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Country-specific Emission Factors for Agricultural Soils and Rice Cultivation in Japan

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NIAES

Country-specific Emission Factors for agricultural soils and rice cultivation in Japan

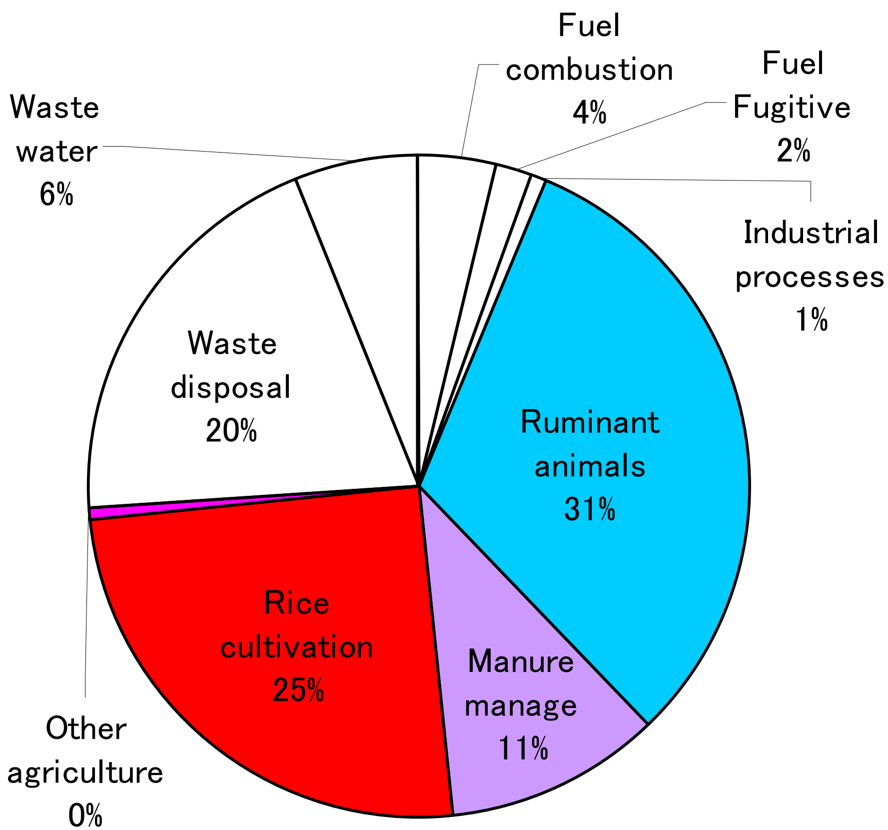
CONTENTS

- EF for direct and indirect N_2O from agricultural soils
- EF for CH_4 from rice cultivation
- Activity data preparation
- Recent programs for mitigation

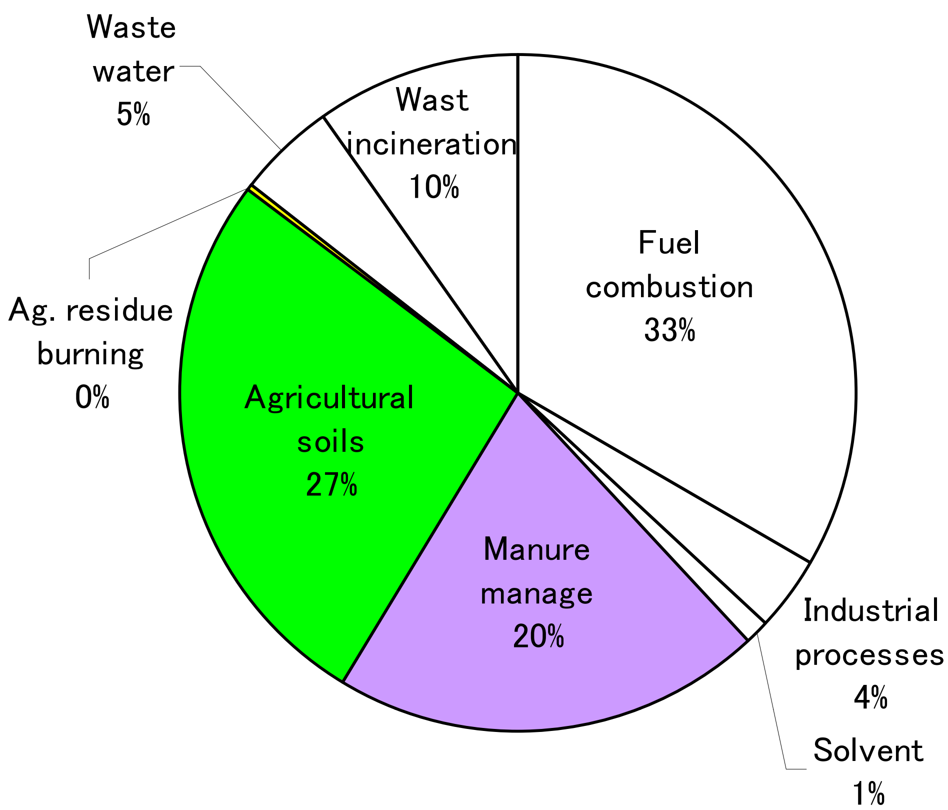
NIAES

National Inventory for Japan
Anthropogenic Sources for CH_4 and N_2O

CH_4 : 1.08 Mt (22.6 Mt CO_2 eq.)



