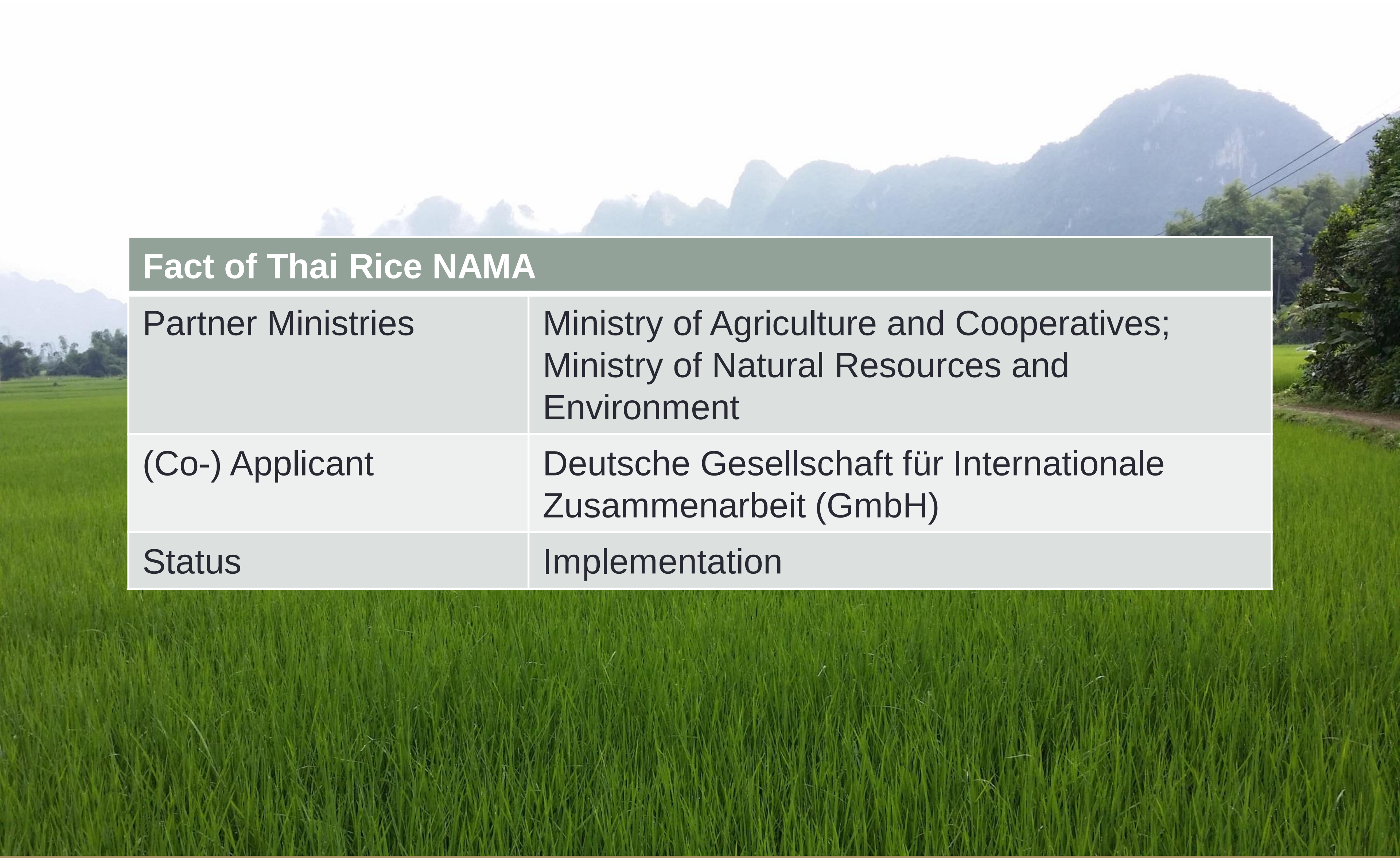
The Project Overview

Minister of Agriculture and Cooperatives of Thailand, and 40 participants attending the Thai Rice NAMA Project Meeting at the Ministry of Agriculture and Cooperatives (MoAC) on 20 June 2017.

Thai agricultural sector contributes to global efforts for climate change mitigation officially

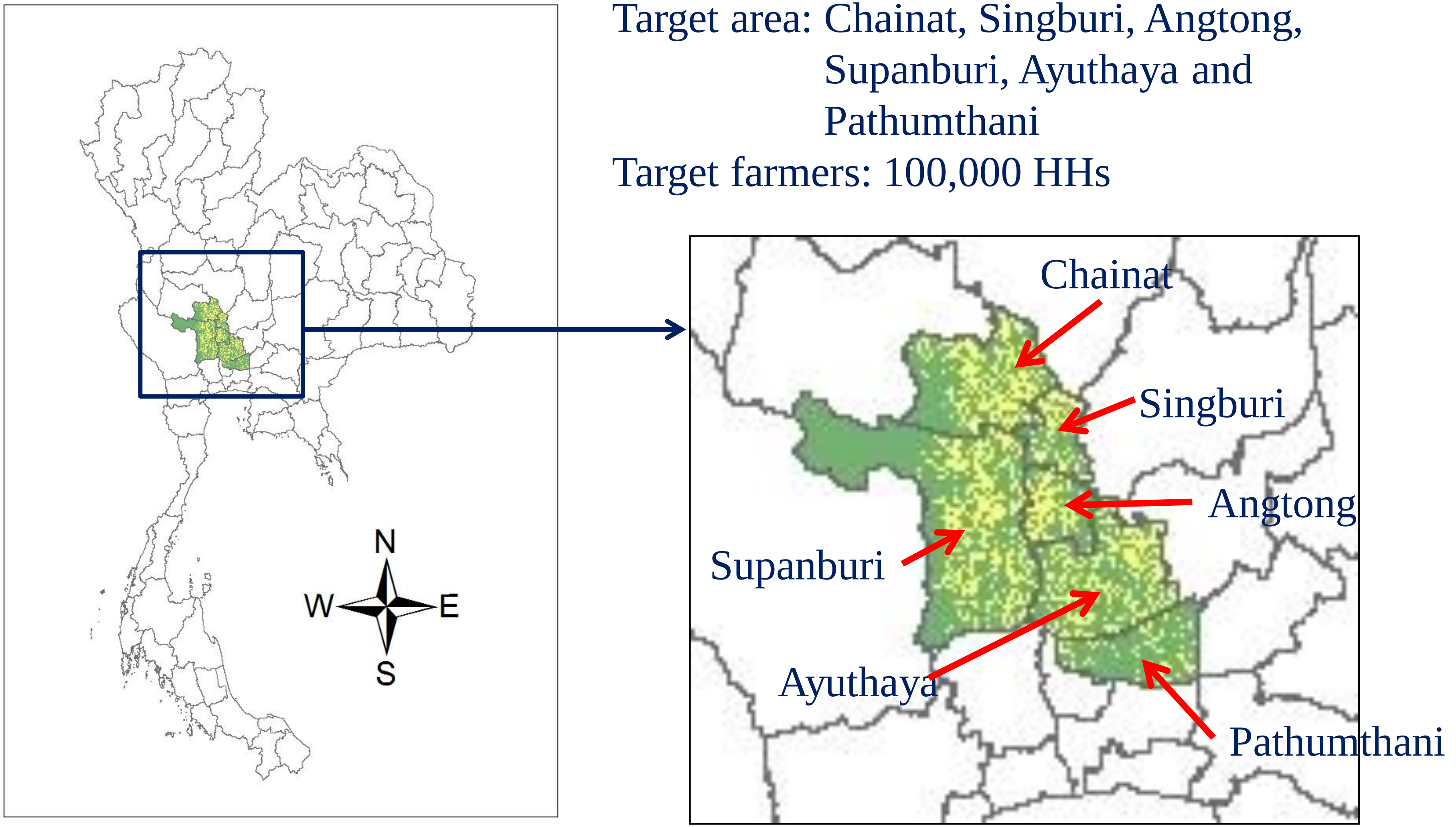
Rice Department (RD)

