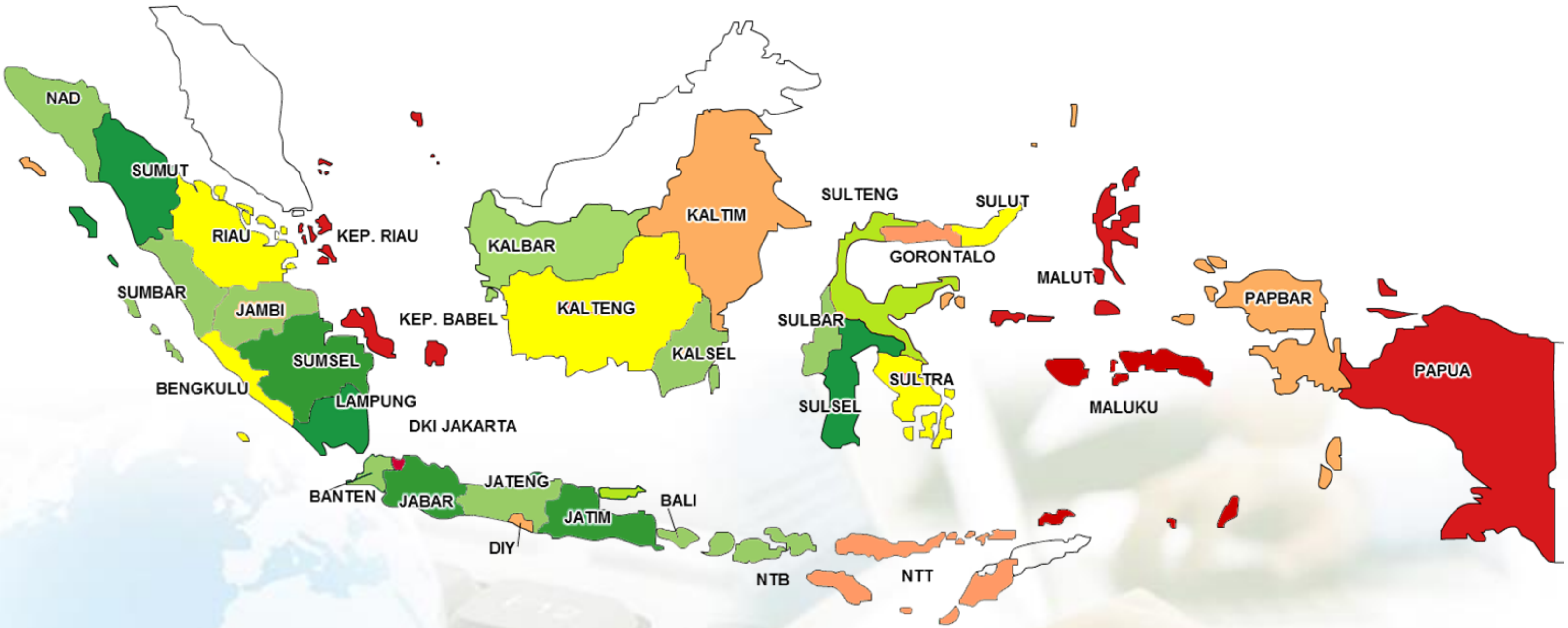




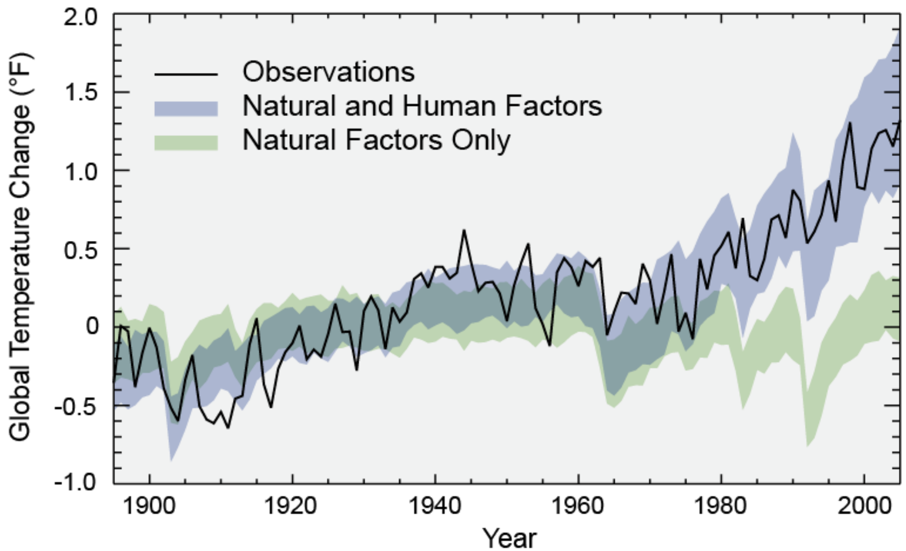

INDONESIA COUNTRY REPORT
ON
Intensive rice cultivation for sustainable agriculture and greenhouse gas mitigation



Indonesian Agricultural Environment Research Institute – IAERI
Indonesia Agency for Agriculture Research and Development – IAARD
Ministry of Agriculture

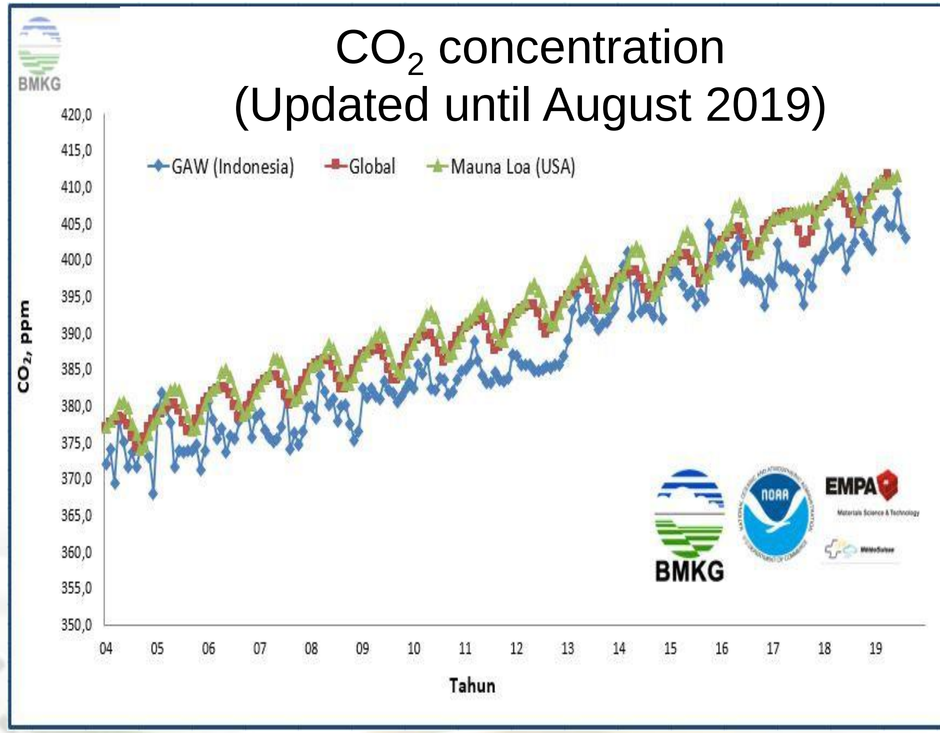
OUTLINE

- Background
- Current situation
- Updating GHG research on intensive rice cultivation
- Conclusions

