Country-specific Emission Factors for Rice Cultivation in the Philippines

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Outline

- Concerns with the EFs used in 1994 inventory
- The IRRI Project on methane measurement
- How country-specific EFs were developed
- Views about the newly developed EFs
- Conclusion and Recommendation

Concerns with 1994 EFs in Rice

- For the Philippine NC1, the EFs used were:
  - For irrigated: 2.3 kg/ha/day
  - For rainfed: 0.4 kg/ha/day
  - These EFs were based on IRRI Methane Project **preliminary** results in 1994
- The 1996 IPCC default value = 2 kg/ha/day
- However, the IRRI Methane Project continued the measurements until 1999; thus **more data and information were generated**

The IRRI International Research Program on Methane Emissions from rice fields in Asia

- Automated closed chambers measuring system: 24 hours/day for the whole growing season; 2-3 cropping seasons.
- Five countries (8 stations):
  - China (2)
  - India (2)
  - Indonesia (1)
  - Philippines (2)
  - Thailand (1)

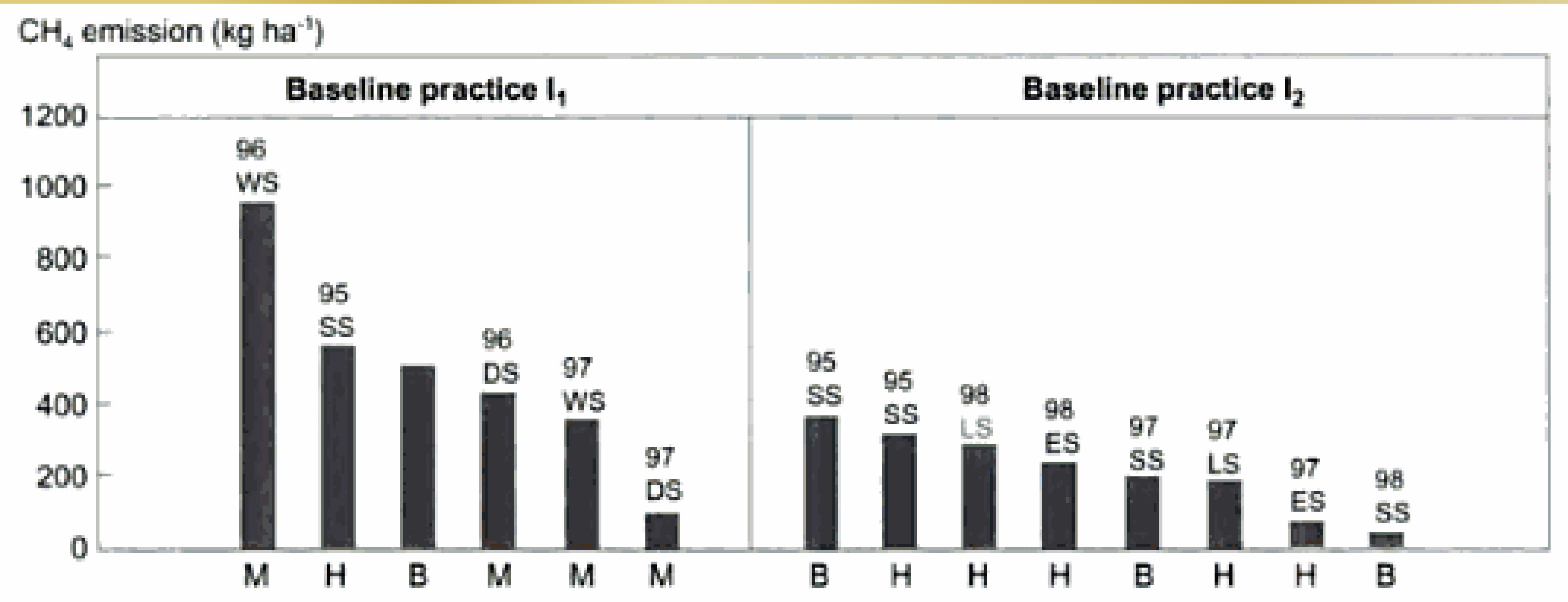
All findings were published in a book "**Methane Emissions from Major Rice Ecosystems in Asia**", Development in Plant and Soil Sciences, Kluwer Academic Publishers