N_2O : 0.049 Mt N (23.8 Mt CO_2 eq.)



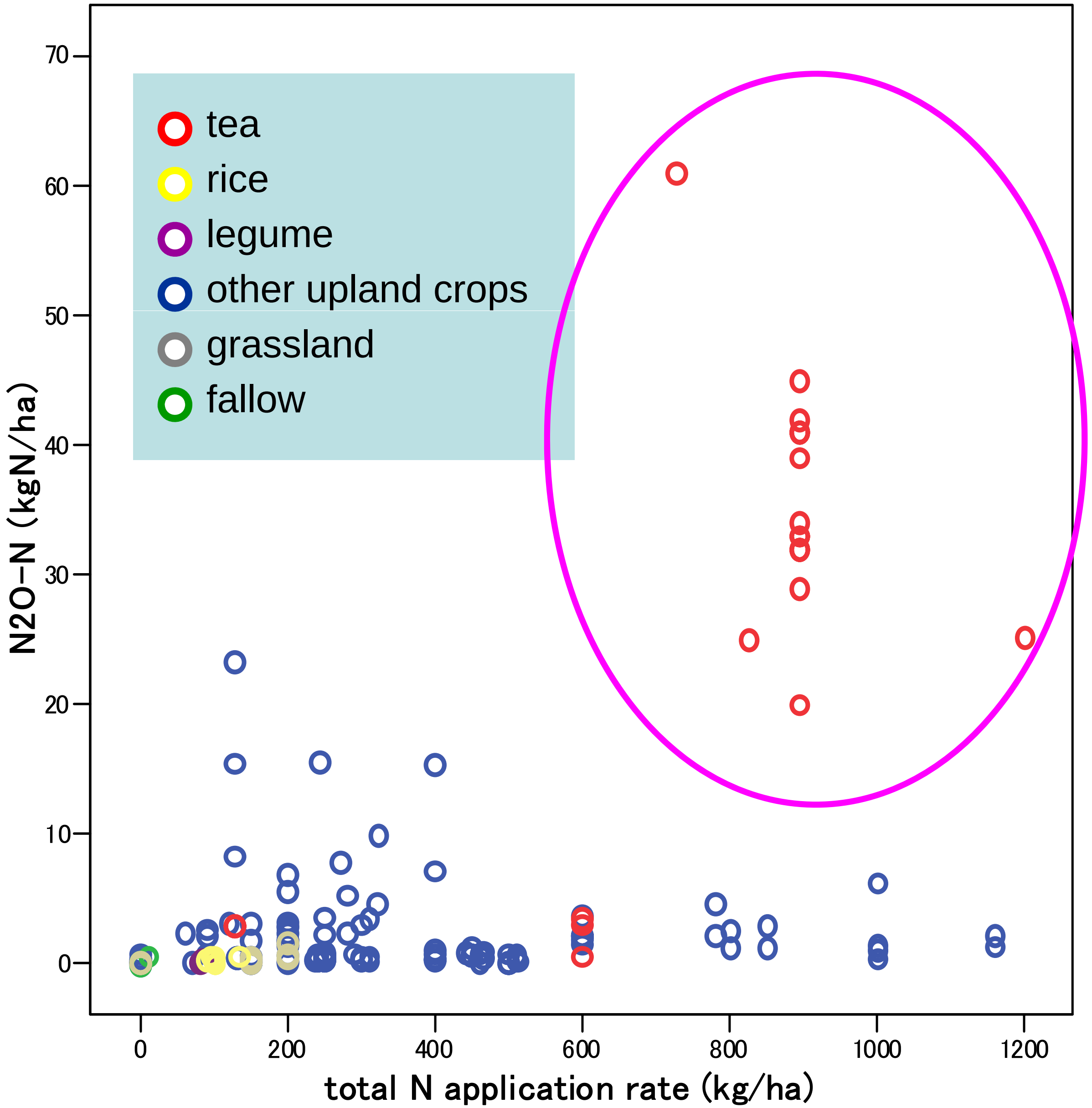
Inventory in 2007 (Colored parts indicate agricultural sources)