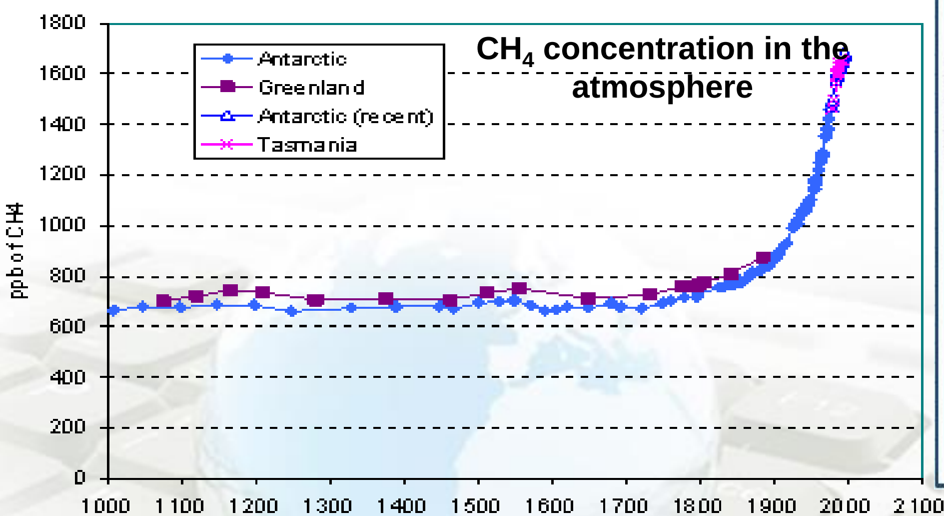


Source:
https://19january2017snapshot.epa.gov/climate-change-science/causes-climate-change_.html

Human activities have been the dominant cause of that warming



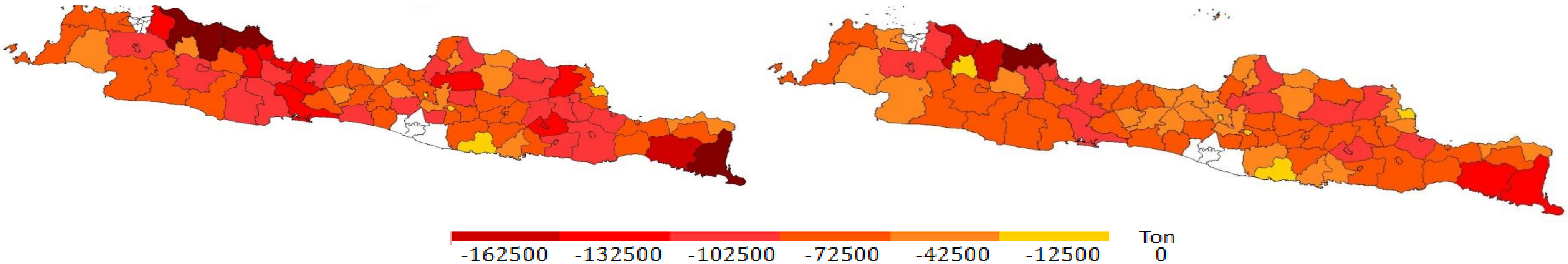
Concentration of CO_2 - Kototabang - Global - Mauna Loa (BMKG, 2019)



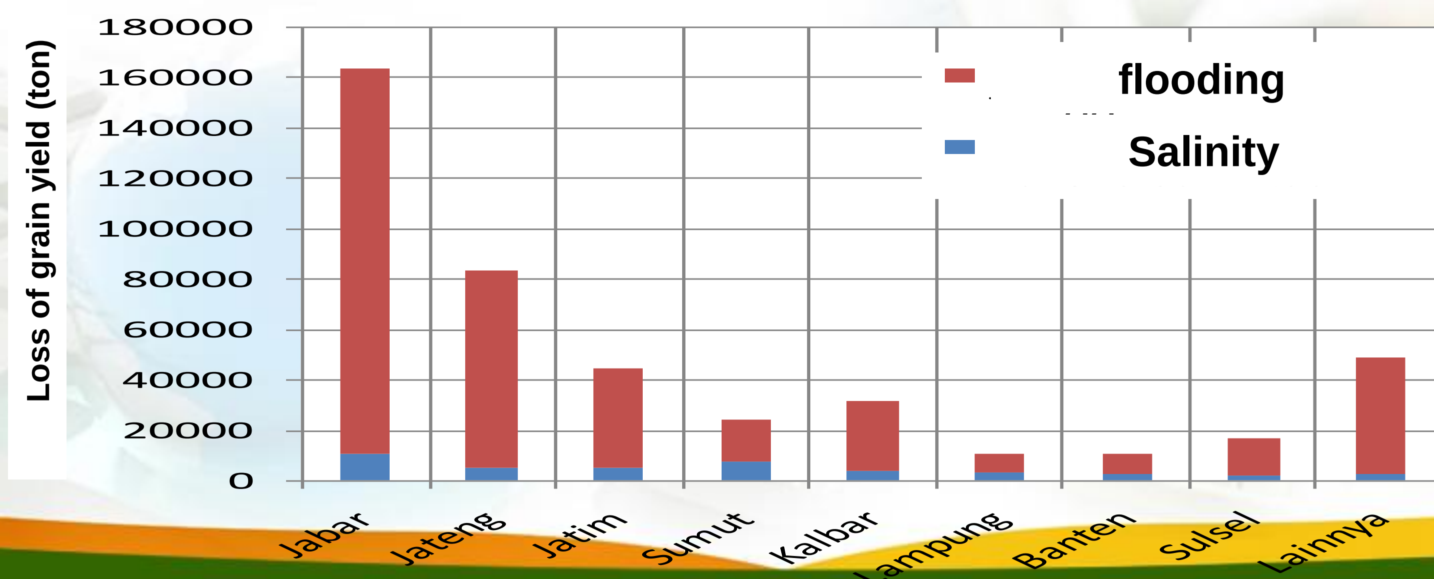
Methane content in the atmosphere obtained from measurements in glaciers in Antarctic and Greenland and in environmental samples collected in Tasmania (Alvim CF, 2006)