Rice Department (RD), under the MoAC, which is a member of the National Committee on Climate Change, is the main implementing agency for the sustainable development of the rice sector. The RD participates and coordinates the implementation of the Thai Rice NAMA”. (Mr. Anan Suwannarat, Rice Department Director General (now is Permanent Secretary))



Fact of Thai Rice NAMA	
Partner Ministries	Ministry of Agriculture and Cooperatives; Ministry of Natural Resources and Environment
(Co-) Applicant	Deutsche Gesellschaft für Internationale Zusammenarbeit (GmbH)
Status	Implementation

Thai Rice NAMAs Project Area



Target area: Chainat, Singburi, Angtong, Supanburi, Ayuthaya and Pathumthani

Target farmers: 100,000 HHs

Target Area

Overview of Thai Rice NAMA

Goal

To achieve transformational change through a paradigm shift from conventional to low-emission farming (AWD, chemical fertilizer and rice straw management) in Thailand

Objectives

- **Farmers have adopted the SRP** Standard/GAP++ and thereby reduce GHG emissions and realize additional co-benefits.
- **Mitigation services** are provided in the market and utilized by the farmers to achieve SRP certification.
- **Innovative incentive schemes** are established on the national level to support the transformation of the whole rice sector to low-emission production.

Duration

- 5 years from Aug 2018 – Aug 2023

Budget

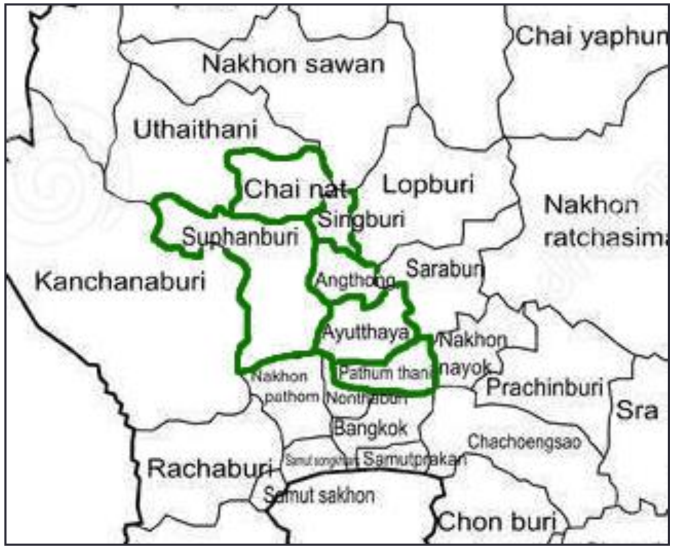
- 14.9 million Euro

* Thai Rice NAMA is a pilot project in developing low-carbon rice farming approach.

Project Target

- 100,000 farmer households in irrigated areas of the six target provinces (Chainat, Angthong, Pathum Thani, Singburi, Ayutthaya, and Suphanburi, and nearby watershed areas)
- Benefit 450,000 farmer household members and 2,100 mitigation service providers
- Target rice farming areas: 2,846,376 rai in wet season and 2,846,376 rai in dry season
- Total annual rice yield at 3,984,926 tons in 5th year (1,992,463 tons in wet season 2022 and 1,992,463 tons in dry season 2022/2023)*
- Reduce GHG emissions by 1.73 million tCO2eq over 5 years of project implementation

Central Plain

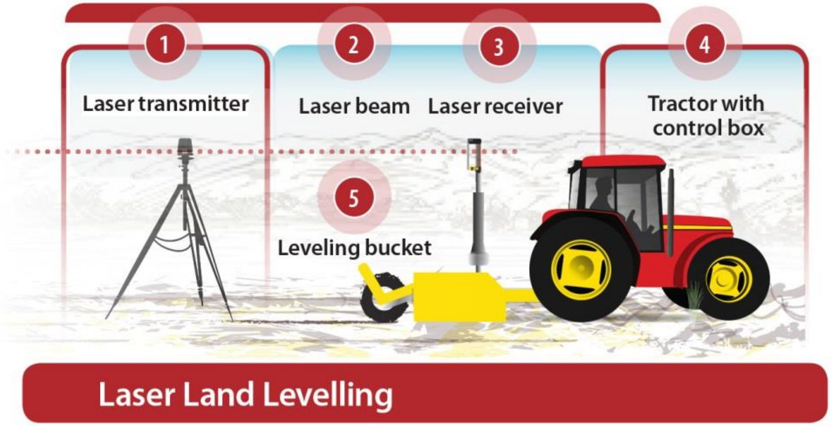


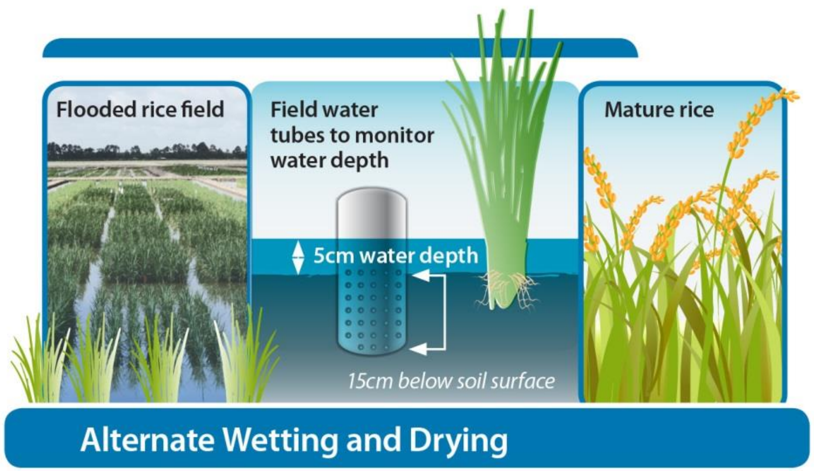
* Average yield is 0.7 ton/rai and 100% adoption rate

