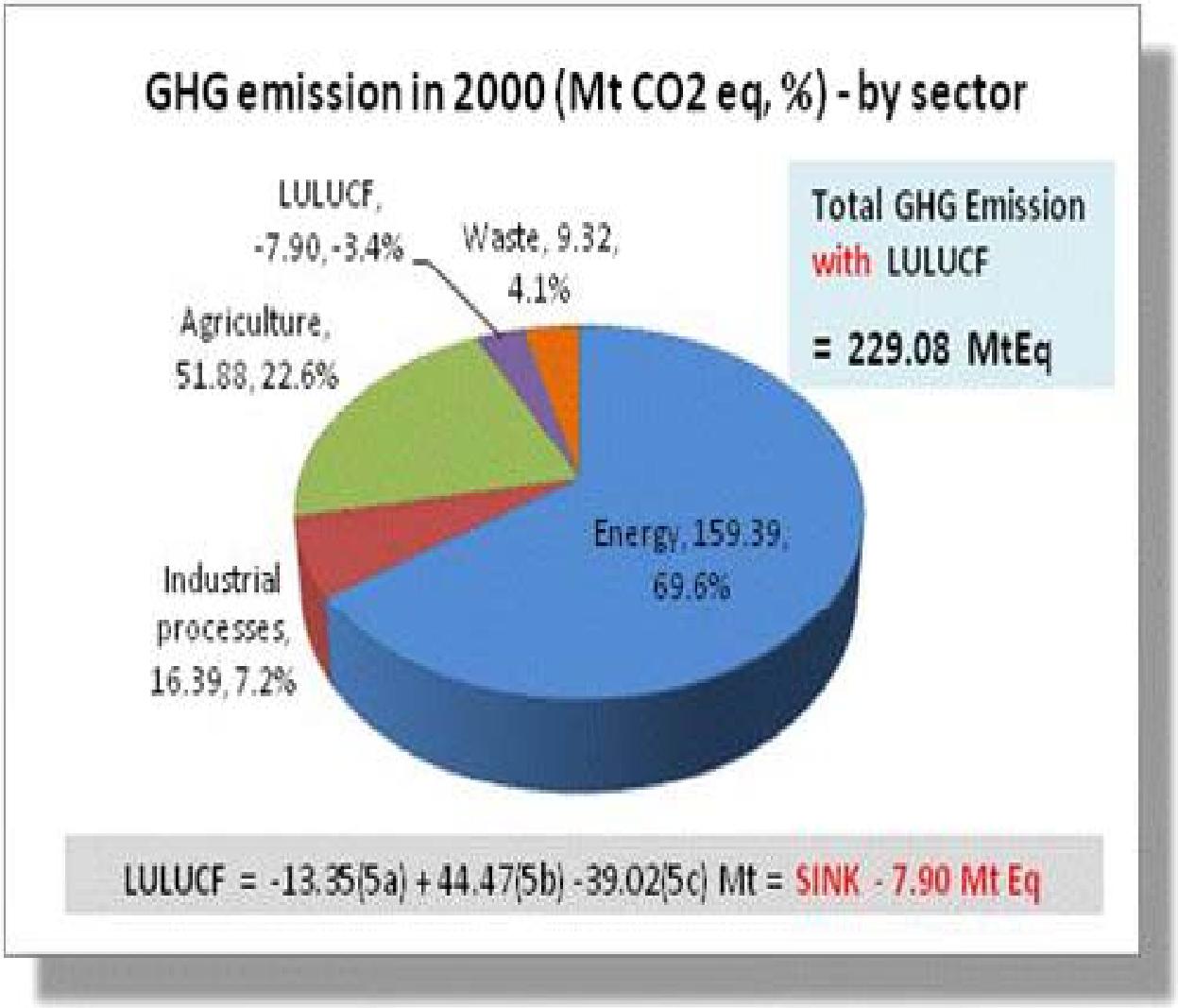
Greenhouse gas emissions, mitigation and soil carbon sequestration potential for Thailand paddy fields

Amnat Chidthaisong and Sirintornthep Towprayoon

The Joint Graduate School of Energy and Environment, and the Commission of Higher Education's Center for Energy Technology and Environment, King Mongkut's University of Technology Thonburi, Thailand

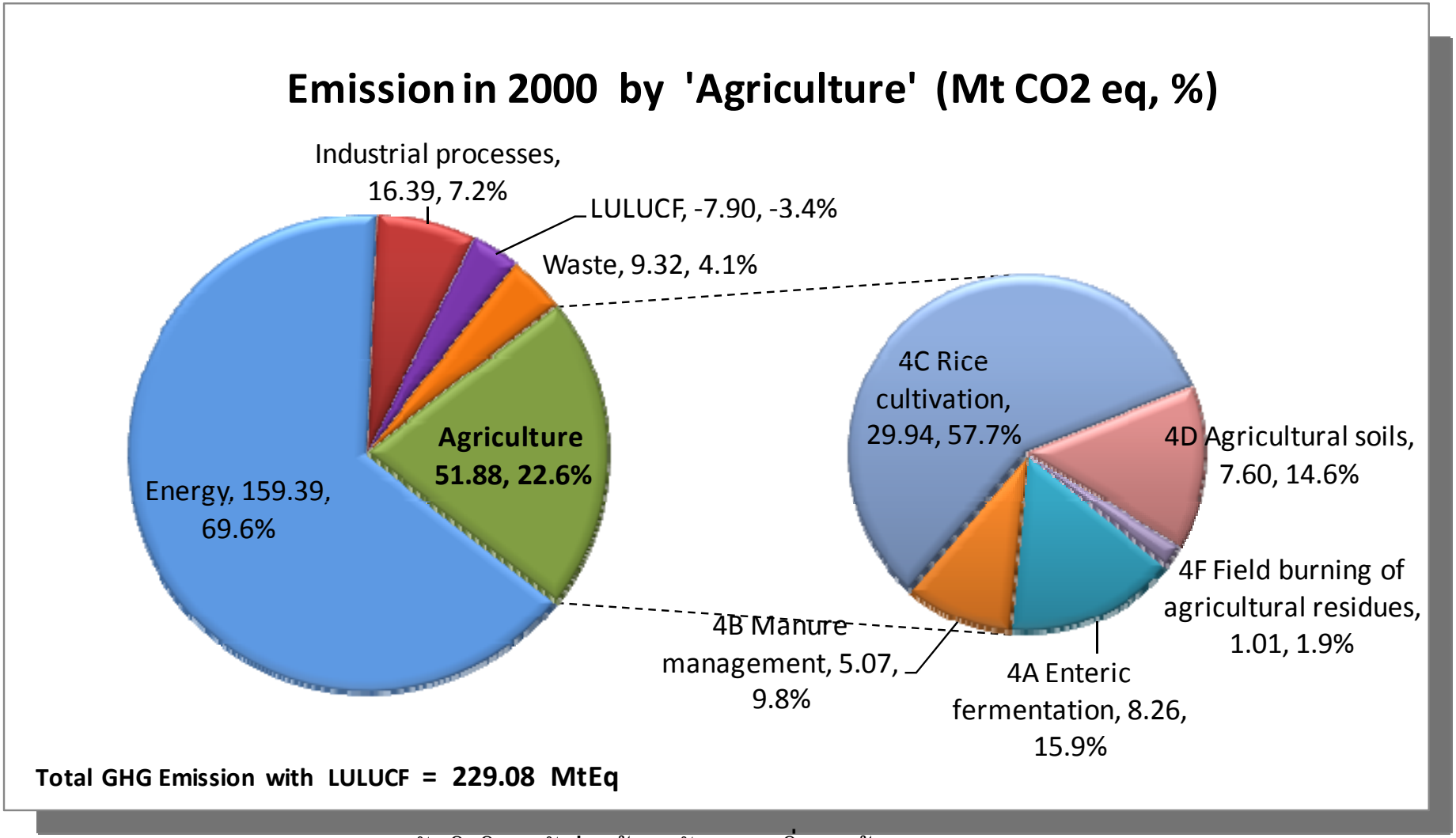
Thailand agriculture and greenhouse gas emissions