Characterization of the experimental sites

Table 1. Characterization of experimental sites

Station, country	Ecosystem	Geographic coordinates	Soil properties				Detailed information (this issue)
			Texture	pH	Org C (%)	Total N (%)	
Beijing, China	Irrigated	39° 93′ N 116° 47 ′E	Silty clay loam	7.0	0.99	0.09	Wang et al.
Hangzhou, China	Irrigated	30° 23′ N 120° 20′ E	Silty clay	6.2	2.4	0.22	Lu et al.
New Delhi, India	Irrigated	20° 38′ N 70° 10′ E	Sandy clay loam	8.2	0.45	0.069	Jain et al.
Maligaya, Philippines	Irrigated	15° 67′ N 120° 88′ E	Silty clay	6.1	1.3	0.09	Corton et al.
Cuttack, India	Rainfed	20° 50′ N 86° 00′ E	Clay loam	7.0	0.54	0.048	Adhya et al.
Jakenan, Indonesia	Rainfed	6° 68′ S 111° 20′ E	Silty loam	4.7	0.48	0.05	Setyanto et al.
Los Baños, Philippines	Rainfed	14° 18′ N 121° 25′ E	Silty clay	6.3	1.5	0.14	Wassmann et al. Abao et al.
Prachinburi, Thailand	Deepwater	13° 92′ N 101° 25′ E	Clay	3.9	1.2	0.17	Chareonsilp et al.

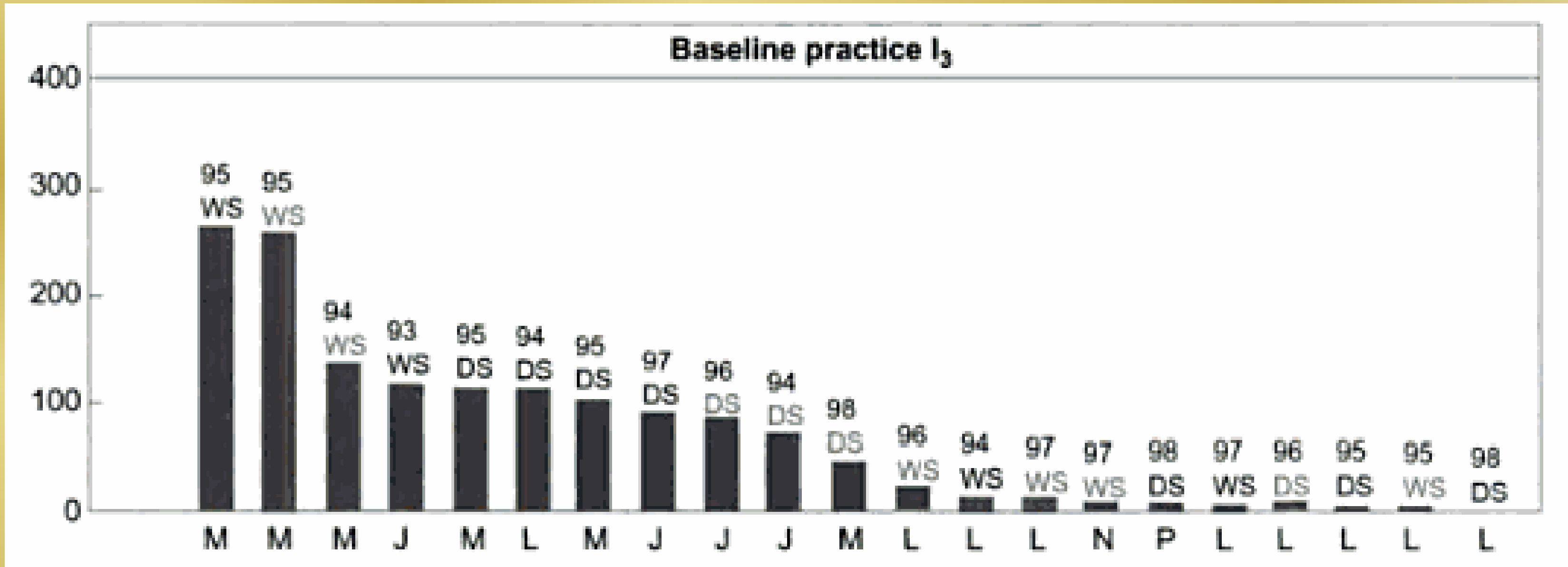
Seasonal CH4 Emissions under different baseline practices