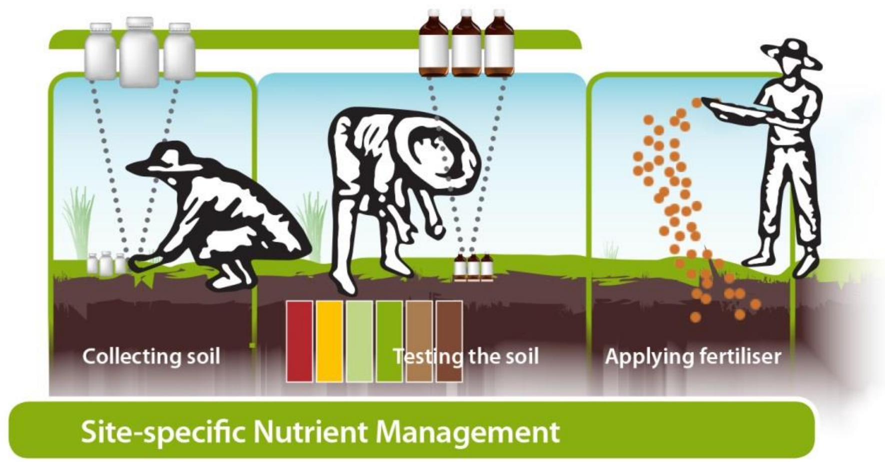
The Partners for the implementation the Thai Rice NAMA project

- Rice Department, Ministry of Agriculture and Cooperatives
- GIZ (The GIZ is owned by the German government)
- Office of Natural Resources and Environmental Policy and Planning
- Department of Agricultural Extension
- Royal Irrigation Department, Land Development Department
- Bank for Agriculture and Agricultural Cooperatives
- Office of Agricultural Economics
- National Bureau of Agricultural Commodity and Food Standards

Mitigation Technologies

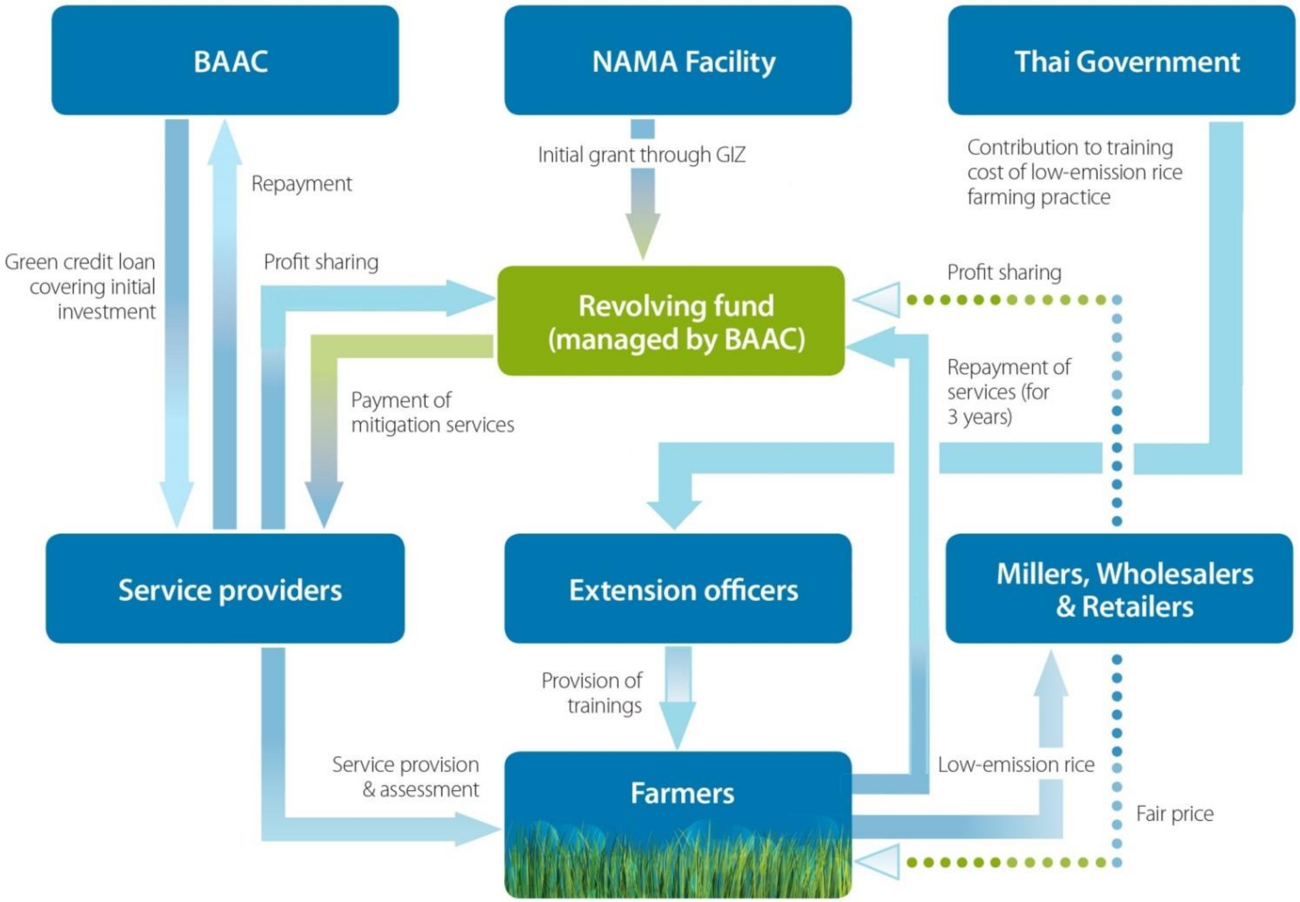






https://www.asean-agrifood.org/

Financial Mechanisms



The project plan

The Project Plan

No.	Activity	Responsible	2018						2019					
			Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	Prepare 1) a short project brief and FAQ for PR communication, media, press, website, 2) a long project brief for project partners and PPT presentation, and 3) value proposition for different audiences	GIZ												
2	Communicate selection result to partners, embassy, and public (official letter & PR)	GIZ												
3	Draft executive orders for setting up: - A Policy Advisory Committee - A Project Steering Committee - Three Working Groups - Six Sub-Steering Committees at Provincial Level	Core Team												
4	TORs for consultants - National Consultants (3) - International Consultants (2) - IRRI - M&E consultant (if needed)	GIZ												
5	Thai Rice NAMA Focal Point Meeting	RD/GIZ			26									
6	Formalize the project between RD & GIZ TH - Agreement, develop team, assign resources, procurement and set up office - Role of GIZ as NSO - Modify project plan as needed	RD/GIZ												
7	Formalize grant agreement between BAAC & GIZ HQ - Agreement, develop team, assign resources and procurement - Role of GIZ as NSO - Modify project plan as needed	BAAC/GIZ/R&R												

The Project Plan

No.	Activity	Responsible	2018						2019					
			Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
8	Set up financial mechanism & buiness model - Revolving Fund Operation - BAAC Green Credit Operation - Farmer procedures & repayment - Business development plan for service providers	BAAC/WG3/R&R												
9	Visit and provide briefing to Minister of MoAC	RD/GIZ												
10	Organize official meeting with MoAC (Chaired by Minister) - Thai Rice NAMA Briefing - Policy Direction & Guidance - Propose Executive Orders to establish policy advisory committee, project steering committee, and working groups (Refer to Executive Orders during DPP)	RD/GIZ												
11	Several Project Preparation/Implementation Meetings (3 working group levels) Key agenda - Present a long project brief to project partners - Present draft executive orders for setting up six sub-steering committees at provincial level - Site selection - Technolgy transfer - Identify and cluster actions/measures and roles and responsibilities of partners for implementing project activities - Set up M&E working group - PR communication strategy - Role of GIZ as NSO - Modify project plan as needed - Etc.	RD/BAAC/3WGs/GIZ/Consultants												