Impact of Climate change

Without the increase of CO_2 | **With the increase of CO_2**



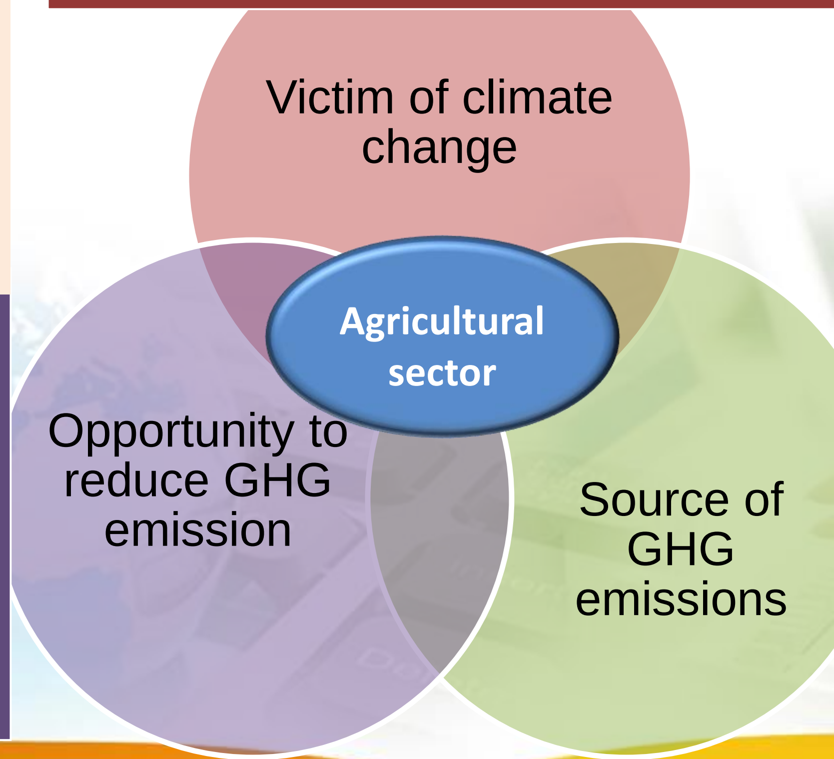
Map of of yield loss. It was expected that 42.500-162.500 ton yield loss from paddy field in Java due to land conversion and global warming (the rise of CO_2 concentration) → salinity by 2025 (Source : KP3I, 2010). The highest loss will be found in the northern part of West Java (Indramayu, Karawang and Subang)



Agricultural position on climate change

- Vulnerable ➔ victim of cc ➔ need adaptation tech.
- Source of GHG emission ➔mitigation approach

- Yield loss
- Pest and diseases infestation
- Flood and drought



- Annual crop absorb CO_2
- Land and crop management reduce CH_4, CO_2 and N_2O emissions

- Paddy field and livestock (CH_4 emission)
- Peatland (CO_2 emission)

Emission reduction targets and sector contributions for achievement of target (in percentage)

Sector	Emission Reduction Target by 2020[1]		Emission Reduction Target by 2030[2]	
	26% (Uncondi-tional)	41% (Condi-tional)	29% (Uncondi-tional)	38% (Condition-al)
Forestry and peatland	87.62	87.38	59.31	60.15
Waste	6.26	6.56	1.31	2.61
Energy and Transportation	4.95	4.71	37.93	36.61
Agriculture	1.04	0.93	1.10	0.34
Industry	0.13	0.42	0.34	0.29
Total	100.00	100.00	100.00	100.00

Source: [1]Presidential Regulation No.61/2011, [2]MoEF (2016)

Kyoto Protocol
2008-2012

Transition Period
2013-2020

Paris Agreement
2020-2030

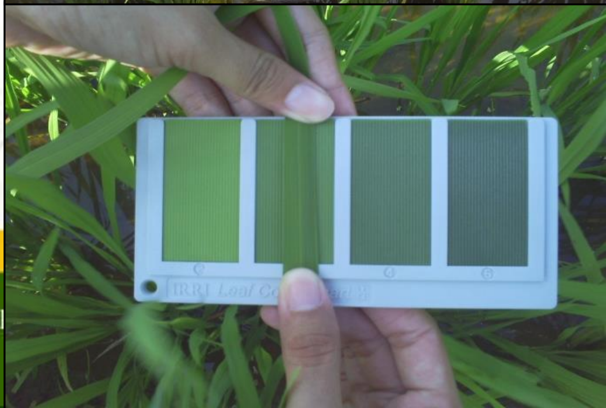
Indonesia voluntary emission reduction 26-41%

Indonesia NDC 29% + 41%

- In an effort to achieve food security, the Ministry of Agriculture made a policy of agricultural development by preparing food self-sufficiency program embodied with **UPSUS PAJALE (Special Effort of Increasing Productivity of *Rice*, Corn and Soybean)** → *land optimization: arrange of planting season, rehabilitation of tertiary irrigation, subsidize agricultural machineries, seeds and fertilizers etc.*
- Intensification can be conducted with planting the rice field more than 3 times in Java or 2 times in suboptimal areas.
- There is a question that the intensity of rice field with the approach of environmentally safe agriculture such as the integrated rice crop management system (ICM) will enhance greenhouse gas emission due to the organic inputs given to the soil.

Treatments on Intensive rice cultivation research

1. Convensional (farmer method, continuos flooded)
2. Convensional (farmer method, intermittent irrigation)
3. ICM (integrated crop management), continuos flooded
4. ICM use intermittent irrigation
5. SRI (System of Rice Intensification), use intermittent irrigation
6. Semi-SRI (anorganic and organic fertilizer use, intermittent irrigation)