I1 = continuous flooding with organic amendments
I2 = midseason drainage with organic amendments

Note: X-axis labels are first letters of Hangzhou, Beijing, and Maligaya.

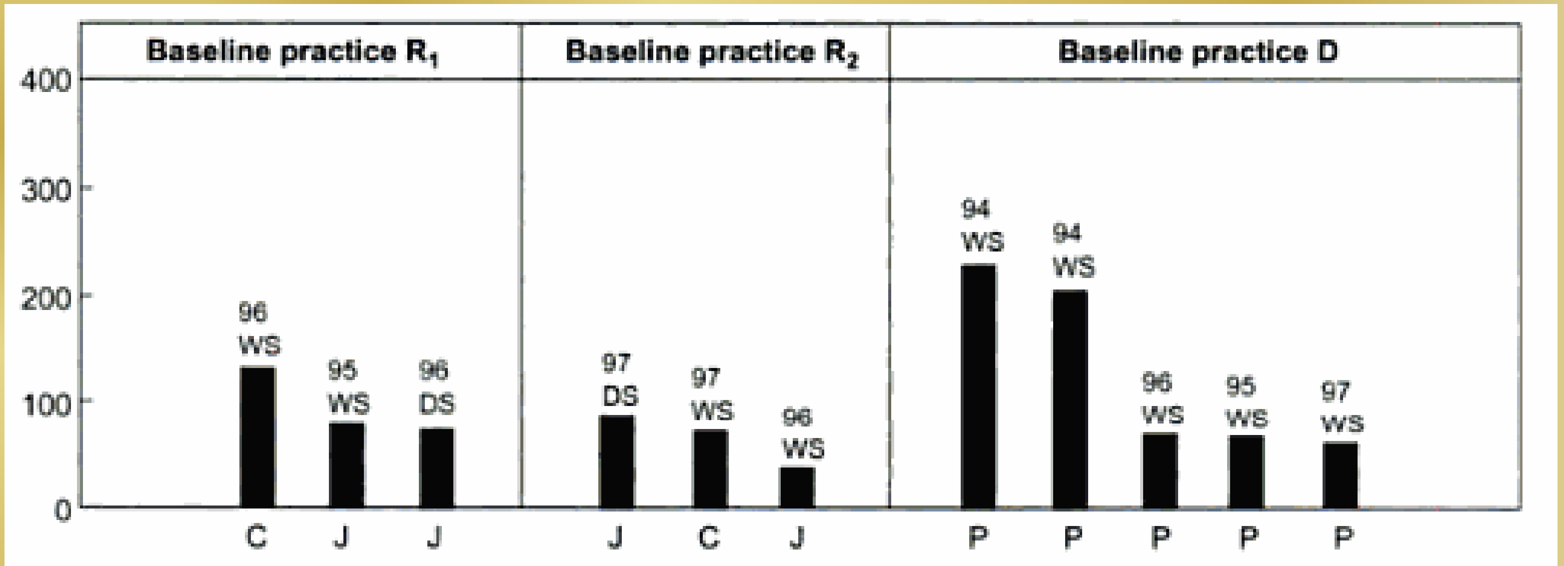
Seasonal CH4 Emissions under different baseline practices



I3 = continuous flooding, without organic amendments

Note: X-axis labels are first letters of Maligaya, Jakenan, Los Banos, New Delhi and Prachinburi.

Seasonal CH4 Emissions under different baseline practices



R1 = continuous flooding with organic amendments
R2 = midseason drainage with organic amendments

Note: X-axis labels are first letters of Cuttack, Jakenan, and Prachinburi.