The Project Plan

No.	Activity	Responsible	2018						2019					
			Jul	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
12	M&E Plan Development - Set up baseline and data collection system (Socio-Economic benefits and MRV system)	RD/OAE/GIZ												
13	Mitigation Technology Demonstration Plots													
14	Organize Project Steering Committee Meeting - Propose results from no.6, 7, 8, 11 & 12 for consideration and approval - Propose to set up six sub-steering committees at provincial level	RD/GIZ												
15	Organize Policy Advisory Committee Meeting - Propose results from no.6, 7, 8, 11, 12 & 13 for consideration and approval	RD/GIZ												
16	Organize Six Sub-Steering Committees at Provincial Level - Develop detail implementation plan	RD/GIZ												
17	Project communication and outreach to farmers	RD												
18	Organize Project Kick-Off event at Provincial Level (Tentatively Ayutthaya) - PR materials (brochure, press release, short project brief)	RD/GIZ				30								
19	Organize Two Project Launch Events @ MoAC and German Embassy - Agreement signing ceremony - PR materials (brochure, press release, short project brief)	RD/BAAC/GIZ												
20	Organize Revolving Fund Kick-off Event	BAAC/GIZ												
21	Prepare Thai Rice NAMA Operational Guidelines	Core Team												
22	Start Land Preparation													
23	Wet Season													

The scaling-up of climate-smart rice cultivation technologies in Thailand extends and implements along with rice policies:

- Consolidate rice farming (Big farm)
- Organic rice farming
- Niche market rice farming
- Community rice seed center
- Improving Agricultural commodity production efficiency learning center

Under the collaboration of stakeholders

Thank for all Partners
and Thank for Your Attention

กรมการข้าว

กรมชลประทาน

กรมพัฒนาที่ดิน

KING MONGKUT'S UNIVERSITY OF TECHNOLOGY THONBURI

กรมส่งเสริมการเกษตร

IRRI International Rice Research Institute

german cooperation
DEUTSCHE ZUSAMMENARBEIT

Implemented by
giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Better Rice Initiative Asia
BRIA
Better Rice, Better Life

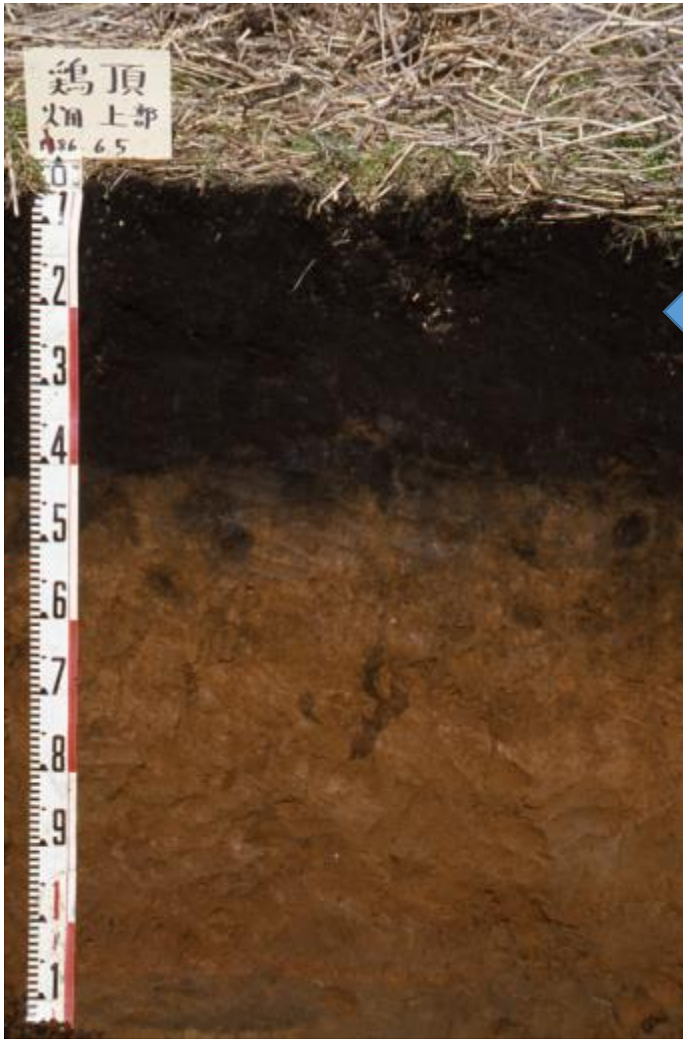
OLAM

NARO

Soil C sequestration for sustainable food production and climate change mitigation

Yasuhito Shirato Ph.D.
Research Manager for Climate Change
Institute for Agro-Environmental Sciences (NIAES)
National Agriculture and Food Research Organization (NARO)

Soil carbon (C) sequestration & climate change mitigation



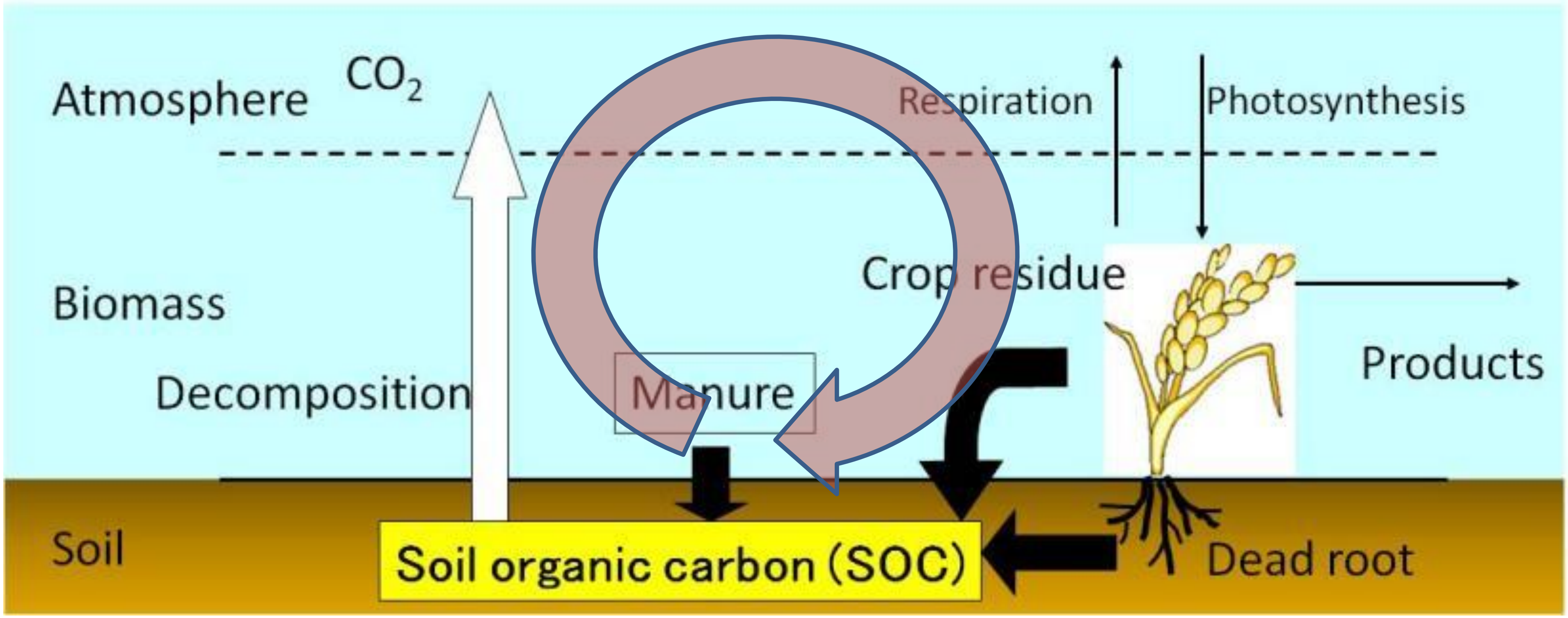
"Carbon" accumulated as black-colored "soil organic matter"