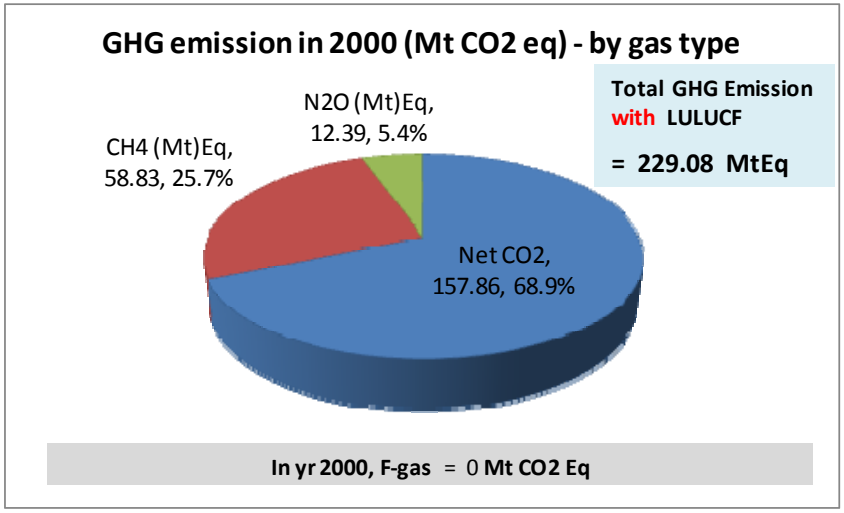
National total including LULUCF = 229.09 Mt CO_2e

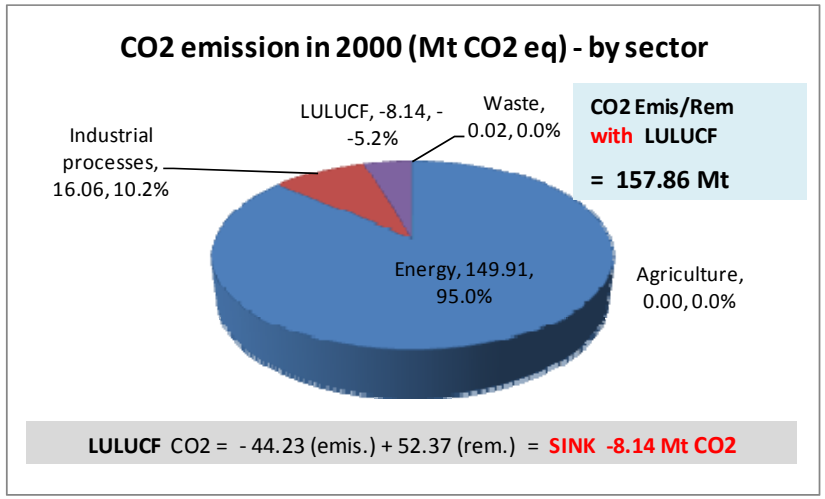
Emission in 2000 (Mt CO_2e,%)

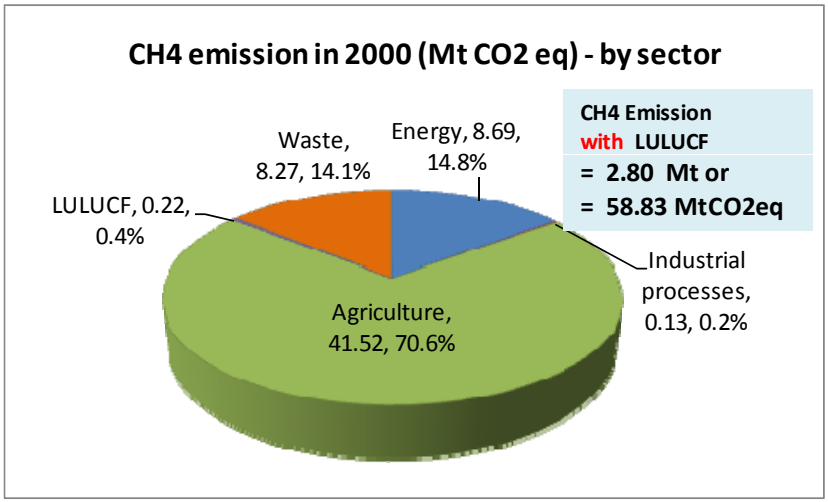
Greenhouse gas emission in 2000 from 'Agriculture'