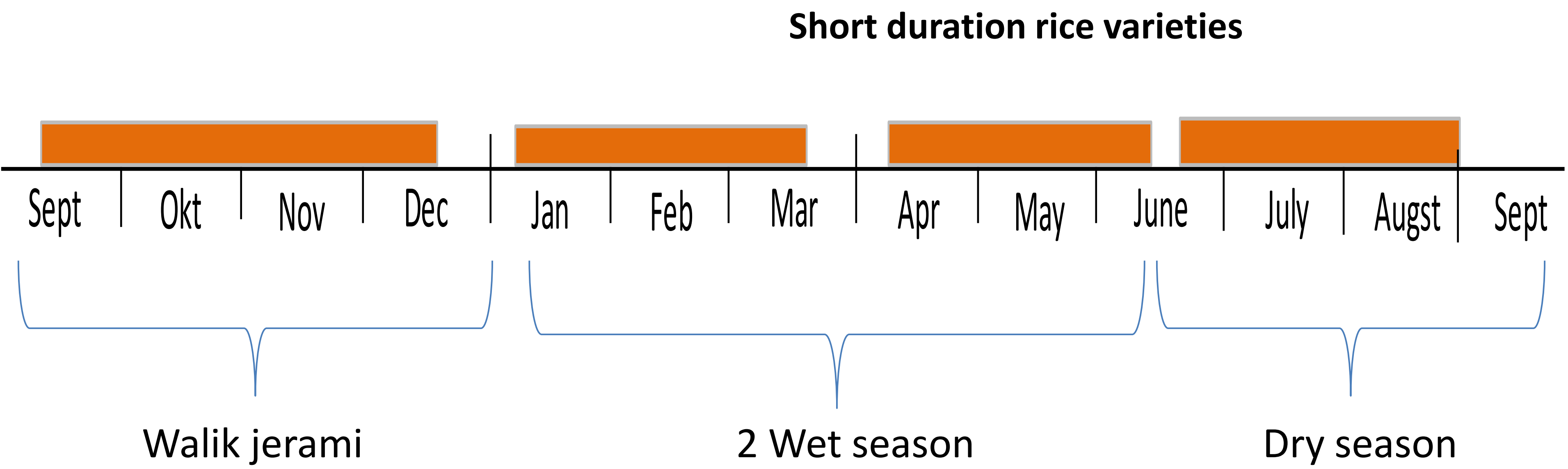


Treatments:

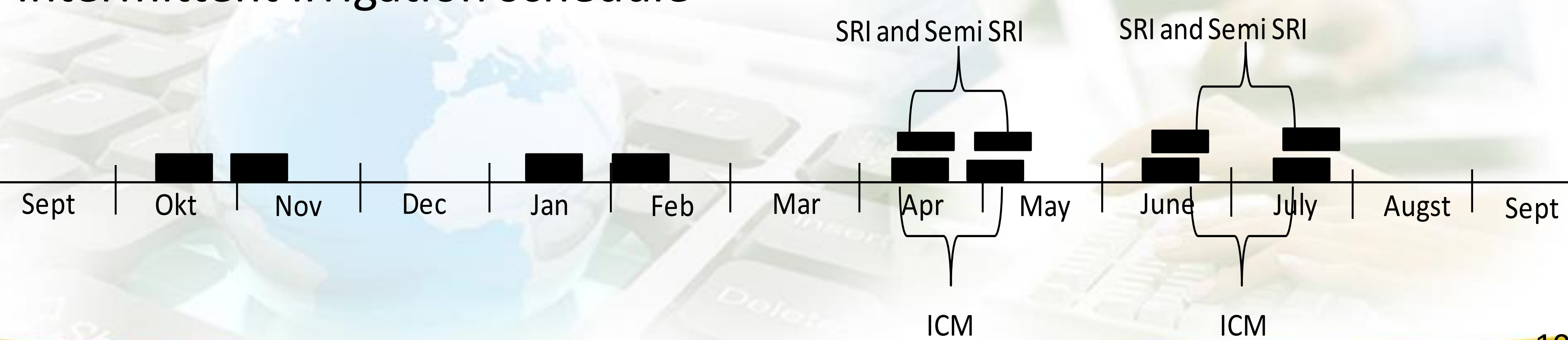
Treatments	Inorganic Fertilizer (kg/ha)			Organic Fertilizer (t/ha)	Water management	Age of seedling (DAS)	Seedling/ hole	Plant spacing (cm)
	N	P	K					
Convensional , continuos flooded	120	90	90	-	continuos flooded	25	> 1	20 x 20
Convensional, intermittent	120	90	90	-	intermittent	25	> 1	20 x 20
ICM, continuos flooded	BWD	90	90	2	continuos flooded	15	1	legowo 2:1
ICM, intermittent	BWD	90	90	2	intermittent	15	1	legowo 2:1
SRI, intermittent	-	-	-	15	intermittent	10	>1	30 x 30
Semi SRI, intermittent	60	45	45	15	intermittent	10	>1	30 x 30

BWD: leaf colour chart

Planting Schedule



Intermittent Irrigation schedule



The study was conducted at experimental farm of IAERI during 4 consecutive rice growing seasons: (September-December: RS), (January-March: RS), (March-June: DS) and (June-September: DS) .