Andosol (Japan) profile~ 1m

Dark-colored soils have higher concentration of carbon

<

C cycle and soil C sequestration



•In cropland, C in "biomass" does not change in longer time-scale. Increase in SOC means decrease in atmospheric CO_2 ➔sink of CO_2. ➔ Mitigation

For increasing SOC:
Increase C input or decrease decomposition rate.

Difference between soil C sequestration and other GHGs mitigation

Soil C sequestration	CH4 and N2O mitigation
Positive effect on soil fertility ➔contribute to food security	
Not only emission reduction. Possible to be "sink"	Emission reduction

Positive correlation between soil C and crop yield

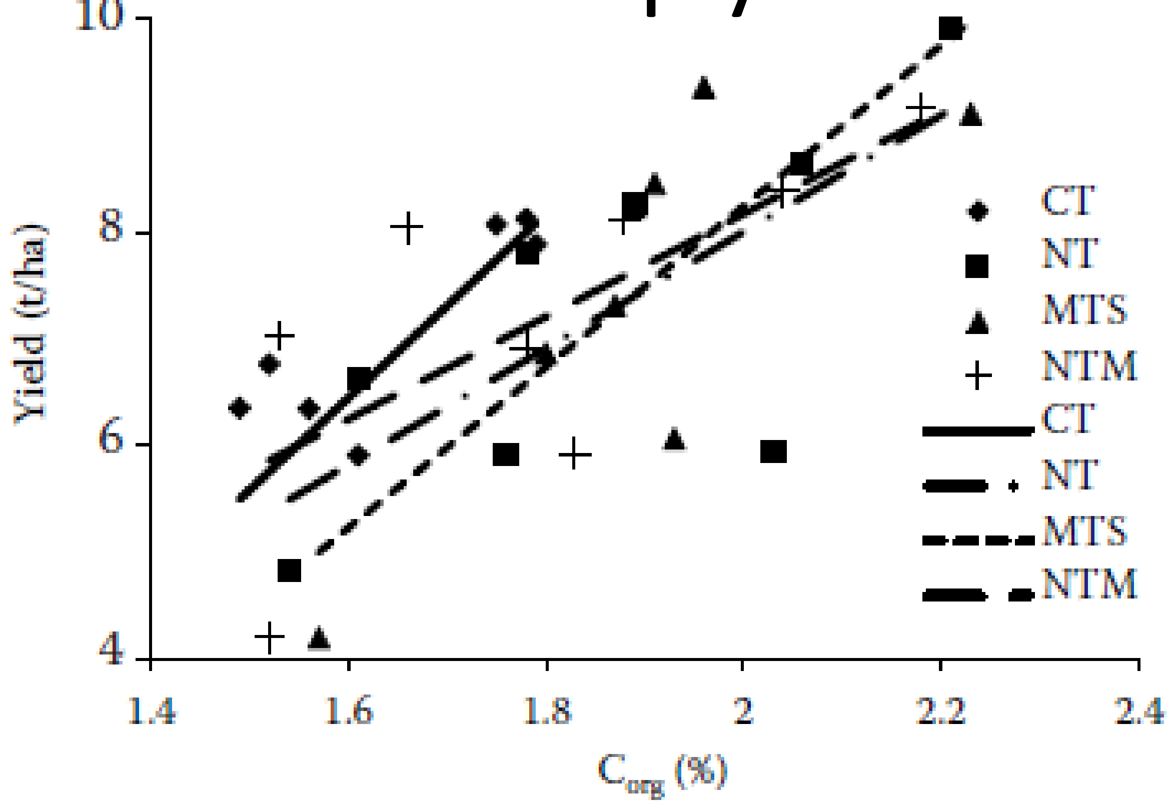
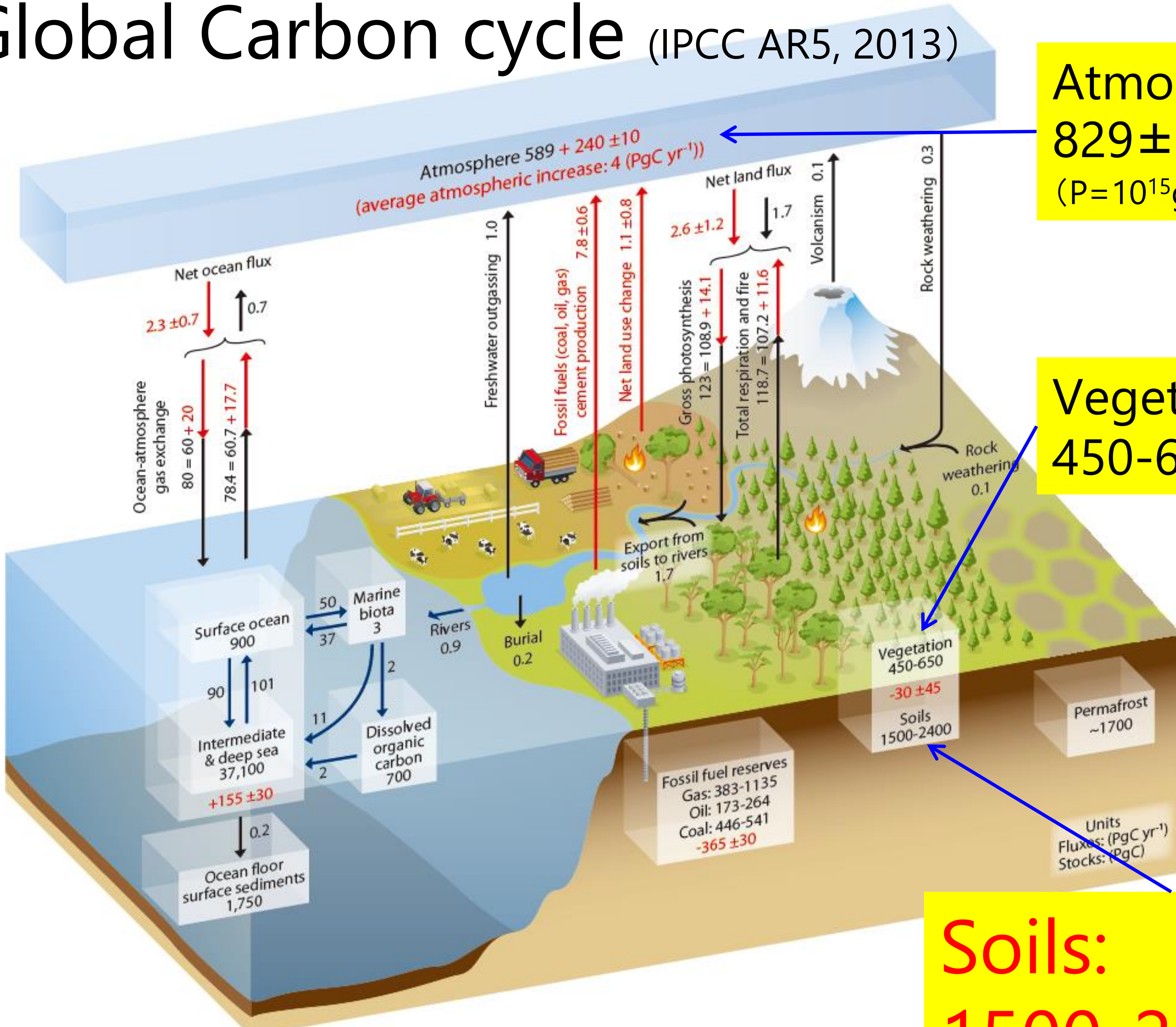