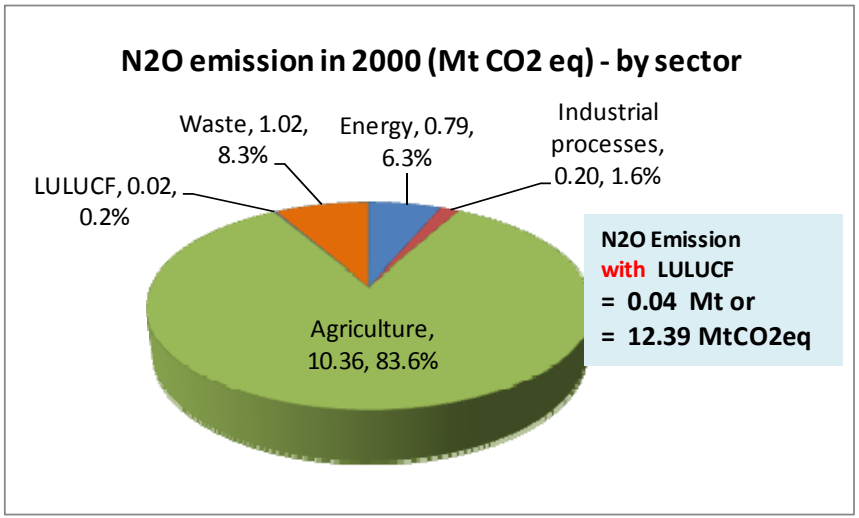


Emission in 2000 by gas types

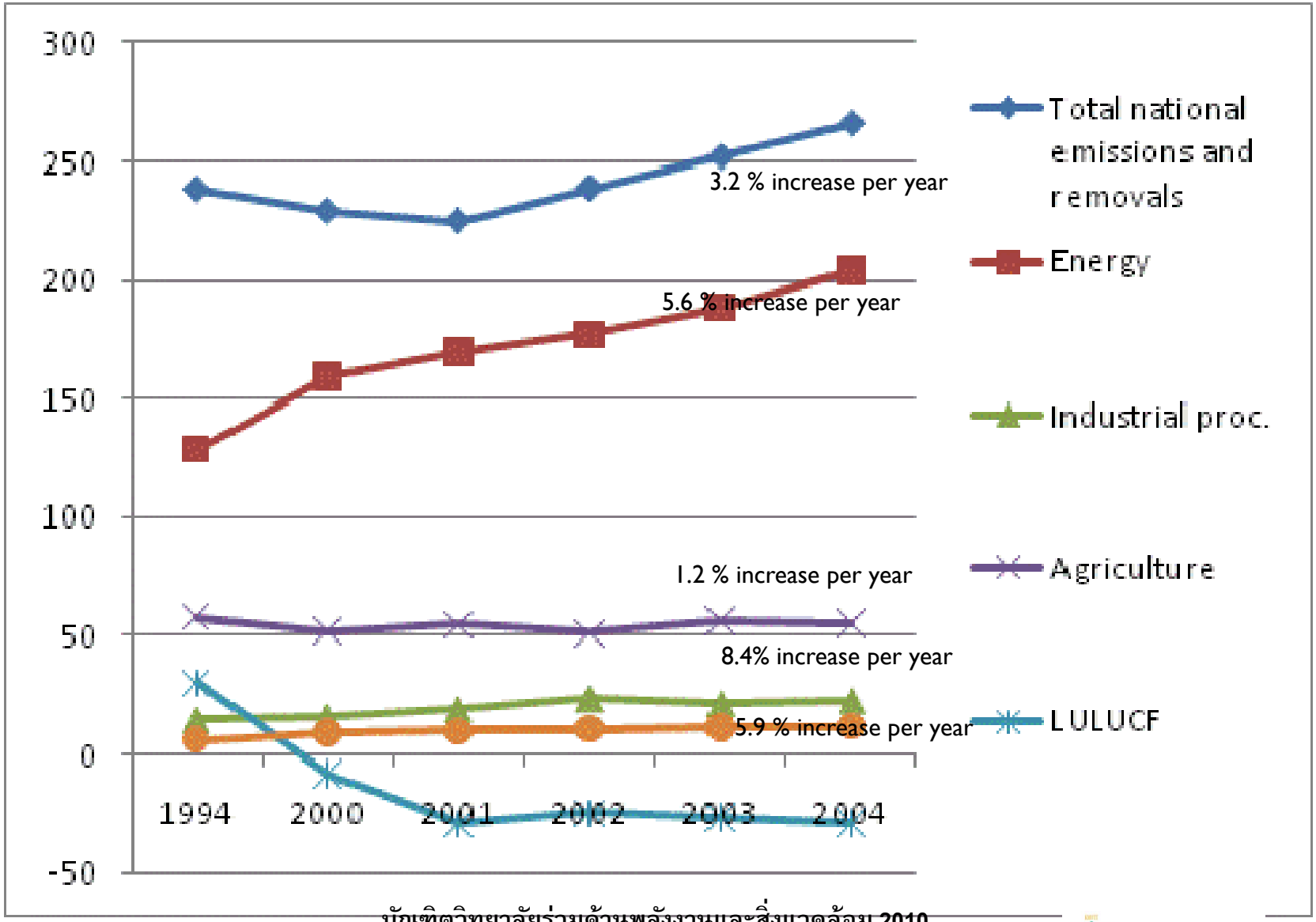


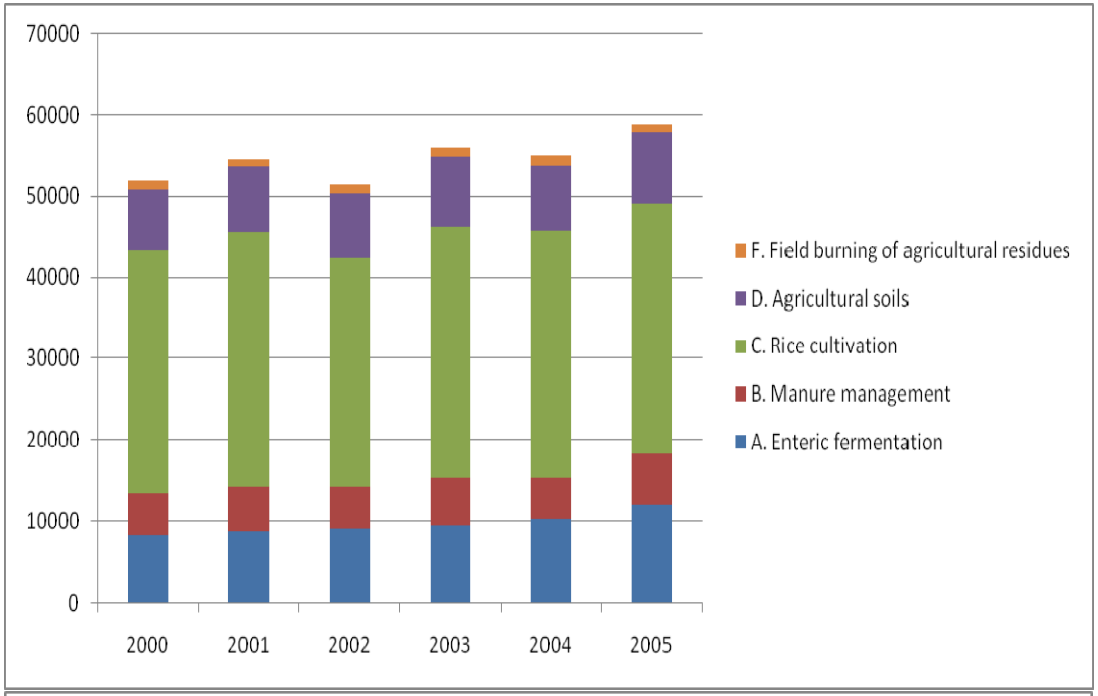


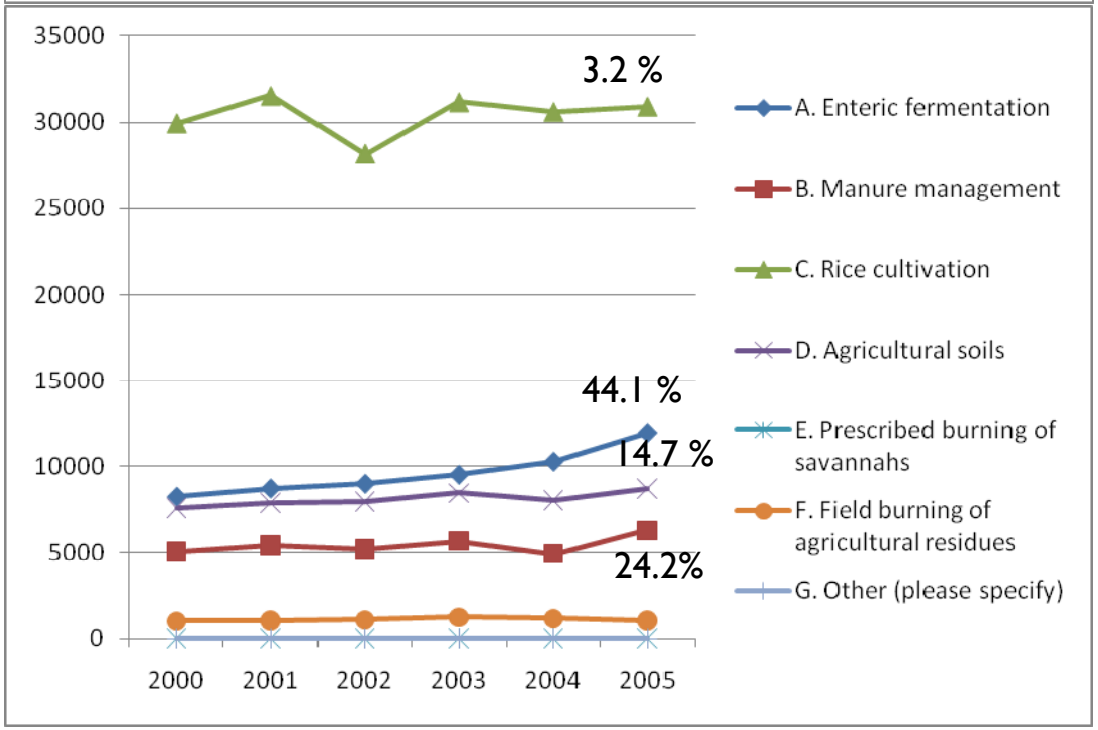




National Total Emission 2000 – 2005







Emission from Agricultural Sector from 2000-2005

Gg CO_2 equivalent

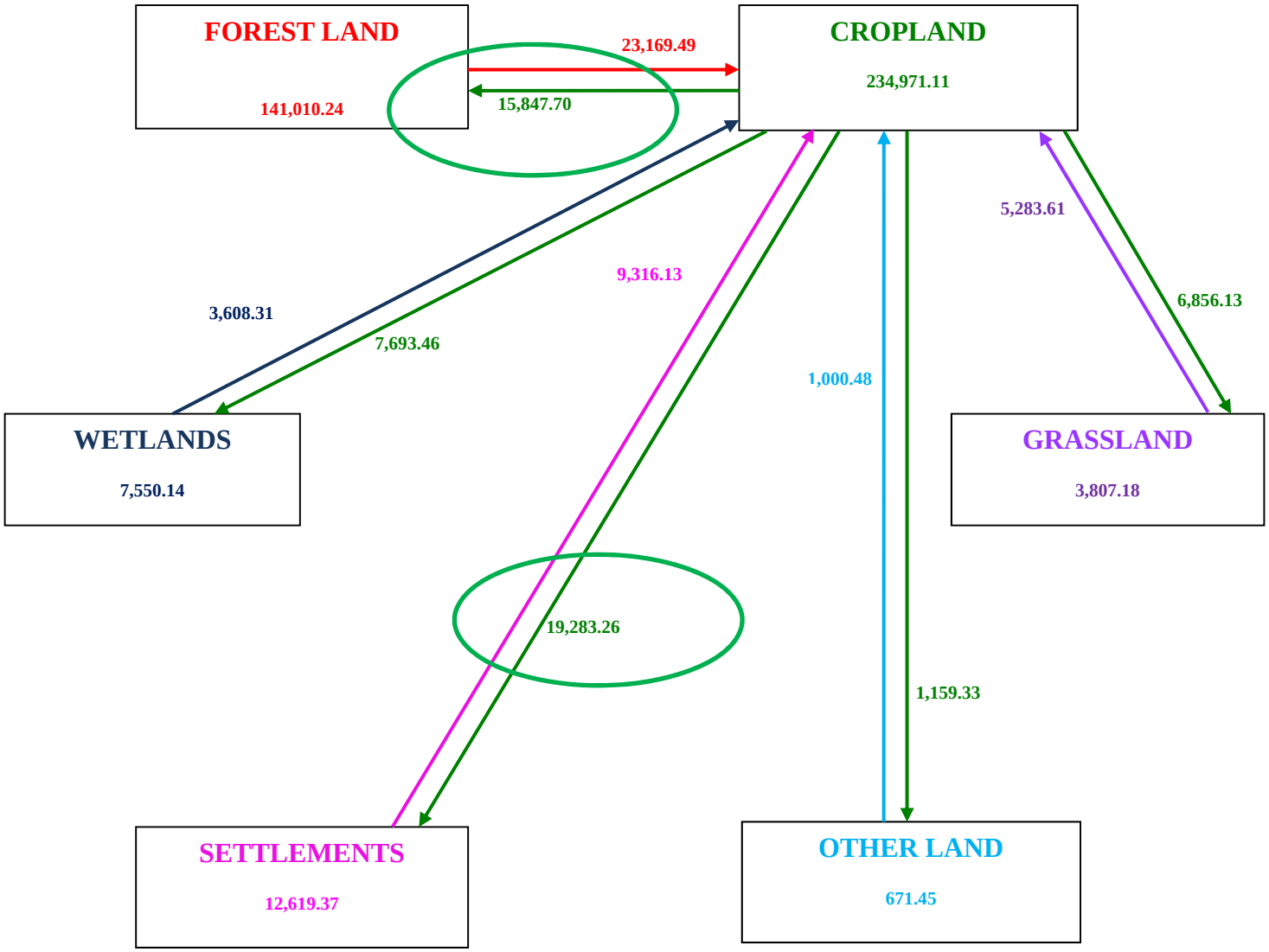
Greenhouse gas emission from Agricultural sector:

- **Contributes ~ 20-24% to country total emission during 1994-2005**
- **Major source of methane (~70%), most from rice cultivation**
- **Major source of N_2O (~80%), most from soil emission**

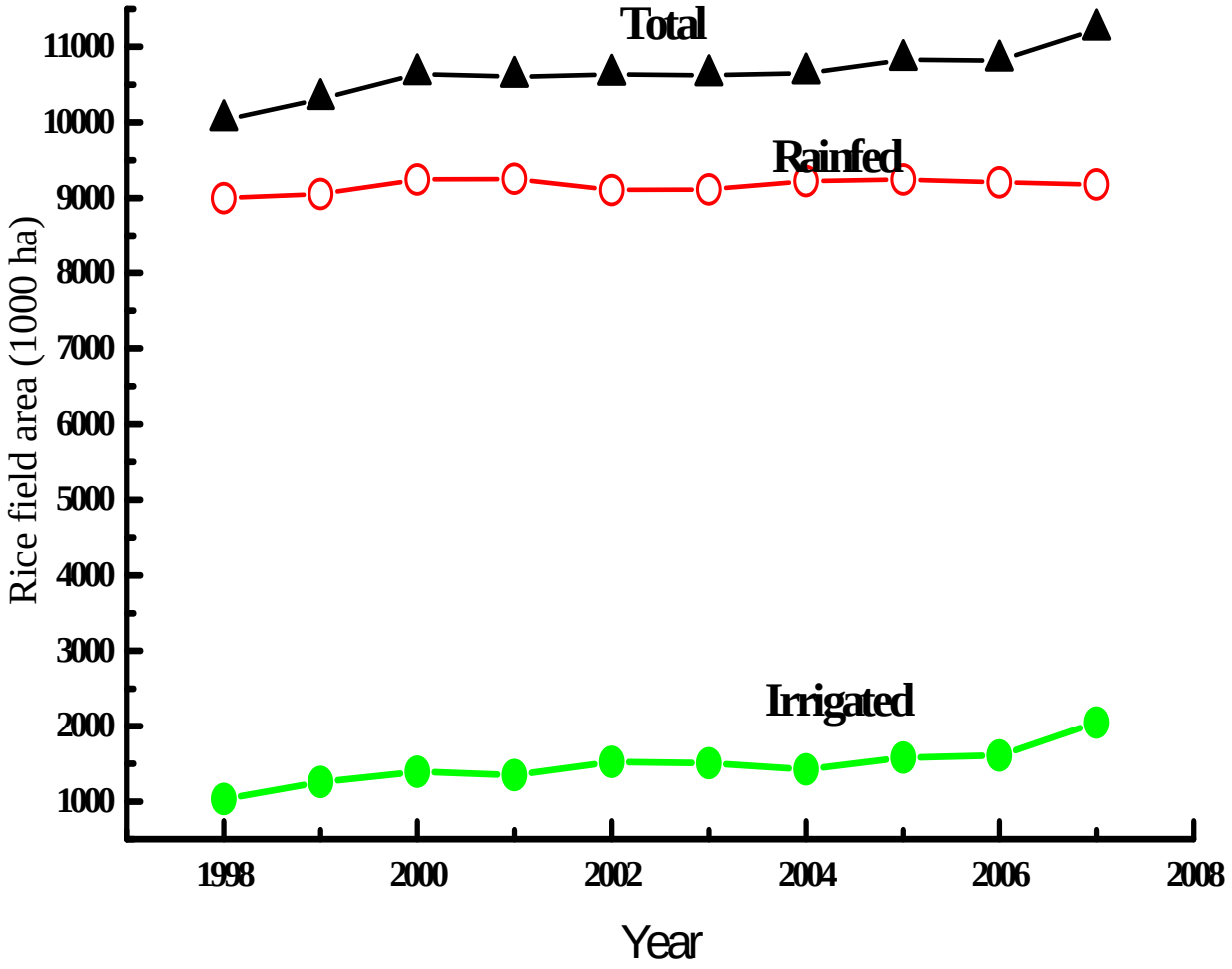
Thailand land use change

Land use categories	Land use (km^2)		Land use change	
	2000	2007	km^2	%
Forest land	172,013.04	162,571.27	-9,441.77	-1.84
Cropland	285,810.98	277,349.13	-8,461.85	-1.65
Grassland	12,740.48	14,445.86	1,705.39	0.33
Wetlands	14,414.11	19,237.39	4,823.27	0.94
Settlements	25,398.86	36,922.13	11,523.27	2.25
Other land	2,737.48	2,589.17	-148.31	-0.03
Total	513,114.95	513,114.95		

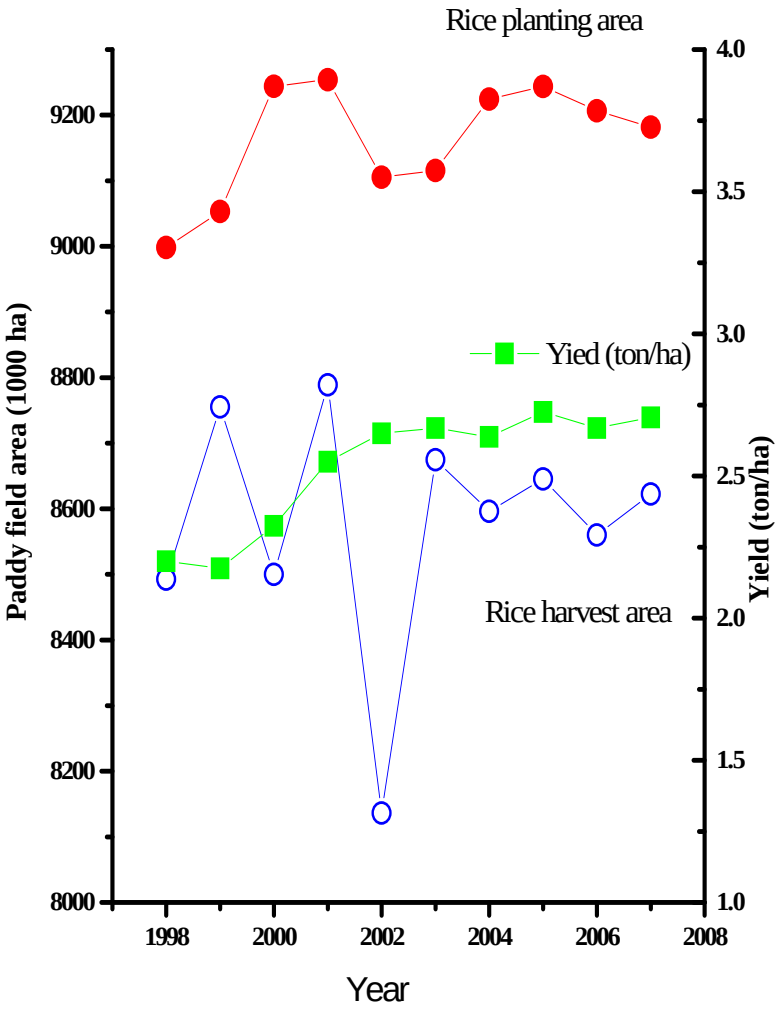
Cropland area change 2000➔2007 (km^2)