What the IRRI Findings suggest?

EQUATION 5.1
CH_4 EMISSIONS FROM RICE CULTIVATION

$$CH_{4\ Rice} = \sum_{i,j,k} (EF_{i,j,k} \bullet t_{i,j,k} \bullet A_{i,j,k} \bullet 10^{-6})$$

Where:

$CH_{4\ Rice}$ = annual methane emissions from rice cultivation, Gg CH_4 yr^{-1}

EF_{ijk} = a daily emission factor for *i*, *j*, and *k* conditions, kg CH_4 ha^{-1} day^{-1}

t_{ijk} = cultivation period of rice for *i*, *j*, and *k* conditions, day

A_{ijk} = annual harvested area of rice for *i*, *j*, and *k* conditions, ha yr^{-1}

i, *j*, and *k* = represent different ecosystems, water regimes, type and amount of organic amendments, and other conditions under which CH_4 emissions from rice may vary

EQUATION 5.2
ADJUSTED DAILY EMISSION FACTOR

$$EF_i = EF_c \bullet SF_w \bullet SF_p \bullet SF_o \bullet SF_{s,r}$$

Where:

EF_i = adjusted daily emission factor for a particular harvested area

EF_c = baseline emission factor for continuously flooded fields without organic amendments

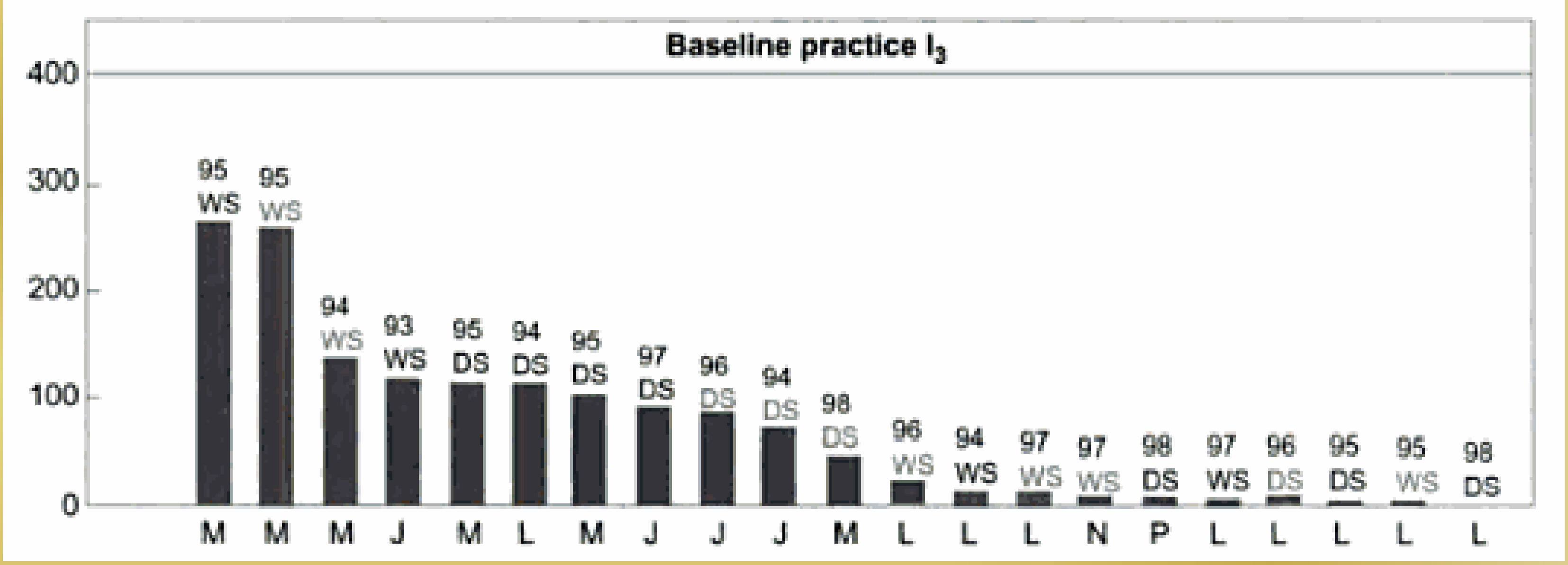
SF_w = scaling factor to account for the differences in water regime during the cultivation period (from Table 5.12)