Figure 4. Relationship between winter wheat yields and values of organic C content in topsoil under different tillage systems during the period 2002 to 2009. CT – conventional tillage; NT – no tillage; MTS – minimum tillage + straw; NTM – no tillage + mulch

Mikanova et al. (2012)

Global Carbon cycle (IPCC AR5, 2013)



Atmosphere: 829±10 Pg ($P=10^{15}g$)

Vegetation: 450-650 Pg

Soils: 1500-2400 Pg

The 4 per 1000 initiative

- Launched in 2015 @ Paris COP 21
- Increase of 0.4% of total terrestrial SOC annually can offset annual increase in atmospheric CO_2
- Climate change mitigation & sustainable agricultural production
- Over 280 partners (countries, NGOs etc.)

- Scientific & Technical Committee (STC)
- 14 scientist from the world
- Give technical advice

Criticisms

- Slogan (soil C as win-win strategy) is welcome for all, but criticisms on 0.4% target exists

1. Trade-off with other GHGs
2. Too ambitious target
3. Equilibrium and non-permanency

1. Trade-off: need to evaluate total Global Warming Potential (GWP)

e.g. Mitigation option: "Increase C inputs to soils"

Soil C increase (CO_2 decrease)

Trade-off

Total GWP?

CH_4 and N_2O increase

Combination with other mitigation option
e.g. Paddy water management to offset this

2. Too ambitious target

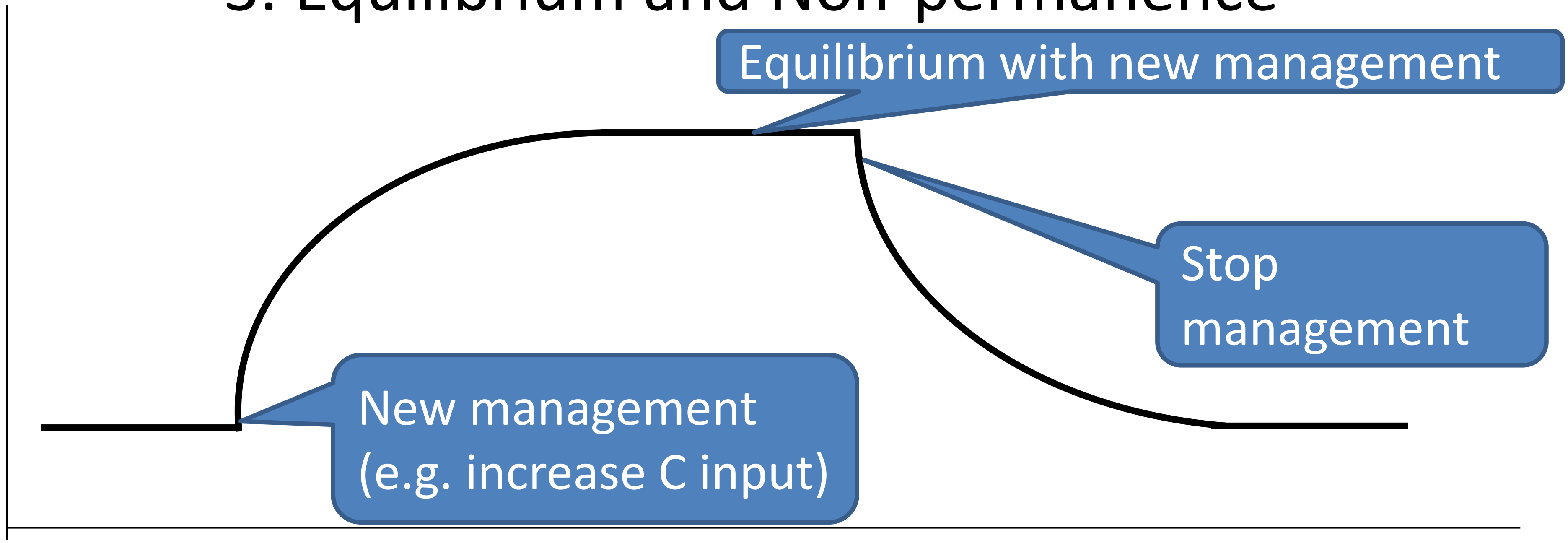
- 0.4% per year (slope) is not feasible quantitatively: estimates are too high globally but also locally

- Large variability of SOC storage rates depending on soil type and climatic conditions and management options.
- Even an additional storage, less that 4‰ would help mitigate CO2 emissions.

- Farmers will not be able to adopt it: social and economical constraints (costs, need for continuous financial incentives)

- Address first the farm sustainability (SOC storage is likely to come with success in sustainable production).
- Demonstrate the benefits of soil carbon and related incentives.

3. Equilibrium and Non-permanence



- C storage is limited with time (equilibrium) and the rate of storage starts decreasing once storage is initiated.
  - Even an additional storage over a few decades would help mitigate CO2 emissions.
  - Predictions must account for these kinetics.
- Non permanence of SOC storage
  - Management practices should be sustainable in terms of crop production.

Advantages of paddy soils

- Slow decomposition under anaerobic condition
- Large amount of C enter soils as roots and stubbles even though straw is removed

More sustainable system than upland crop system

Let’s join the 4per1000!

- Although there are lots of criticisms
- To achieve food security and climate change mitigation

https://www.4p1000.org/c

Thank you for your attention!