National Inventory for Japan

N_2O from agricultural soils

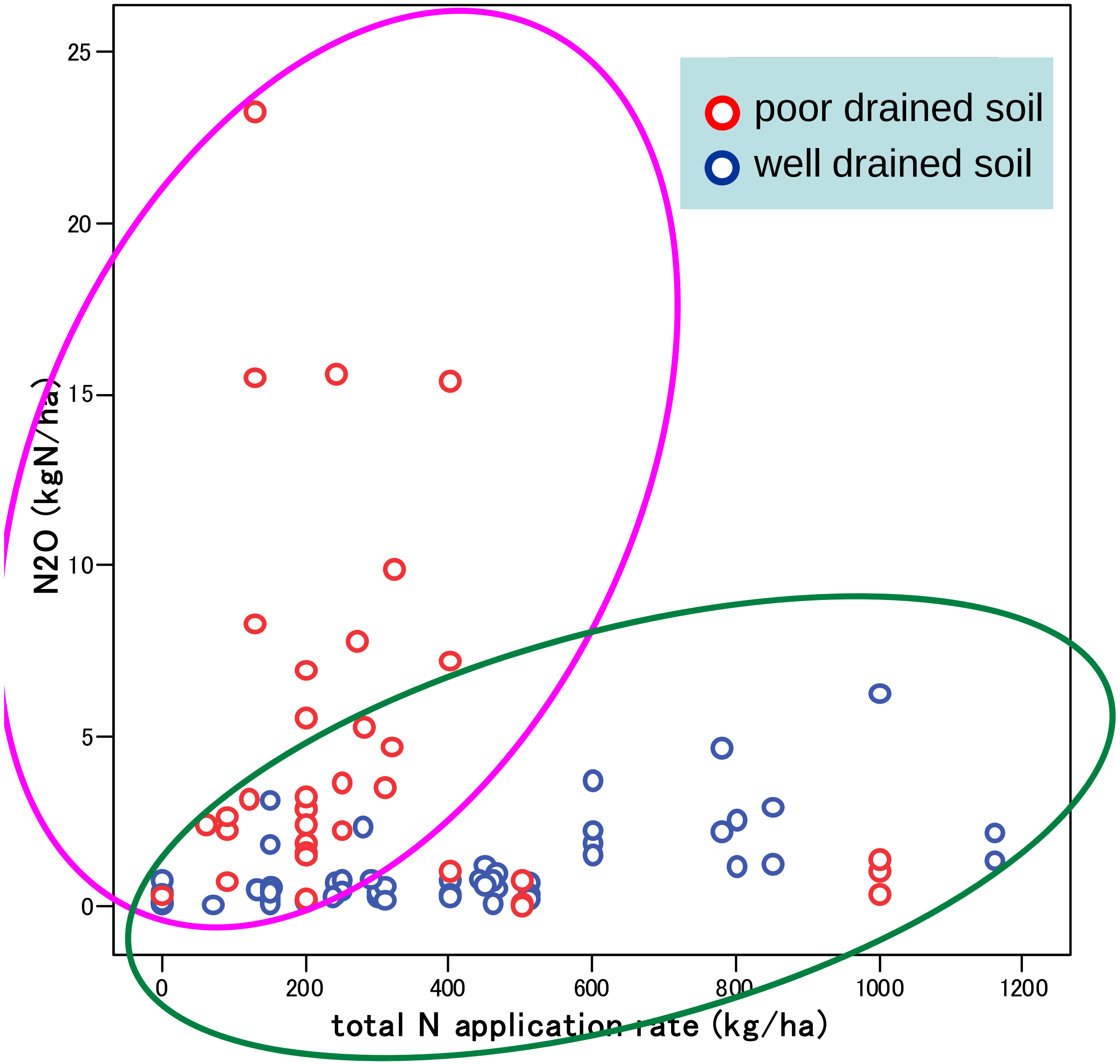
Methodology

- Tier 2 methodology for N_2O from mineral fertilizer and animal manure
- Country-specific EFs for 3 crop types, which are based on seasonal field monitoring at 36 sites
- Identical EFs for mineral fertilizer and animal manure
- Tier 1 methodology for other N_2O sources



- No clear relationship with N application rate
- Emissions from tea are remarkably high
- Emissions from rice are remarkably low
- Therefore, country specific EFs are set for 3 categories:
  - tea
  - paddy rice
  - other upland crops

Relationship between N inputs and N_2O emissions from different crop types



Further analysis for other upland crops

- Soil drainage classes were categorized from soil types
- Poorly drained soil > well-drained soil
- No clear relationship for poorly drained soil
- Well-drained soil: $r^2 = 0.38$

Relationship between N inputs and N_2O emissions from upland fields with different soil drainage type (measurement period more than 90 days)

Table
Summary of N2O-N emission and
fertilizer induced N2O-N emission factor from Japanese upland field (except tea filed)
measurement period more than 90 days

soil drainage #	n	mean		standard deviation		median	min	max
N2O-N emission (kgN ha-1)								
well drained soil	67	1.03	a**	1.14		0.61	0.09	6.28
poorly drained soil	35	4.78	b	5.36		2.88	0.07	23.3
Fertilizer induced N2O-N emission factor (%)								
well drained soil	15	0.32	a**	0.49		0.16	0.07	2.02
poorly drained soil	9	1.40	b	0.95		1.26	0.57	3.30
estimated emission factor for all soil		0.62	$	0.48	$$			

☻ poorly drained soil ＞ well-drained soil

☻ EF for upland = 0.62 ± 0.48 % (weighted by area of soil type)

☻ measurement period: more than 90 days

assuming that most of the fertilizer-induced N2O emission should be included in this period, because data availability

National Inventory for Japan
N_2O from agricultural soils

Adopted EFs

Direct N_2O: Mineral fertilizer/Animal manure

Paddy rice: 0.31 (±0.31) % (IPCC default values)
Tea: 2.90 (±1.82) % (from national data analysis)
Other crops: 0.62 (±0.48) % (from national data analysis)