Ciherang

Silugonggo

PS I

PS II

Dodokan

PS III

PS IV

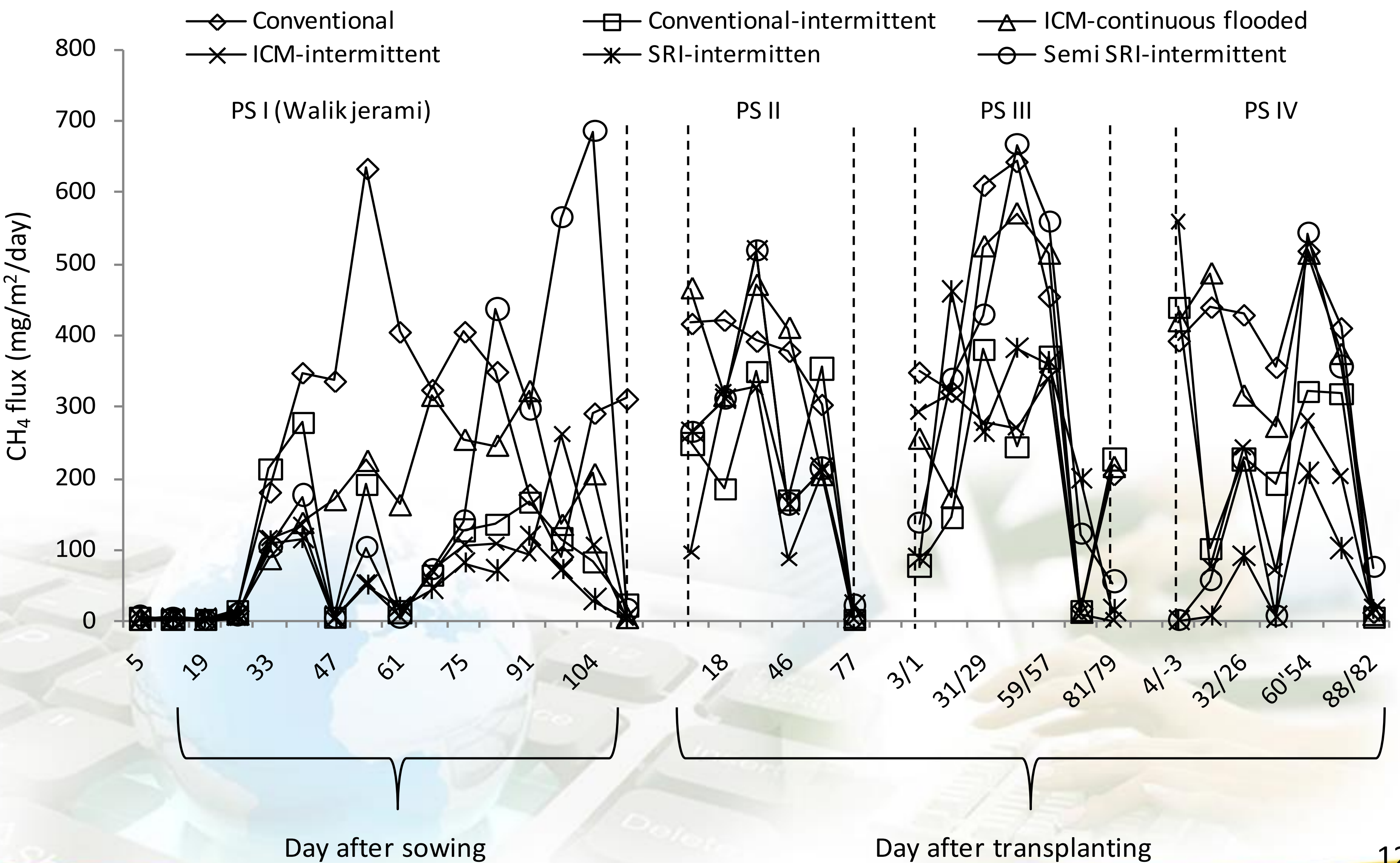
Inpari I

Sept | Oct | Nov | Des | Jan | Feb | March | Apr | May | June | July | August | Sept

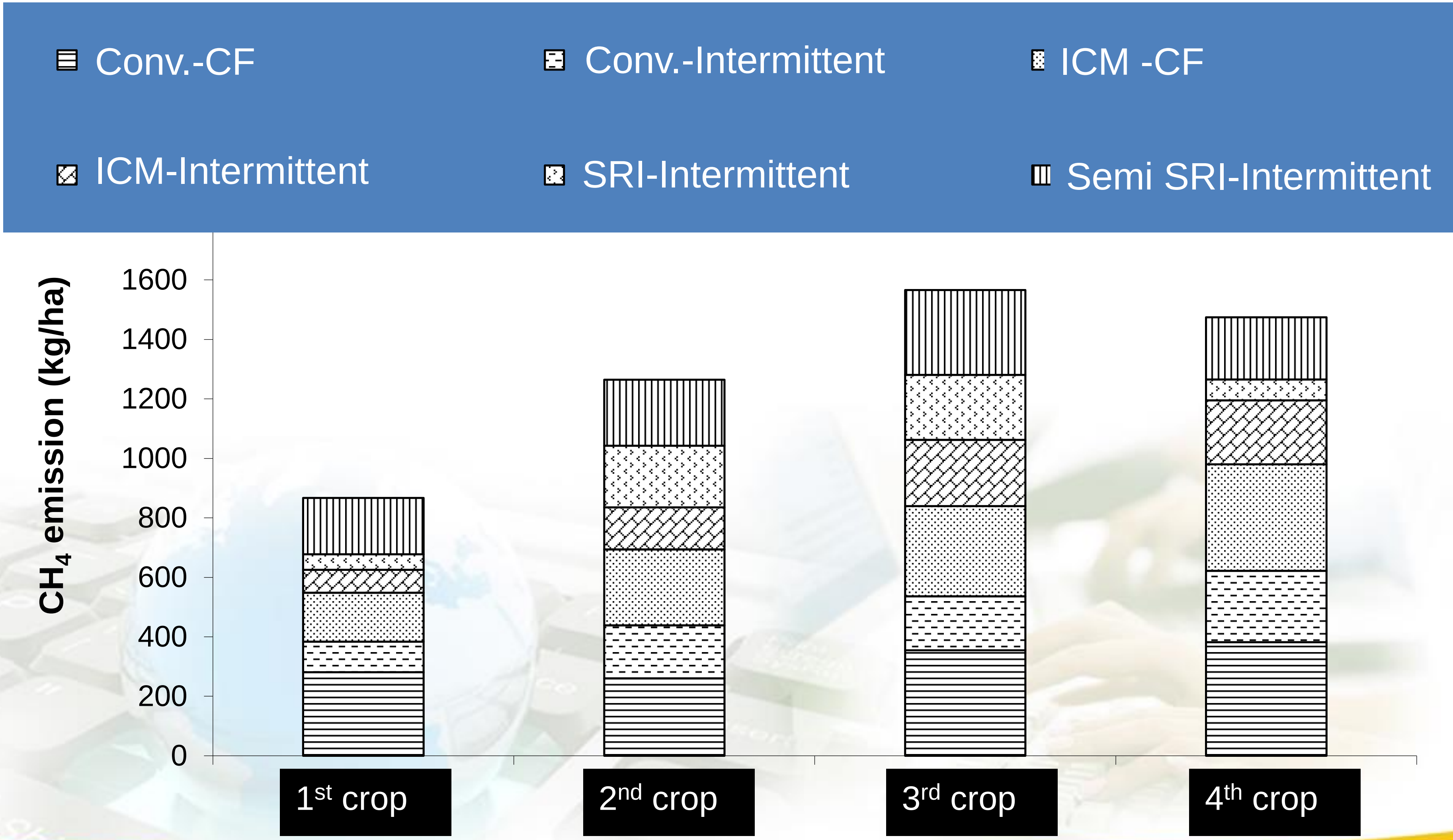
Planting date: 4 Sept Age of seedling:15 days (Conv. and ICM), 10 days (SRI, Semi SRI) Harvest date: 30 Des 2009	Planting date: 31 Des 2009 Age of seedling:15 days (Conv. and ICM), 10 days (SRI, Semi SRI Harvest date: 23 March 2010	Planting date :26 Jan (Conv. and ICM), 28 Jan (SRI, Semi SRI) Age of seedling:15 days (Conv. and ICM), 10 days (SRI, Semi SRI Harvest date: (Conv. and ICM) 8 June; (SRI, Semi SRI) : 15 June	Planting date : 10 June (Conv. and ICM), 16 June (SRI, Semi SRI) Age of seedling:15 days (Conv. and ICM), 10 days (SRI, Semi SRI Harvest date: (Conv. and ICM): 8 Sept (SRI, Semi SRI) : 14 Sept