C – Feedback and comments on workshop design and content

Feedback and comments on workshop design and content

Meeting participants' expectation

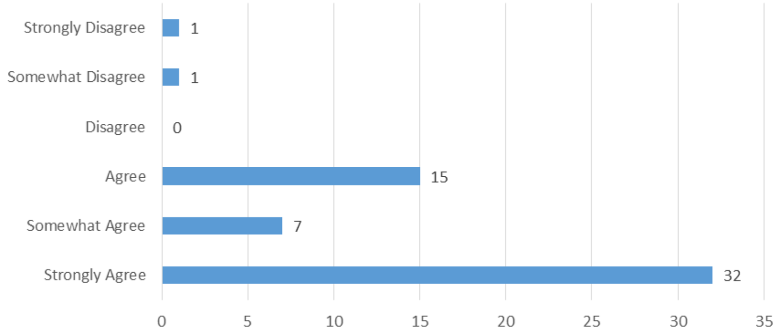
Motivation/ expectation from pre-workshop survey (summarized)

- Networking, linkage, collaboration and partnership
- Gain knowledge on climate change effect on rice-based farming system and its mitigation and adaptation
- Share experiences and learn from other economies: scale up, mitigation, adaptation
- Learn mitigation technologies in rice cultivation as well as tools in monitoring, data validation of reduced emission
- Pros and cons/ trade-off of mitigation technology in rice cultivation
- Firm action plan designed to promote and implement CSA
- Learn current initiatives and practices in the region
- Exchange ideas

Response from pre-workshop survey

Respondents' level of satisfaction

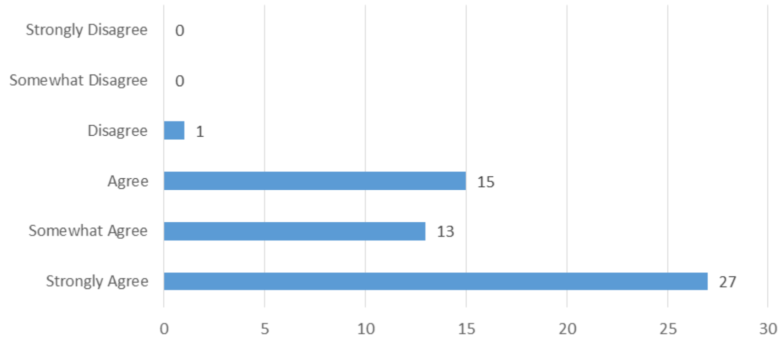
The objective of the workshop is clearly defined



Feedbacks

+ Informative
+ Clearly spelled out up front and checked at end of workshop
+ Well written
+ Follow the roadmap and multiple activities

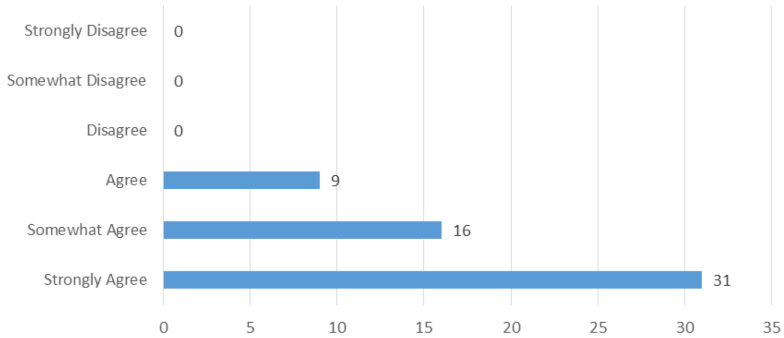
The workshop achieved its intended objectives



Feedbacks

+ Informative
+ Multiple actions
+ Well-organized workshop
+ enthusiastic discussion
+ Clear agenda
+ Well written and clearly explained

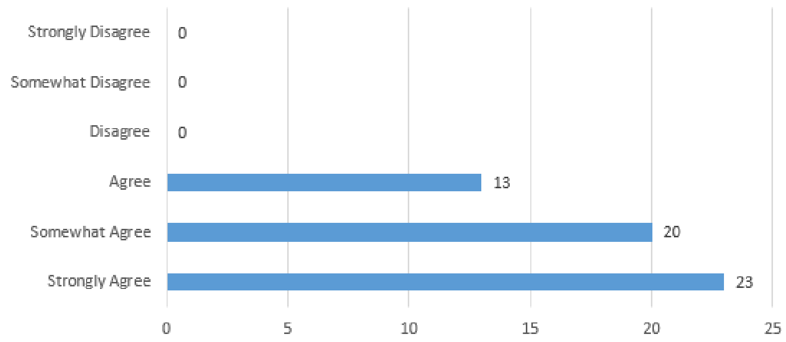
The agenda items and topics were relevant



Feedbacks

+ All papers are relevant
+ topics are suitable
- Some items are too long
- Quite cramp
- Need some successful agribusiness
- Landscape approach
- Roadmap

The sessions were well-structured and easy to be followed



Feedbacks

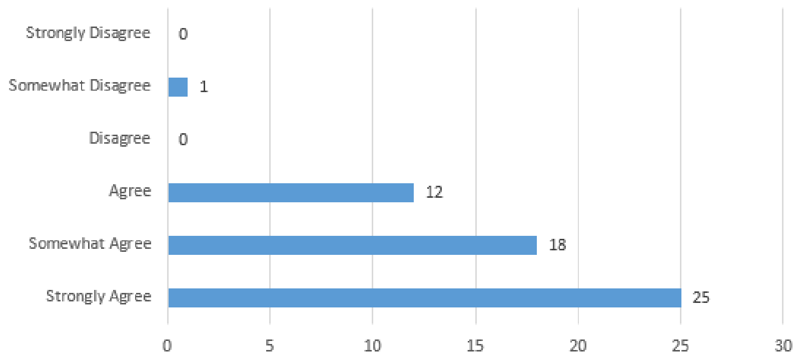
+ fun

+ Clear roadmap

- Confusing

- Need time monitoring

The workshop materials and other resources are useful



Feedbacks

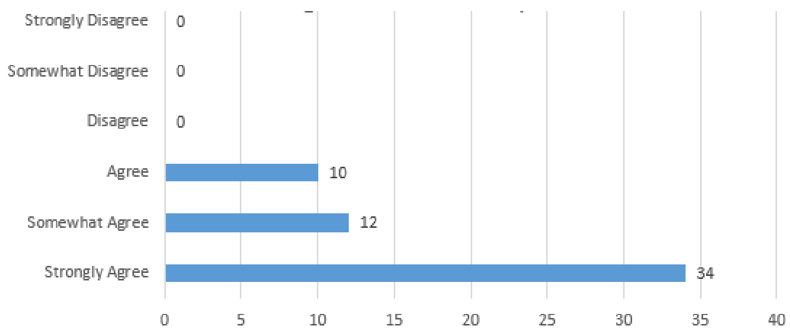
+ useful

+ Sufficient

- Picture on screen are blurred

- Provide presentation slides in advance
- Upload presentations instantly

The moderators and the presenters were well-prepared and knowledgable about the topic