SF_p = scaling factor to account for the differences in water regime in the pre-season before the cultivation period (from Table 5.13)

SF_o = scaling factor should vary for both type and amount of organic amendment applied (from Equation 5.3 and Table 5.14)

$SF_{s,r}$ = scaling factor for soil type, rice cultivar, etc., if available

I3 = continuous flooding, without organic amendments

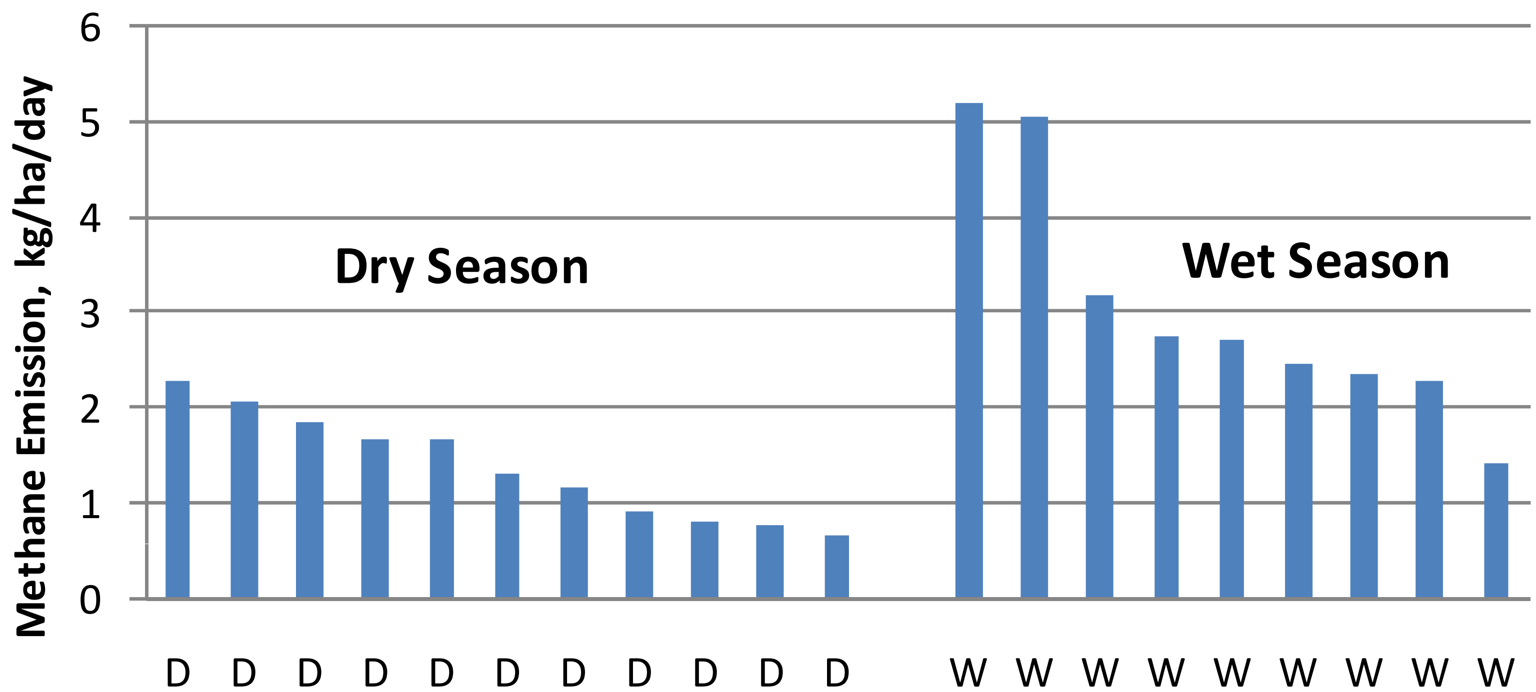


Note: X-axis labels are first letters of Maligaya, Jakenan, Los Banos, New Delhi and Prachinburi.