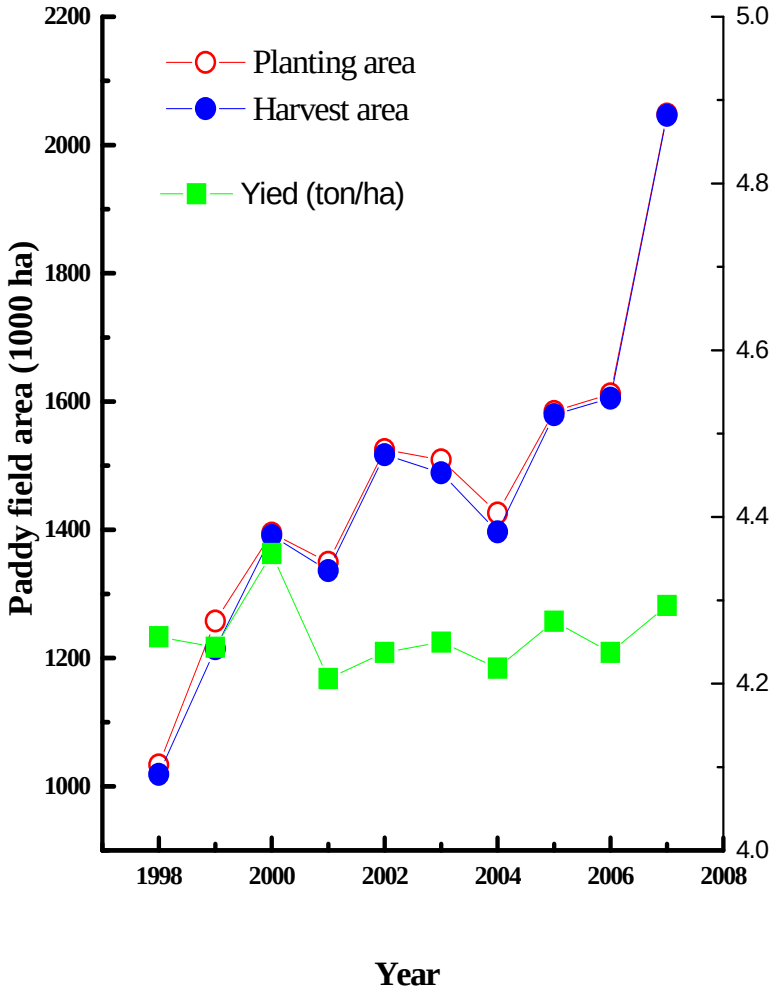
Rice cultivation area 1998-2008



Rainfed rice

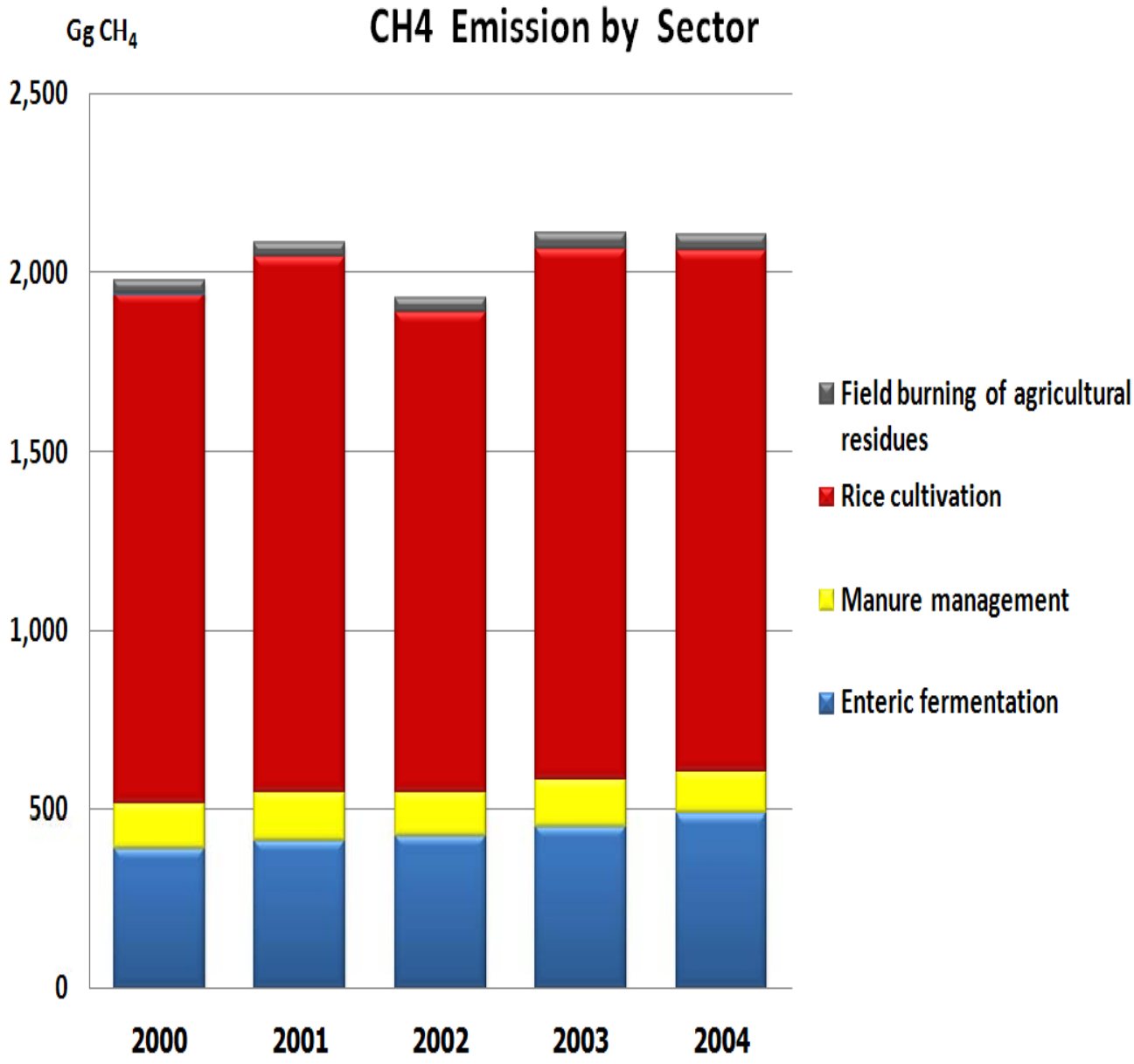


Irrigated rice



CH_4 emission from rice field:

1.1 kg CO_2e/kg rice
55 g CH_4/kg rice



Mitigations

- **Aims: lowering the ratio between emissions and yield;**
  - **Increase yield and reduce emission/keep emission low--mitigation should not affect yield;**
  - **Imply more inputs (cost?)**

Water and straw managements

		Rice straw management		
		Burn	rice straw and stubble **I**ncorporate	
Water management	**M**id-season drainage	MB	MI	
	Local drainage	LB	LI	