Direct N_2O: Crop residues/Legumes

IPCC default values

Direct N_2O: Organic soils

Paddy: 0.30 kg N_2O-N/ha/year (from national data)
Upland: IPCC default values (similar to national data)

Indirect N_2O

Atmospheric deposition (IPCC default values)
Leaching and run-off: 1.24 % (IPCC default values)

National Inventory for Japan

CH_4 Emissions from Rice Cultivation

Methodology

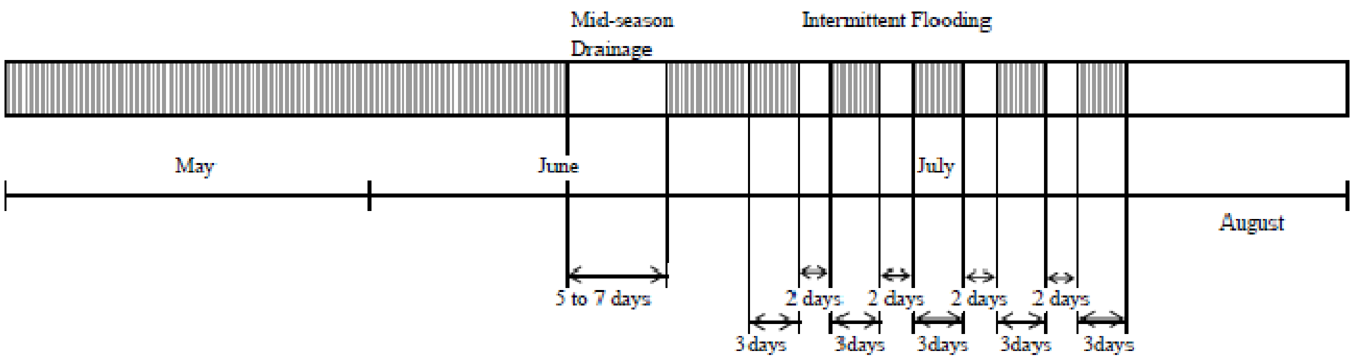
- Tier 2 methodology
- Country-specific EFs for 5 soil types, which are based on seasonal field monitoring at 35 sites over the country during 1992-94
- Country-specific scaling factors (SFs) for 3 organic amendment
- Water management was assumed to be homogeneous intermittent-irrigation for 98% of the rice fields

National Inventory for Japan

CH_4 Emissions from Rice Cultivation

Water Management Categorization

- Water management was assumed to be homogeneous intermittent-irrigation for 98% of the rice fields



- A scaling factor of 1.77 is applied for continuous flooding fields which accounted for 2% of the area
- No consideration for water regime in the pre-season

National Inventory for Japan

CH_4 Emissions from Rice Cultivation

Emission Factors

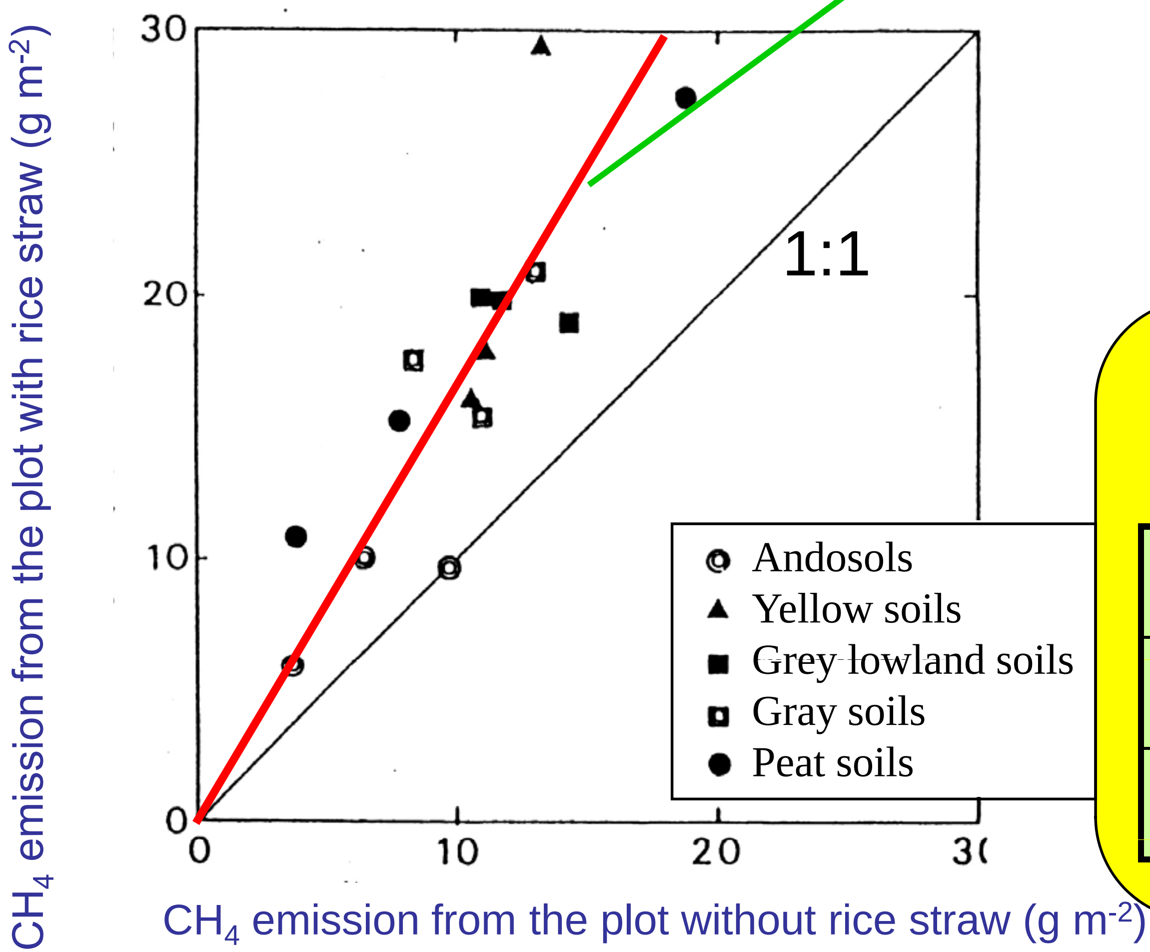
Type of soil	No. of data	Straw amendment	Various compost amendment	No-amendment	Proportion of area
		[gCH_4/m^2/year]			%
Andosol	2	8.50	7.59	6.07	11.9
Yellow soil	4	21.4	14.6	11.7	9.4
Lowland soil	21	19.1	15.3	12.2	41.5
Gley soil	6	17.8	13.8	11.0	30.8
Peat soil	2	26.8	20.5	16.4	6.4