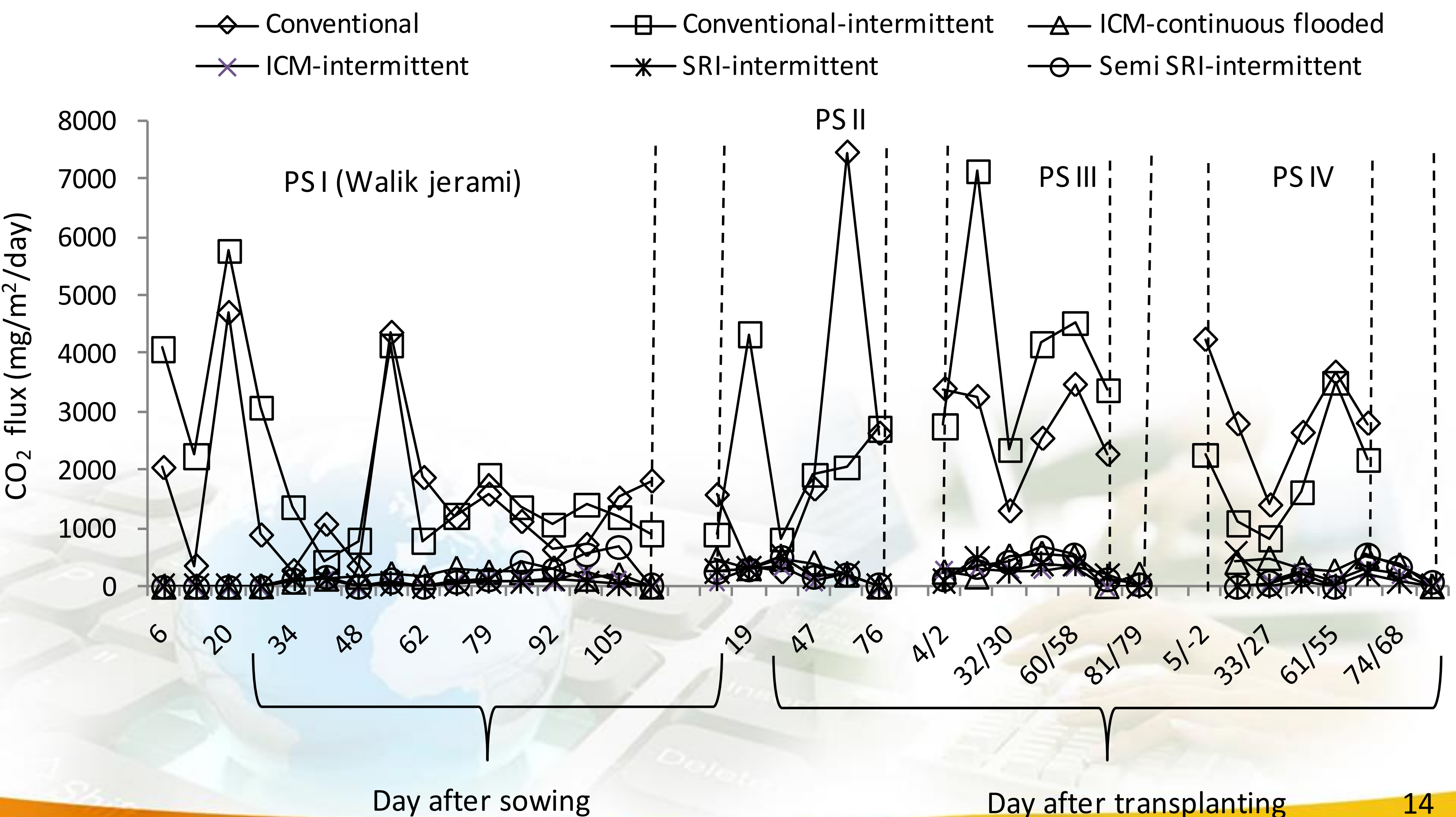

Methane fluxes



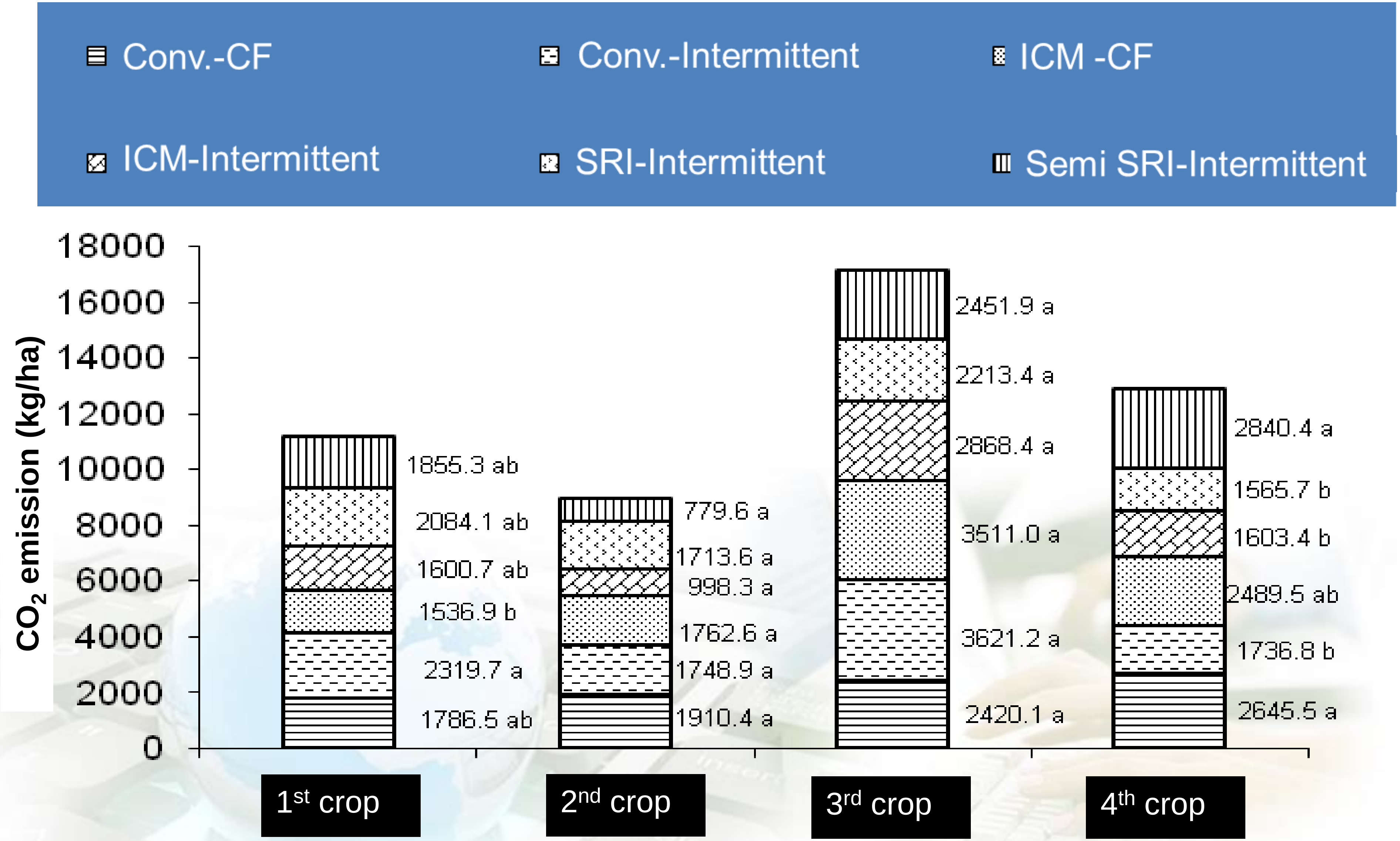
Methane emission per season



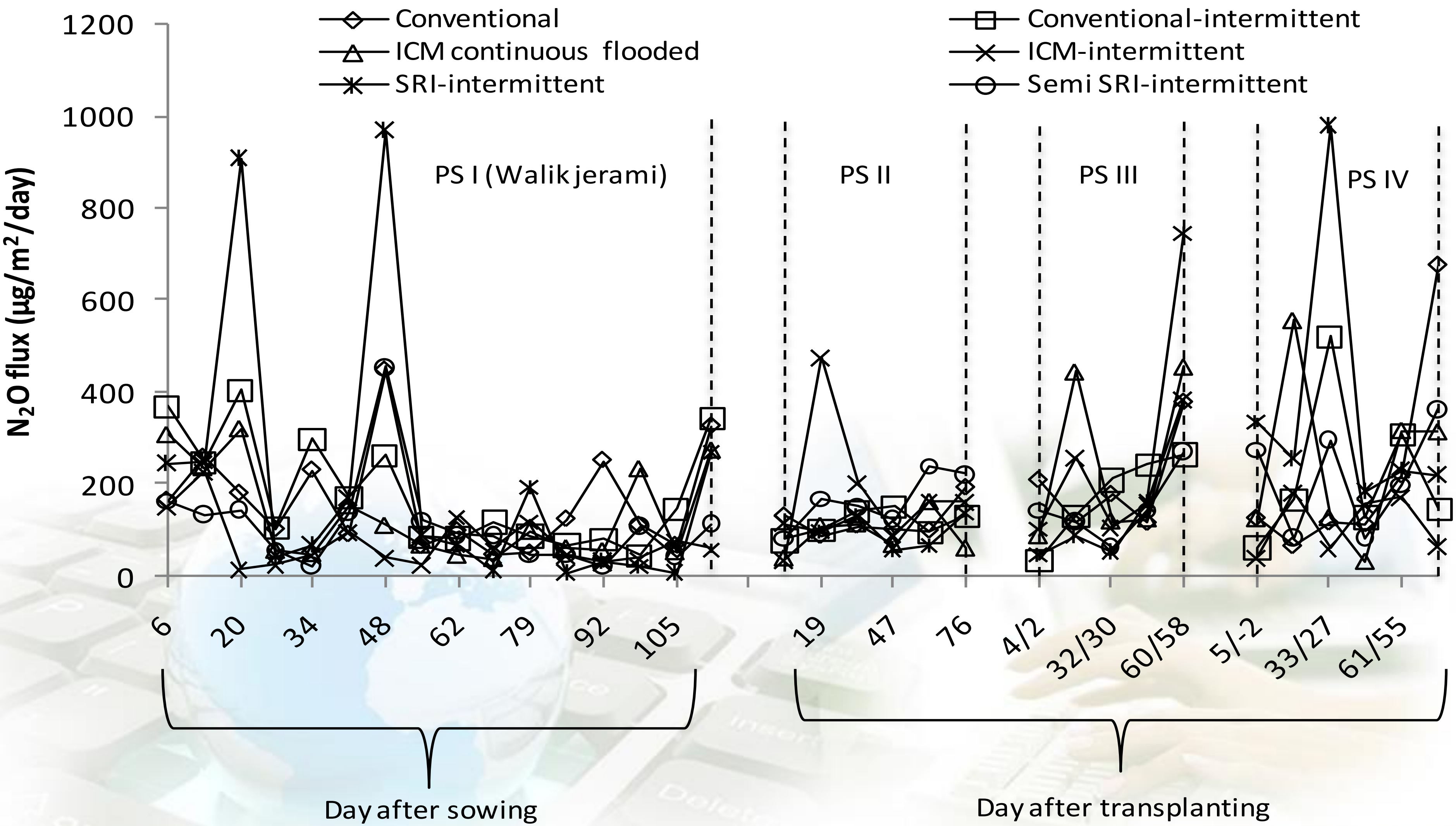
Carbondioxide fluxes



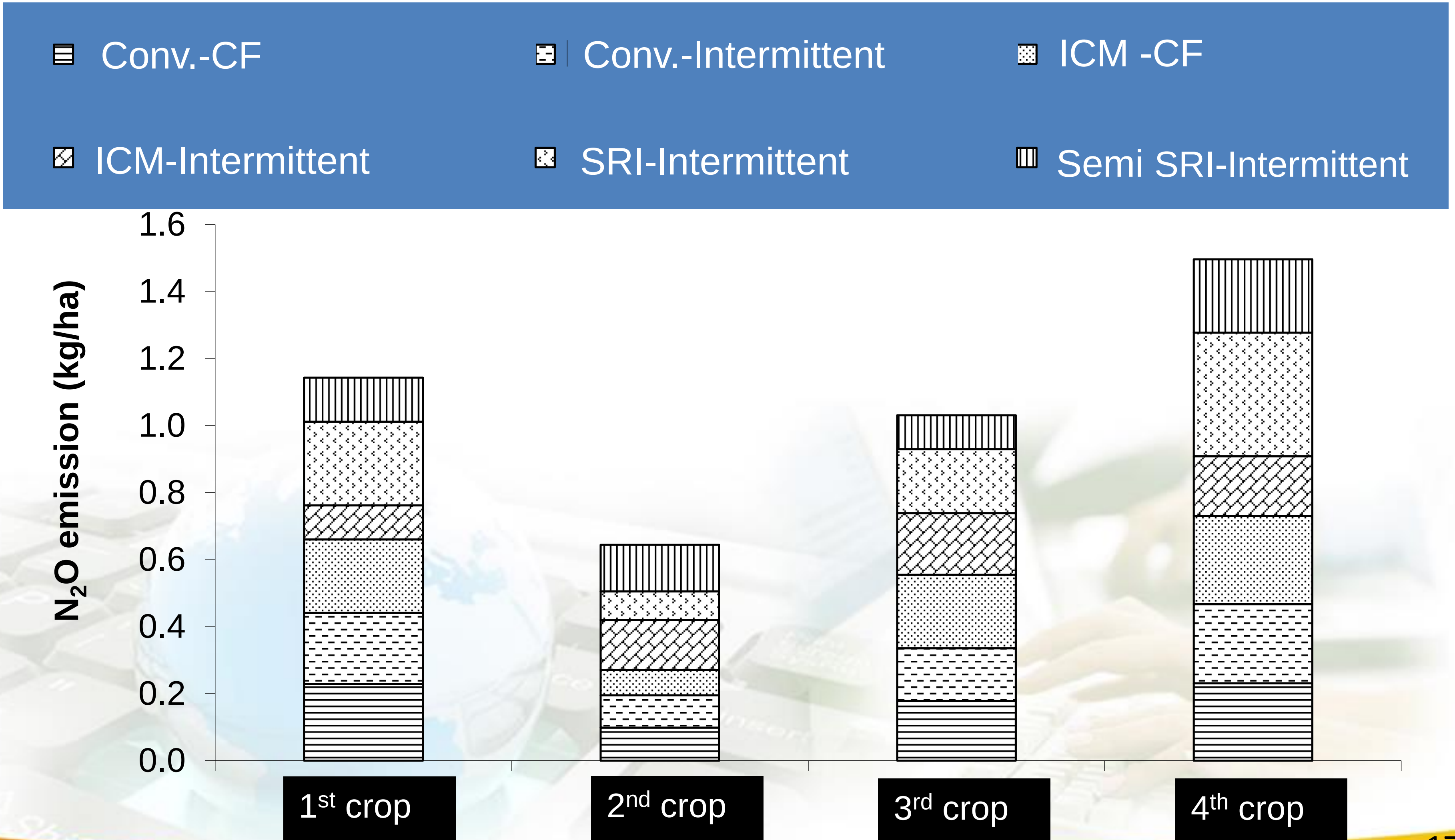
CO_2 emission per season



Nitrous oxide fluxes



N_2O emission per season



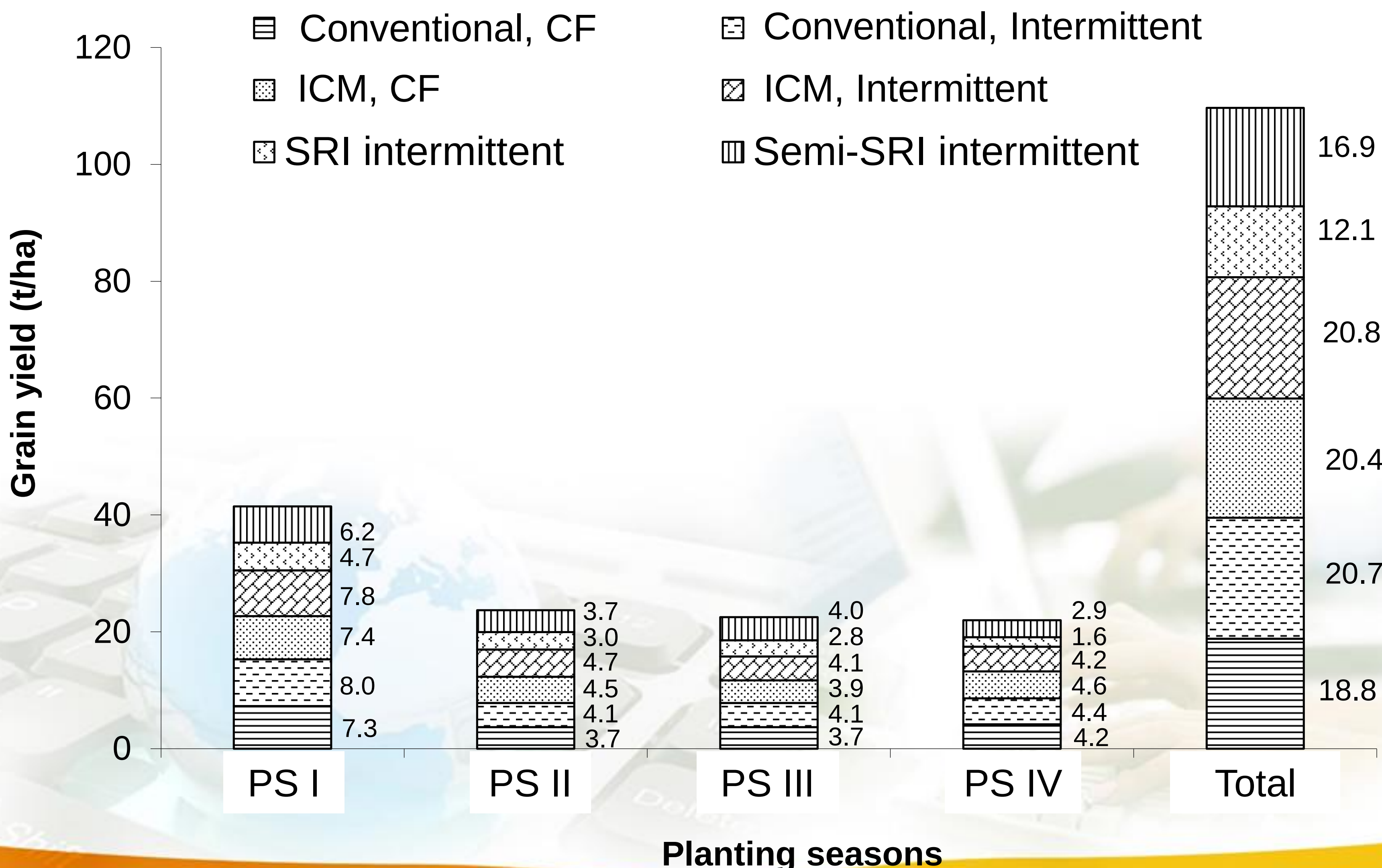
Global Warming Potential

Treatments	GWP ($t\ CO_2$-eq/ha)				Total of GWP ($t\ CO_2$-eq/ha/year)	Yield (t/ha/year)	Index of yield/ GWP
	PS I	PS II	PS III	PS IV			
Conventional	8.3	7.9	10.6	11.5	38.4	18.8	0.49