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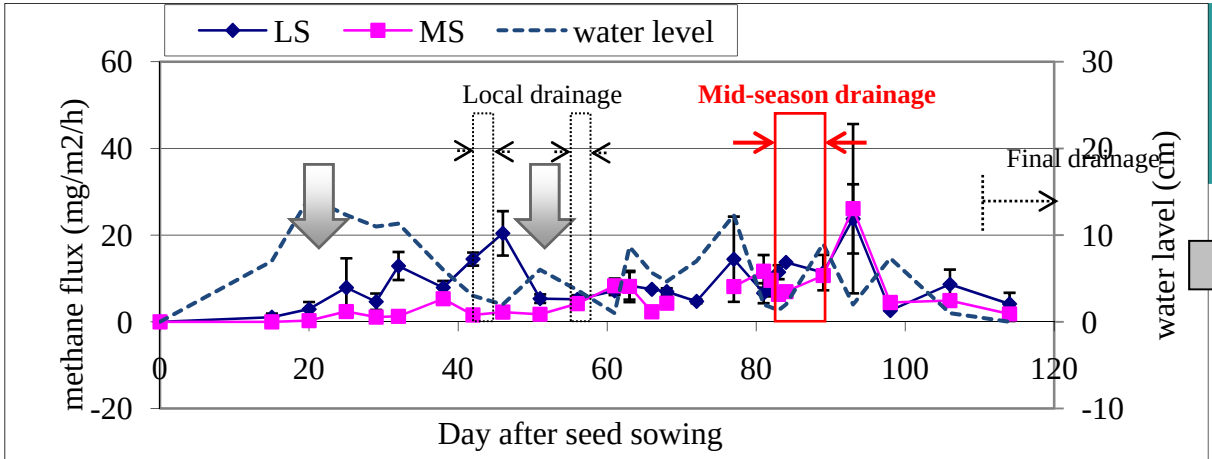
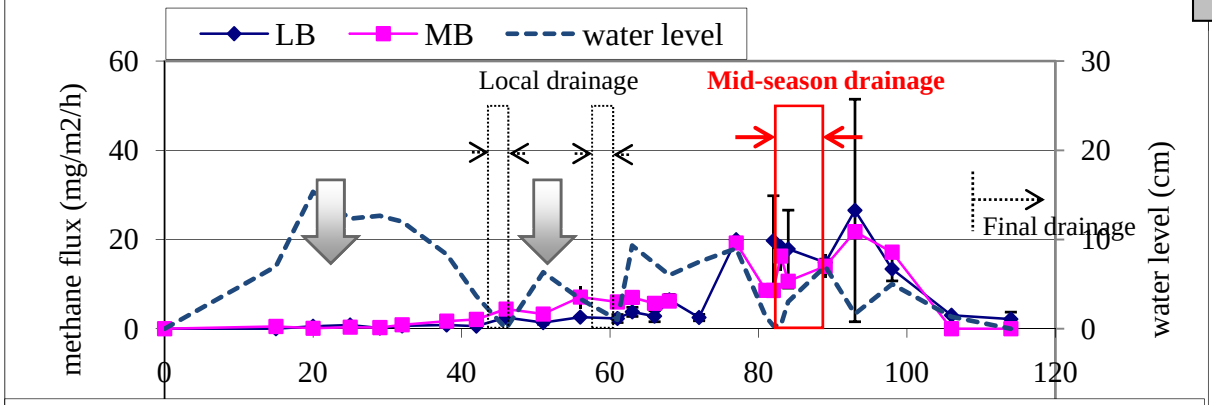
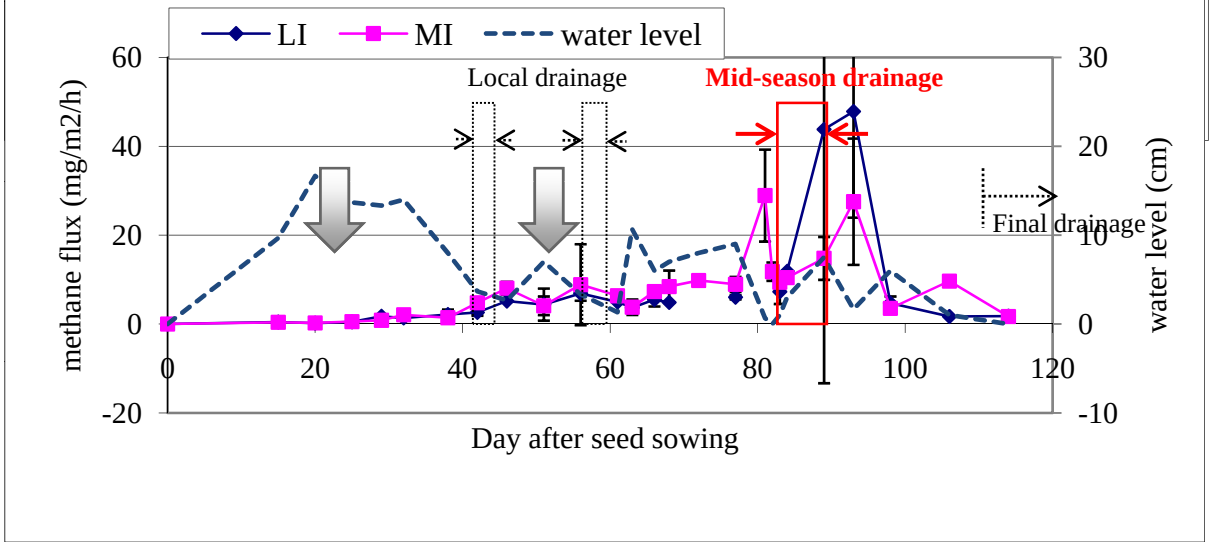
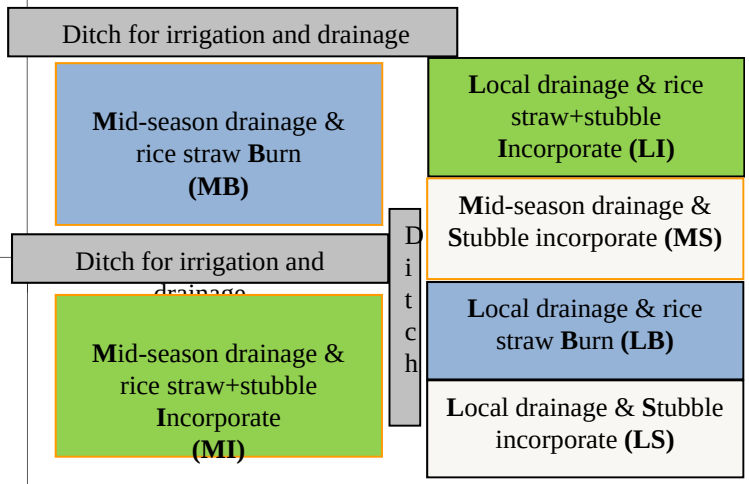






Wet season



- (unit ; g/m^2)
  - LS = 22.7^{c} : MS = 11.15^{a}
  - LB = 15.63^{ab} : MB =14.40^{ab}
  - LI = 18.03^{b} : MI = 17.56^{b}

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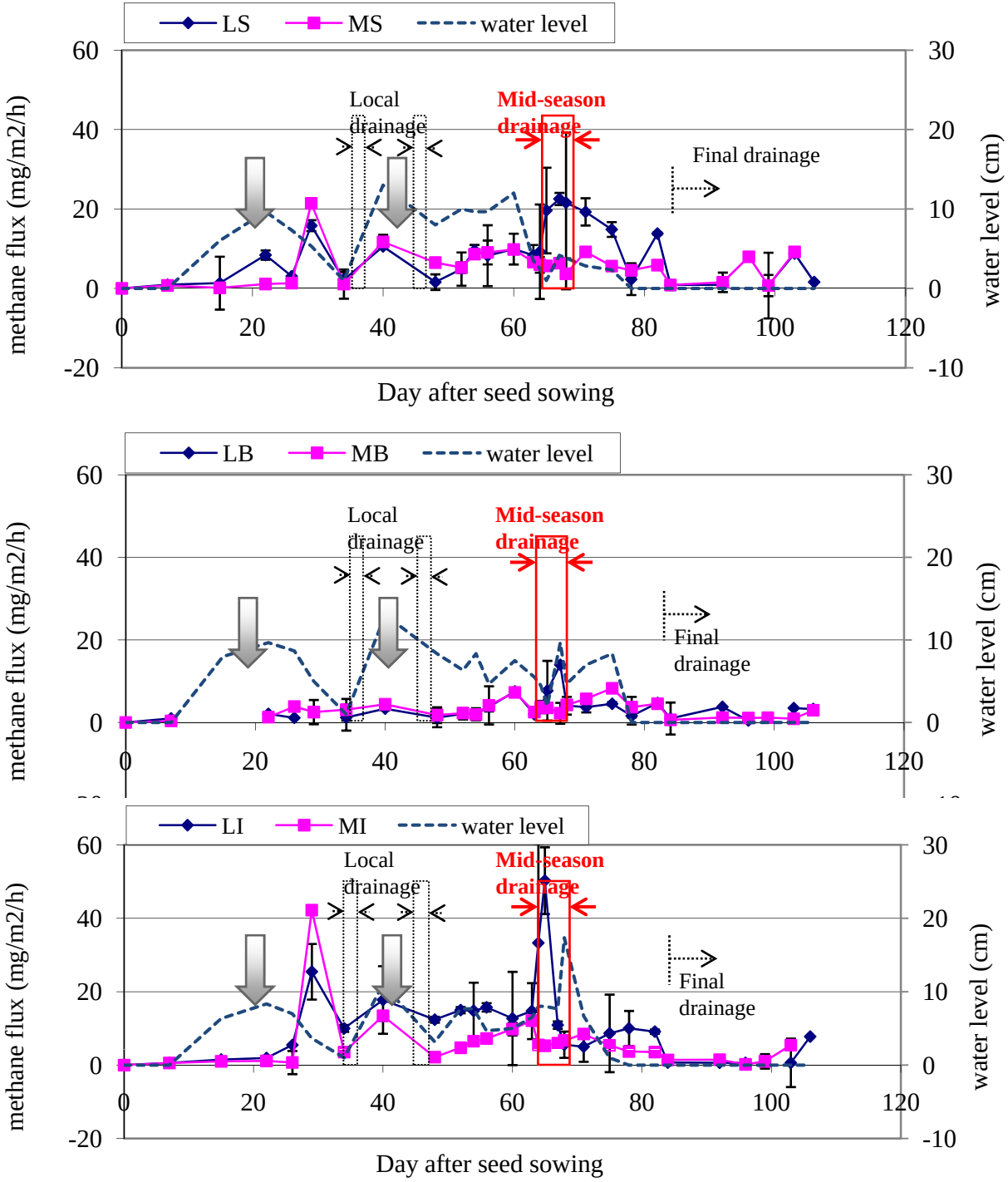