- Based on field monitoring campaign during 1992-1994 at 35 sites over Japan
- Measured by conventional water management with mid-season drainage followed by intermittent flooding

National Inventory for Japan

CH_4 Emissions from Rice Cultivation

Calculation for Organic Amendment Applied



SFo for straw: 1.68

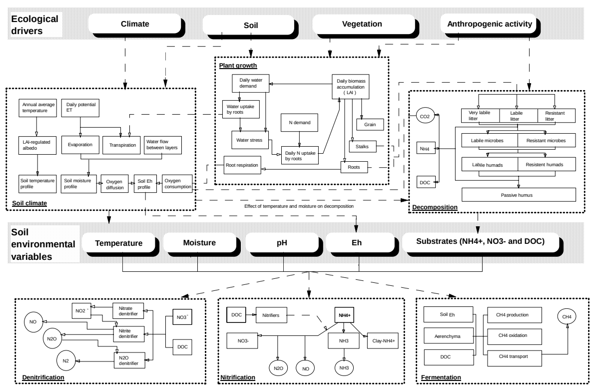
SFo for various compost: 1.25

Activity data based on interview with ca. 2,000 farmers by MAFF

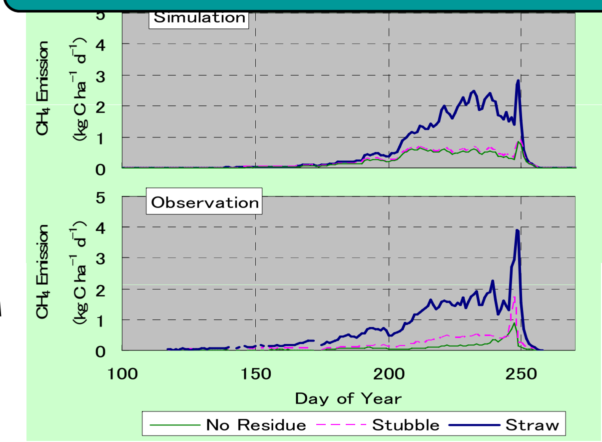
Straw	60%
Compost	20%
No	20%

Estimation of GHG Emissions by a Process-Based Model

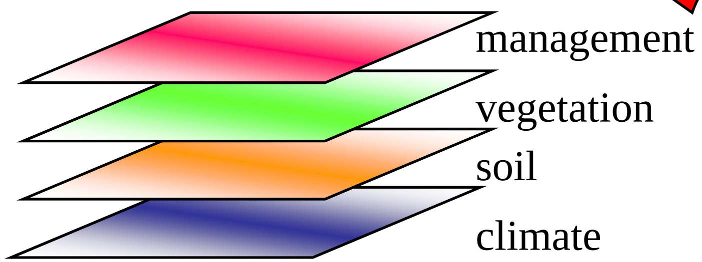
DNDC model



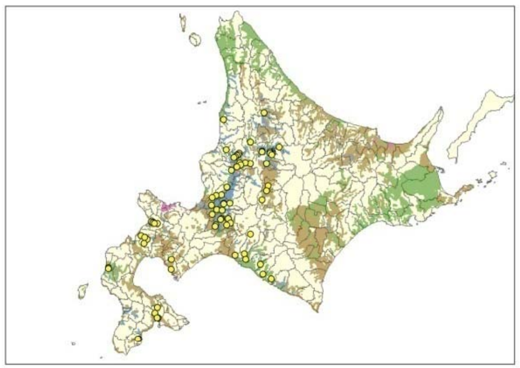
Simulation and validation



GIS data for parameters



Regional estimation

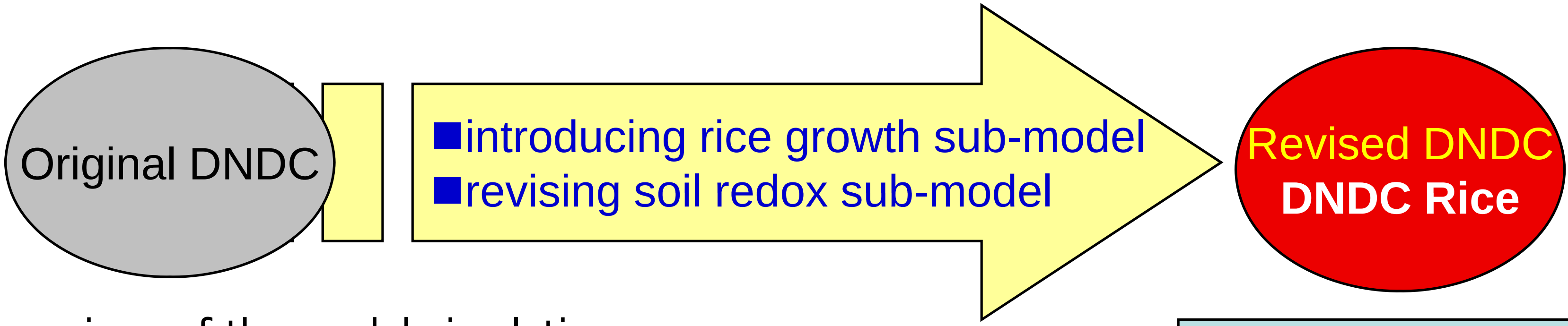


Japan-U.S. High-Level Consultations on Climate Change

"Effects of agricultural land use on emission and absorption of greenhouse gases"

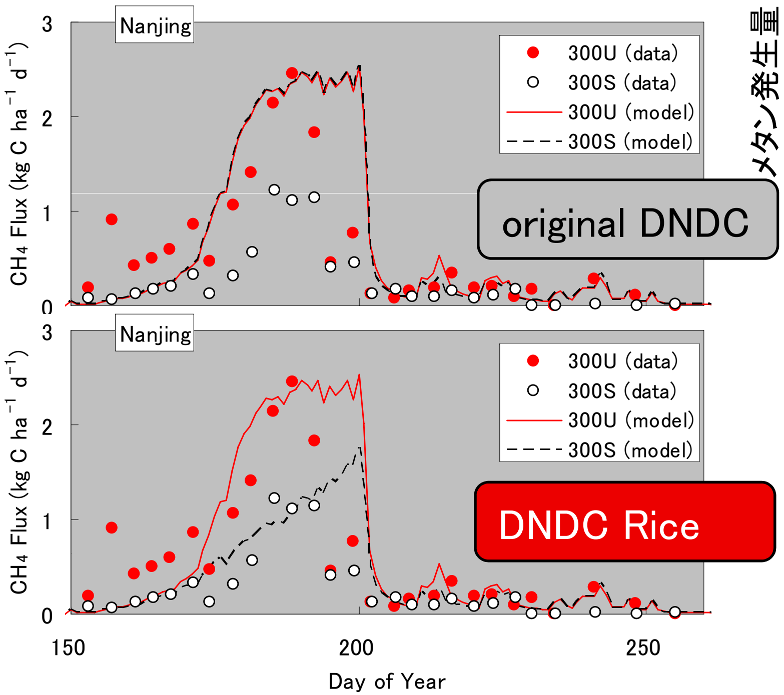
NIAES and University of New Hampshire (Prof. Changsheng Li)