Feedbacks

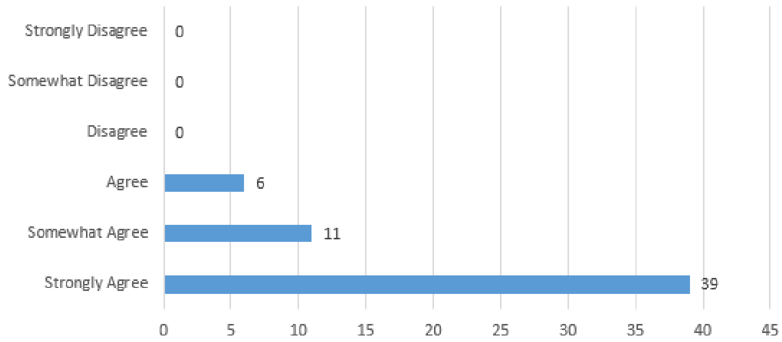
+ Experienced

+ Hands-on

+ Clear instruction

+ Relevant

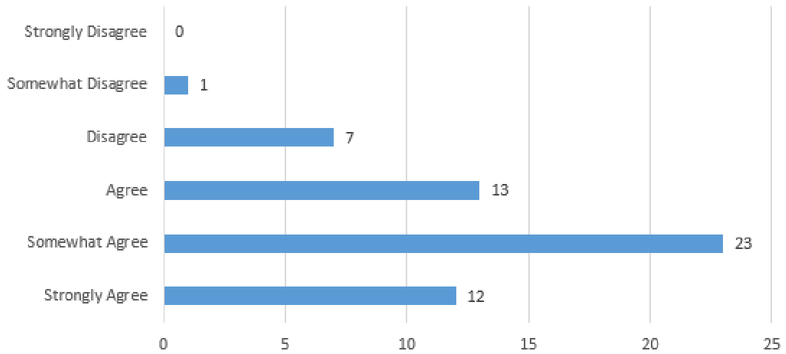
The organizers were reaily accessible and helpful



Feedbacks

+ Prompt response to queries and request for assistance
+ Well-informed
- More information needed

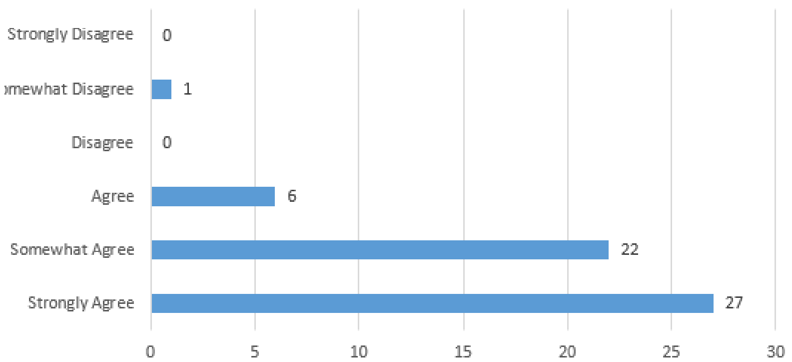
The time allotted for each session was sufficient**



Feedbacks

+ Punctual
+ For a 3-day period it was just appropriate
- More time is needed for group work
- Too short
- Can be improved

The instructions for the interactive sessions were clear and they were well moderated



Feedbacks

+ Well explained and guided
+ Clear structure
- Can be improved
- Make it simpler

Suggestion on workshop

Suggested topics

- Fund mobilization
- Resources management and advocacy
- Analysis of climate change situation of each country
- Climate change adaptation
- Climate value change model
- Adaptation strategy share
- Crop physiology in relation to tolerance
- Information on accounting tools of GHG emission in rice based ecosystem
- More evidence of new climate change technologies
- Institutional approach examples
- Emission factor
- Inventory of country level activities (online)

Comments on the covered topics

- Presentations has to be integrated in thinking of country-level representatives in real-time
- More technical results from country participants
- Focus more on proposal development
- More emphasize on country experience
- Best practices

Suggestion on workshop logistics

- Provide hard copy notes
- Provide participant's contact for further collaboration
- Question/ discussion per session not per presentation
- Funding session could have been through brochures
- Set up table to have more interactions
- Provide advance copies of presentation/paper materials to participants
- The menu must be varied and accommodate to all participants
- Field trip to relevant case study

Suggestion on timing

- Start 8:30 in the morning
- Arrangement for timing of presentation
- Time management
- Reduce time for game
- More accurate on time management

Suggestion on participants

- Invite other stakeholders like selected local government participants and policy makers
- Bring environment/NRM line ministries as participants in addition to ah ministries/research

Suggestion on language

- Adjustment of language especially with jargon
- More effort to accommodate participants with limited English language skills

New workshop idea

- To include or to have climate -smart- resilience - sustainable landscape & adaptation workshop

D – Participants list

Participants (Speakers)

S/N	Title	Name	Position	Organization
1	Mr.	Ali Pramono	Researcher	Indonesian Agricultural Environment Research Institute, Ministry of Agriculture
2	Ms.	Kristine Samoy Pascual	Senior Science Research Specialist	Philippine Rice Research Institute
3	Mr.	Nghia Trong Hoang	Researcher	Hue University of Agriculture and Forestry
4	Dr.	Kazunori Minamikawa	Senior Researcher	Japan International Research Center for Agricultural Sciences

Participants (from the 11 travel-eligible economies only)

Economy	Title	Name	Position	Organization
Chile	Dr.	Viviana Becerra	Senior Researcher in Rice Genetics and Agronomy	Agricultural Research Institute of Chile (INIA)
	Ms.	Sara Hube	Senior Researcher in Climate Change, Greenhouse Gas Emissions	Agricultural Research Institute of Chile
China	Dr.	QIN Xiaobo	Associate Professor	Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences
	Dr.	WAN Yunfan	Associate Professor	Institute of Environment and Sustainable Development in Agriculture, Chinese Academy of Agricultural Sciences
Indonesia	Dr.	Helena Lina Susilawati	Researcher	Indonesian Agricultural Environment Research

Economy	Title	Name	Position	Organization
				Institute
	Ms.	Terry Ayu Adriani	Researcher	Indonesian Agricultural Environment Research Institute
Malaysia		Nor Hafizah Binti Abd. Rahman	Agriculture Office	Department of Agriculture, Malaysia
		Mohd Hasmady bin Ghazali	Agriculture Office	Department of Agriculture, Malaysia
Philippines	Mr.	U-Nichols Asis Manalo	Director-Coordinator, DA Systems-Wide Climate Change Office	Department of Agriculture
	Mr.	Wilfredo Collado	Supervising Science Research Specialist	Philippine Rice Research Institute
	Dr.	Bjoern Ole Sander	Senior Scientist	International Rice Research Institute
Viet Nam	Professor	Pham Quang Ha	Deputy Director General	Institute for Agricultural Environment
	Dr.	Vu Duong Quynh	Deputy Head Department of Environmental Chemistry	Institute for Agricultural Environment
	Dr.	Dong Thi Hoang Tran	Lecturer	Hue University of Agriculture and Forestry
	Dr.	Ly Hai Hoang	Lecturer	Hue University of Agriculture and Forestry