Dry season

(unit ; g/m2)

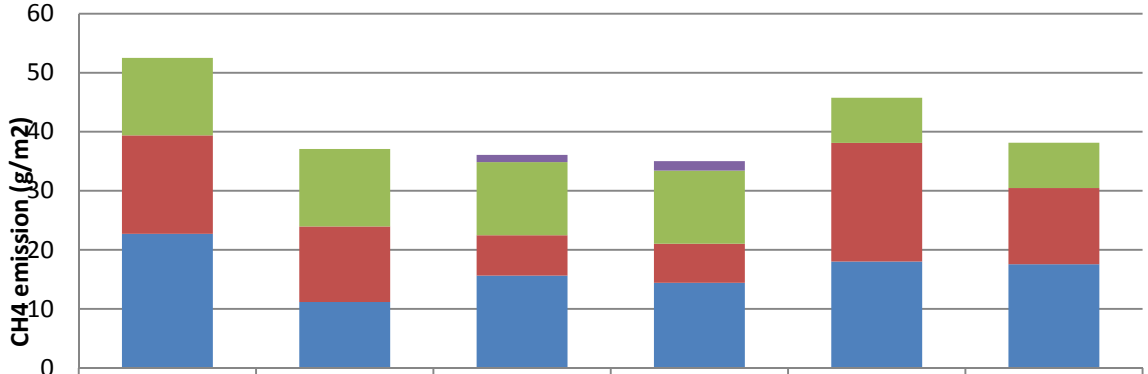
- **LS =16.69^{a} : MS =12.81^{b}**
- **LB = 6.84^{b} : MB = 6.64^{b}**
- **LI = 20.07^{a} : MI = 12.92^{b}**

Annual CH_4 and N_2O emission

Total CH_4 emission

- rice cultivation
  - 1st crop ; I > S > B
  - 2nd crop ; I > S > B
- Fallow period

  S > B > I
- CH_4 from field burning

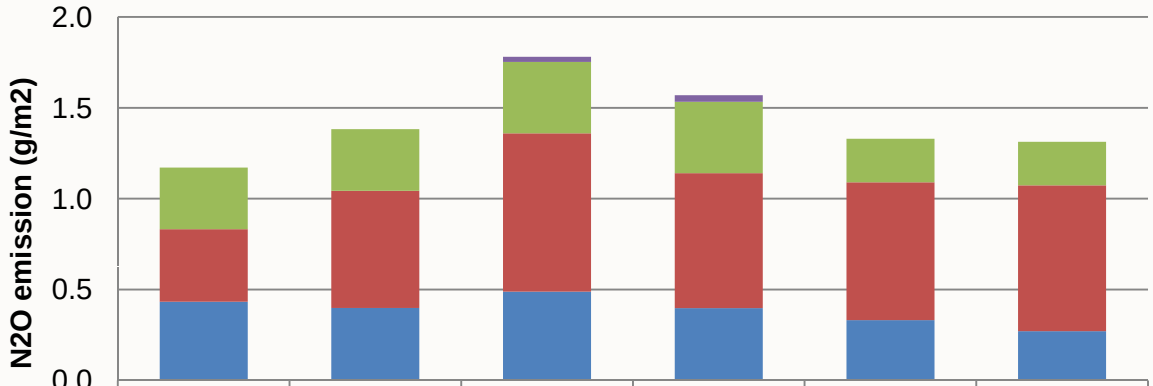


	LS	MS	LB	MB	LI	MI
CH4 from burn			1.22	1.60		
Fallow period	13.13	13.13	12.39	12.39	7.66	7.66
2nd crop	16.69	12.81	6.84	6.64	20.07	12.92
1st crop	22.70	11.15	15.63	14.40	18.03	17.56

Total N_2O emission

- rice cultivation
  - 1st crop ; B > S > I
  - 2nd crop ; B > I > S
- Fallow period

  B > S > I
- N_2O from field burning



	LS	MS	LB	MB	LI	MI
N2O from burn			0.03	0.04		
Fallow period	0.34	0.34	0.39	0.39	0.24	0.24
2nd crop	0.40	0.64	0.87	0.74	0.76	0.80
1st crop	0.43	0.40	0.49	0.40	0.33	0.27

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Grain yield

Plot	Total CH_4 emission (g/m^2)		Grain yield (g/m^2)	
	Wet season	Dry season	Wet season	Dry season
LS	22.70 ± 1.52^{c}	16.69 ± 4.88^{d}	445.49	288.61
MS	11.15 ± 0.89^{a}	12.81 ± 0.60^{e}	461.39	272.93
LB	15.63 ± 0.90^{ab}	6.84 ± 1.02^{e}	549.87	362.53
MB	14.40 ± 1.71^{ab}	6.64 ± 0.82^{e}	463.34	345.54
LI	18.03 ± 2.96^{b}	20.07 ± 5.10^{d}	473.09	232.35
MI	17.56 ± 2.49^{b}	12.92 ± 1.58^{e}	449.21	339.04

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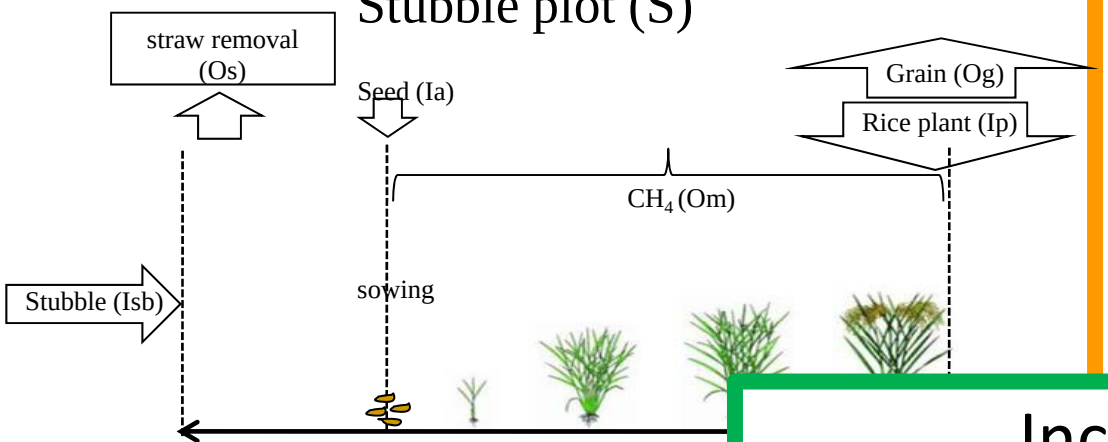
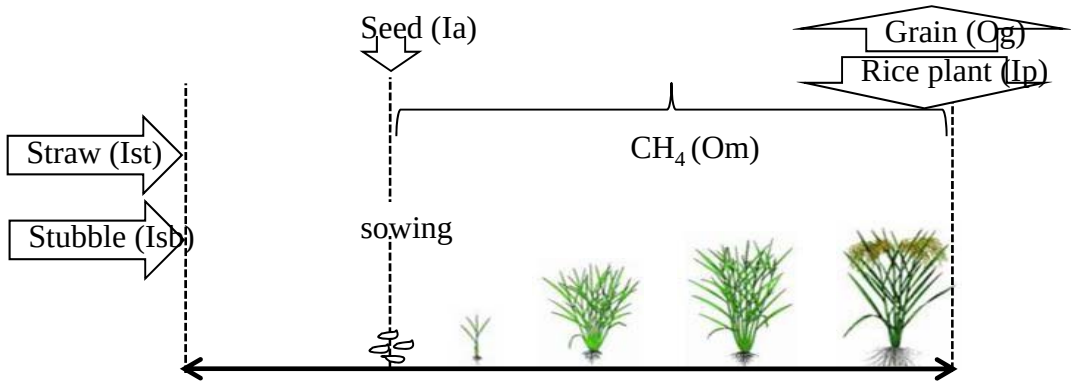
Stubble plot (S)