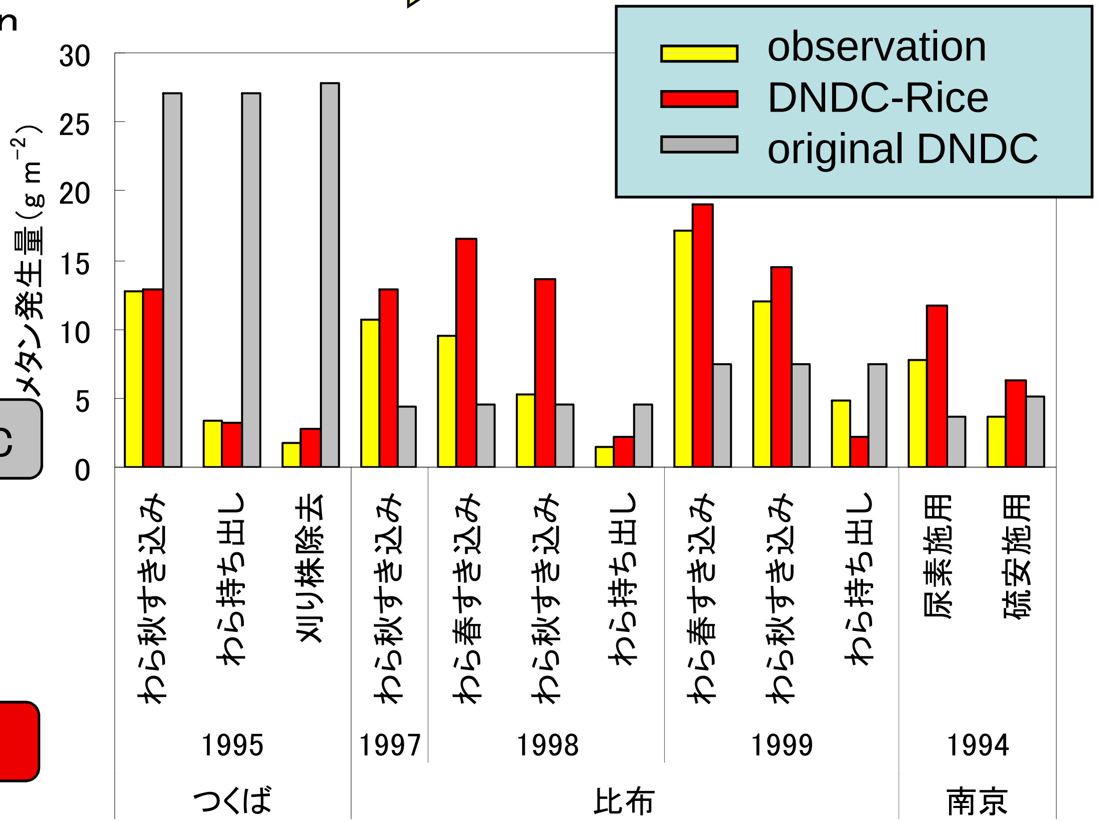
DNDC-Rice Model



Comparison of the model simulation with monitoring data:

Urea application (300U) and $(NH_4)_2SO_4$ application (300S)



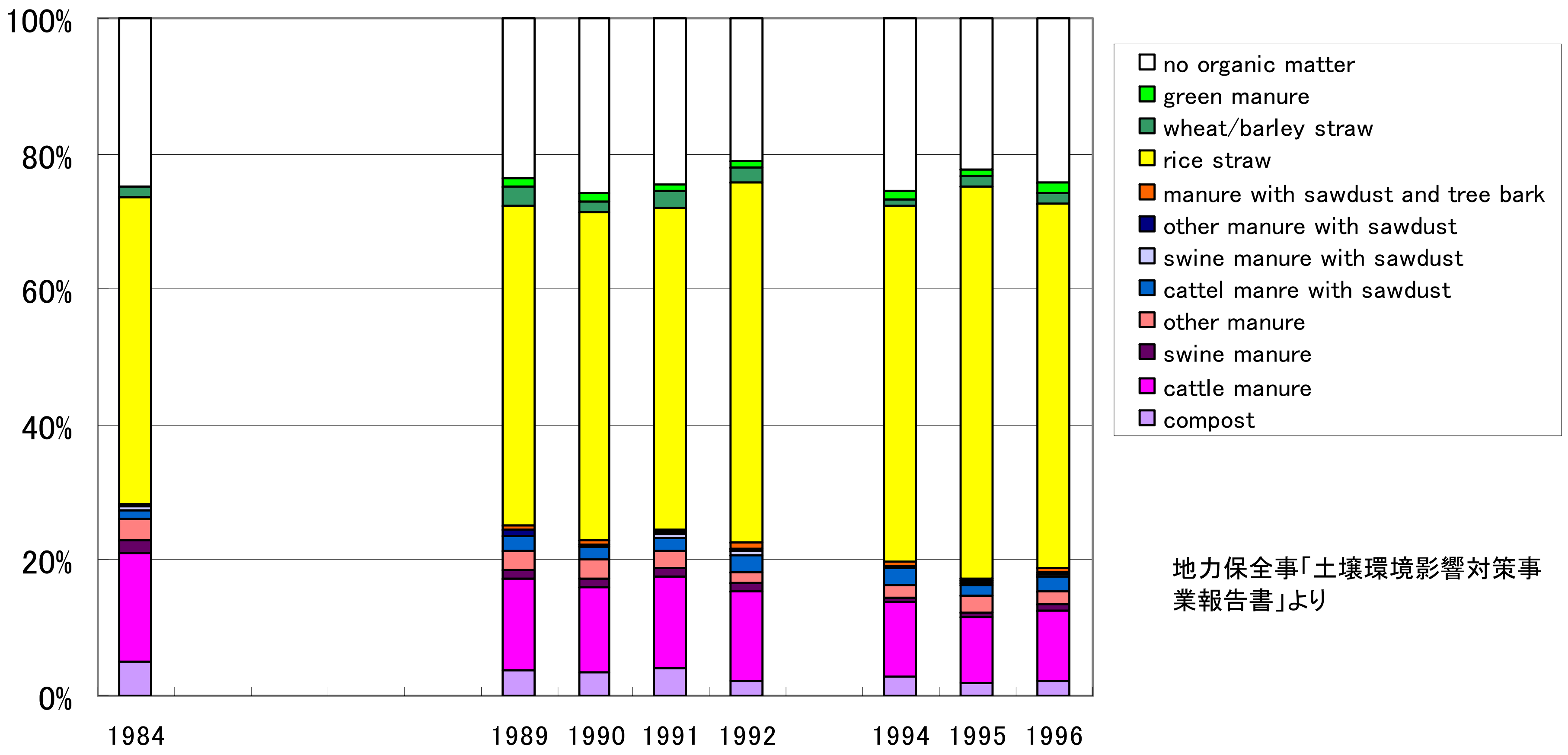


National Inventory for Japan
Activity data preparation

- National statistics
  - MAFF crop statistics
  - MAFF statistics of cultivated and planted area
  - MAFF vegetable production and shipment statistics
  - Yearbook of fertilizer statistics
  - etc.
- Research and interview
  - MAFF basic survey of ground strength: soil type distribution, organic matter management
  - Research on nutrient balance of crops in Japan: N content of non-harvest aboveground portion by crop
  - etc.
- Still some default factors and expert judgments