Table 1. Summary of baseline emissions (i.e. continuously flooded and without organic amendment)

Station	Year	Season	Cultivar	Mean Emission (mg/m2/d)	Mean Emission (kg/ha/d)	Mean DS (kg/ha/d)	Mean WS (kg/ha/d)
Maligaya	1994	Dry	IR72	90.00	0.90	0.86	
			IR72	64.00	0.64		
			IR64	74.00	0.74		
			IR64	114.00	1.14		
	1994	Wet	IR72	269.00	2.69		2.43
			IR72	232.00	2.32		
			IR72	227.00	2.27		
			IR72	243.00	2.43		
	1995	Dry	IR72	184.00	1.84	1.72	
			IR72	166.00	1.66		
			IR72	205.00	2.05		
			IR72	131.00	1.31		
	1995	Wet	IR72	503.00	5.03		3.69
			IR72	317.00	3.17		
			IR72	516.00	5.16		
			IR72	139.00	1.39		
	1996	Dry	IR72	165.00	1.65	1.65	
		Wet	IR72	272.00	2.72		2.72
	1998	Dry	PSBRc28	79.00	0.79	0.79	
Los Banos	1994	Dry	IR72	227.00	2.27	2.27	
				Mean Emission	**2.11**	**1.46**	**2.95**

CH4 Emissions by season



EFs for rice cultivation in the Philippines

Variety	Water Management	Organic amendment	Cropping Season	Emission Factor, kg/ha/day
IR72	Continuous flooding	none	dry season	1.46 (0.64 - 2.27)
IR72	Continuous flooding	none	wet season	2.95 (1.39 -5.16)

Source: Corton et al. 2000; Wassmann et al. 2000

TABLE 5.11

DEFAULT CH_4 BASELINE EMISSION FACTOR ASSUMING NO FLOODING FOR LESS THAN 180 DAYS PRIOR TO RICE CULTIVATION, AND CONTINUOUSLY FLOODED DURING RICE CULTIVATION WITHOUT ORGANIC AMENDMENTS

	Emission factor	Error range
CH_4 emission (kg CH_4 ha^{-1} d^{-1})	1.30	0.80 - 2.20

Source: Yan et al., 2005

Adjusted country-specific EFs

Cropping Season	Rice Ecosystem	SFp	SFw	SFo	EFc kg/ha/day	EFi kg/ha/day
Dry season	Irrigated	1.0	0.57	1.27	1.46	1.05
	Rainfed	1.0	0.27	1.17		0.46
Wet season	Irrigated	1.0	0.57	1.76	2.95	2.97
	Rainfed	1.0	0.27	1.54		1.23

CH4 Emission from Rice Cultivation in the Philippines, 2000

MODULE			AGRICULTURE				
SUBMODULE			METHANE EMISSIONS FROM FLOODED RICE FIELDS				
WORKSHEET			4-2				
SHEET			1 OF 1				
COUNTRY			Philippines				
YEAR			2000				
			A	B	C	D	E
Water Management Regime			Harvested Area (1000 ha)	Season length, days	Baseline emission factor for continuously flooded field without organic amendment (EFc) (kg/ha/day)	Adjusted daily emission factor (EFi) (kg/ha/day)	CH_4 Emissions (Gg)
							E = (A x B x D)/1000
Irrigated							0.00
	Continuously flooded	dry season	1265.742	114	1.46	1.05	151.51
		wet season	1437.612	114	2.95	2.97	486.75
Rainfed	dry season		471.881	113		0.46	24.53
	wet season		862.85	113		1.23	119.93
Deep Water	Water Depth 50-100 cm						0.00
	Water Depth > 100 cm						0.00
Totals			**4,038.085**				**782.71**

Conclusion

- We are confident in using the new country-specific EFs for rice cultivation in the Philippines
- We believe that they have improved our estimates of CH4 emissions from rice field since we were also able to disaggregate by season
- We think that other countries could benefit from the IRRI findings in generating CSEF and in improving their estimate of methane emissions.

Thank you!