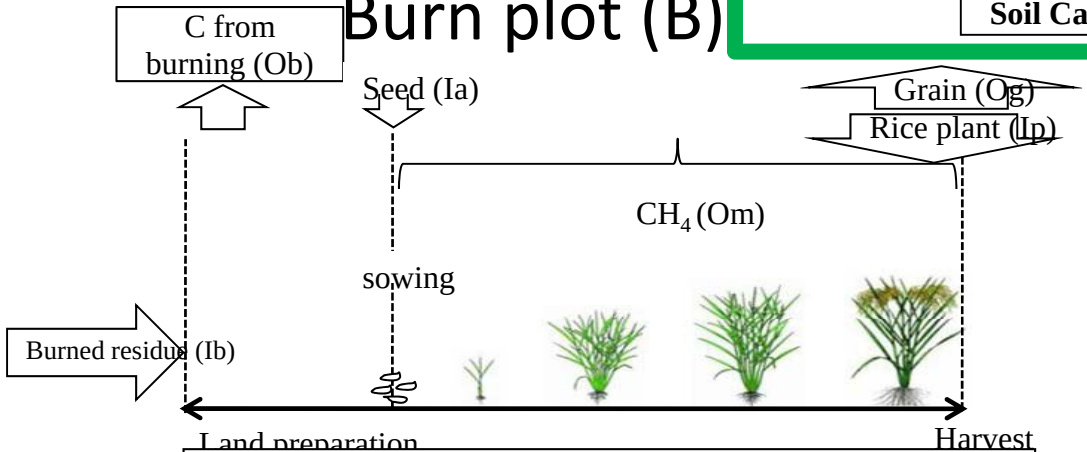
Soil Carbon Budget (SCB) = Isb + Ia + Ip

Incorporate plot (I)

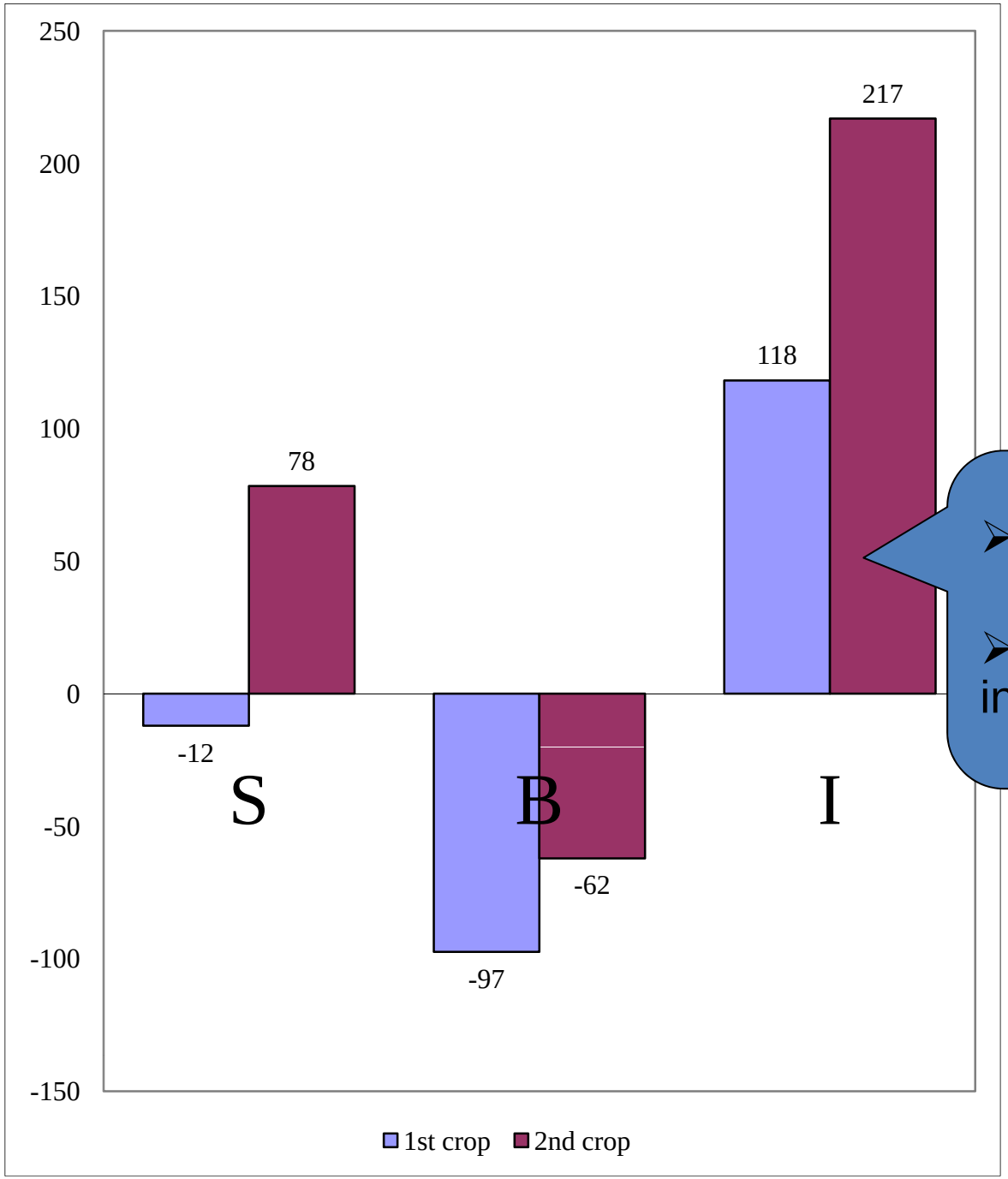


Soil Carbon Budget (SCB) = Ist + Isb + Ia + Ip - Om - Og

Burn plot (B)



Soil Carbon Budget (SCB) = Ib + Ia + Ip - Ob - Om - Og



- SCB increases in 2nd crop
- S,I plot show positive SCB in 2nd crop

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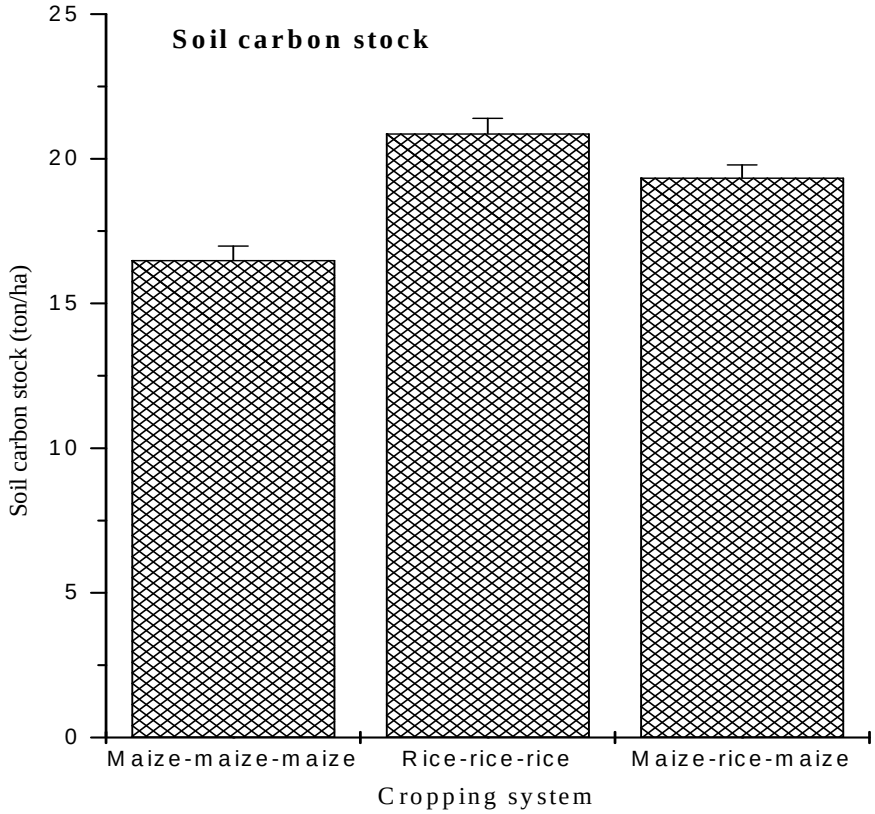
Soil carbon stock
Soil carbon stock (ton/ha)
25
20
15
10
5
0
Maize-maize-maize
Rice-rice-rice
Maize-rice-maize
Cropping system

Summary

- **In Thailand:**
  - **Rice yield is still low in Thailand**
  - **Rice cultivation contributes relatively large to country total emission**
  - **Emission reduction is possibly achieved by;**
  - **Water management associated with straw managements;10-35%**
  - **Results still vary, applicable for rainfed rice?**
  - **Managing soil carbon through cultivation practices/diversification**

Thank you