Conventional-intermittent	4.7	5.6	7.8	7.3	25.8	20.7	0.80
ICM-continuous flooded	5.4	7.6	10.5	10.8	34.4	20.4	0.59
ICM-intermittent	3.4	4.3	8.0	6.6	22.4	20.8	0.93
SRI-intermittent	3.4	6.5	7.3	3.3	20.4	12.1	0.59
Semi SRI-intermitternt	5.2	5.9	9.0	7.7	28.9	16.9	0.58

Organic content before and after intensive rice cultivation

Treatments	Organic content (%)			
	Before		After	
	C	N	C	N
Conventional, CF	0.75	0.20	0.45	0.03
Conventional, Intermittent	0.63	0.13	0.42	0.03
ICM, CF	0.77	0.08	0.47	0.04
ICM, Inttermittent	0.73	0.07	0.43	0.03
SRI, Intermittent	0.61	0.06	0.41	0.03
Semi SRI, Intermittent	1.06	0.04	0.30	0.03

Grain yield


Conventional, CF
Conventional, Intermittent
ICM, CF
ICM, Intermittent
SRI intermittent
Semi-SRI intermittent
Grain yield (t/ha)
120
100
80
60
40
20
0
6.2
4.7
7.8
7.4
8.0
7.3
3.7
3.0
4.7
4.5
4.1
3.7
4.0
2.8
4.1
3.9
4.1
3.7
2.9
1.6
4.2
4.6
4.4
4.2
16.9
12.1
20.8
20.4
20.7
18.8
PS I
PS II
PS III
PS IV
Total
Planting seasons

Conclusions

- Intensification is one of the way to increase rice production
- Intermittent irrigation could reduce GHG emission whatever the crop management .

Thank you

Terimakasih