MAFF Basic Survey

organic matter management in rice cultivation



- from interview of 2,300-2,500 farmers in the country

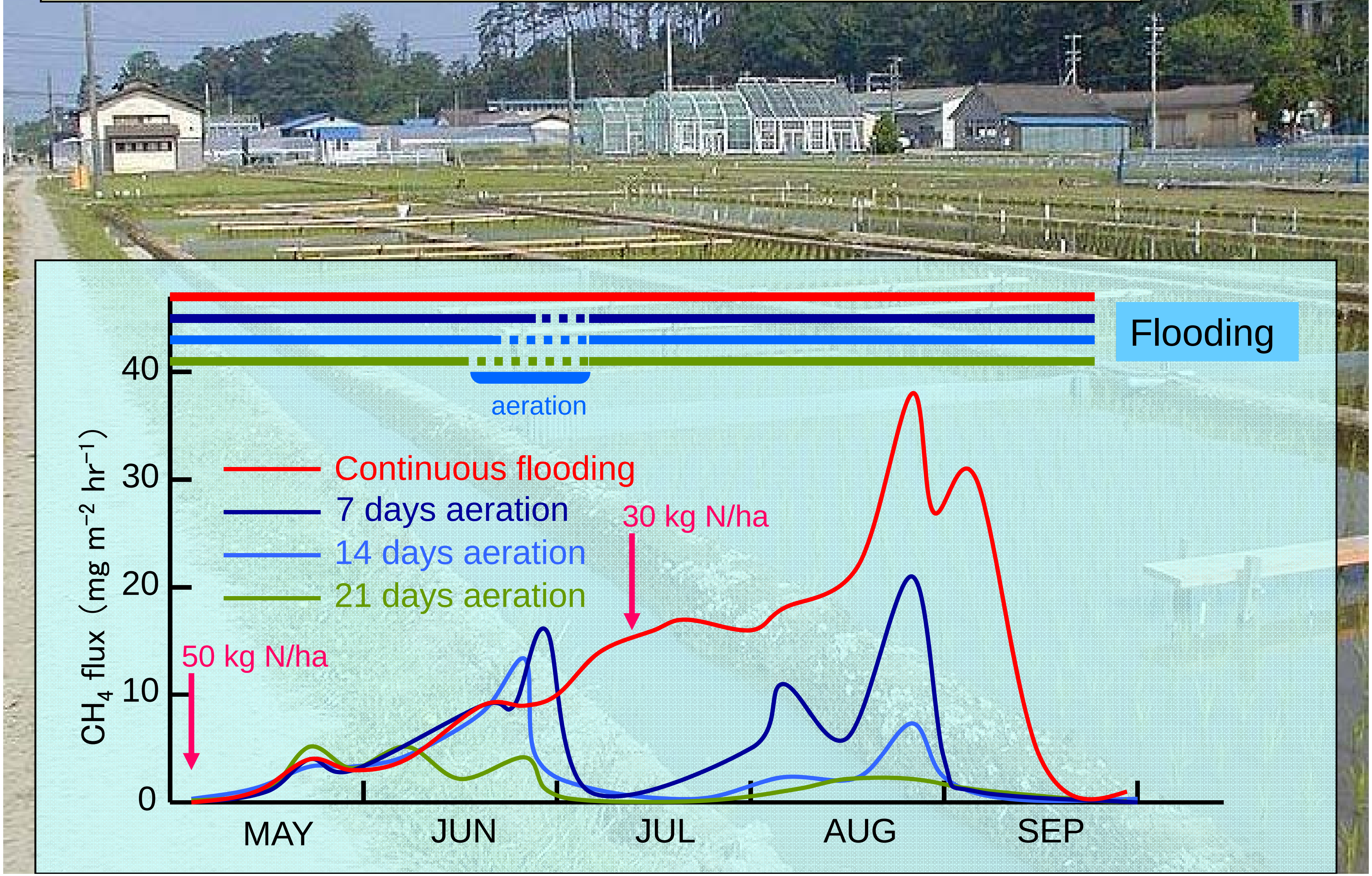
Recent Programs for Mitigation

included in "the Kyoto protocol target plans"

- To reduce application rates of mineral fertilizer N
  - successful by promoting the policies for environmental-friendly agriculture
- To promote composting rice straw in paddy fields
  - not much progress due to cost and labor
- To introduce pro-longed mid-season drainage in paddy fields
  - under experimental stage, but can be extended soon

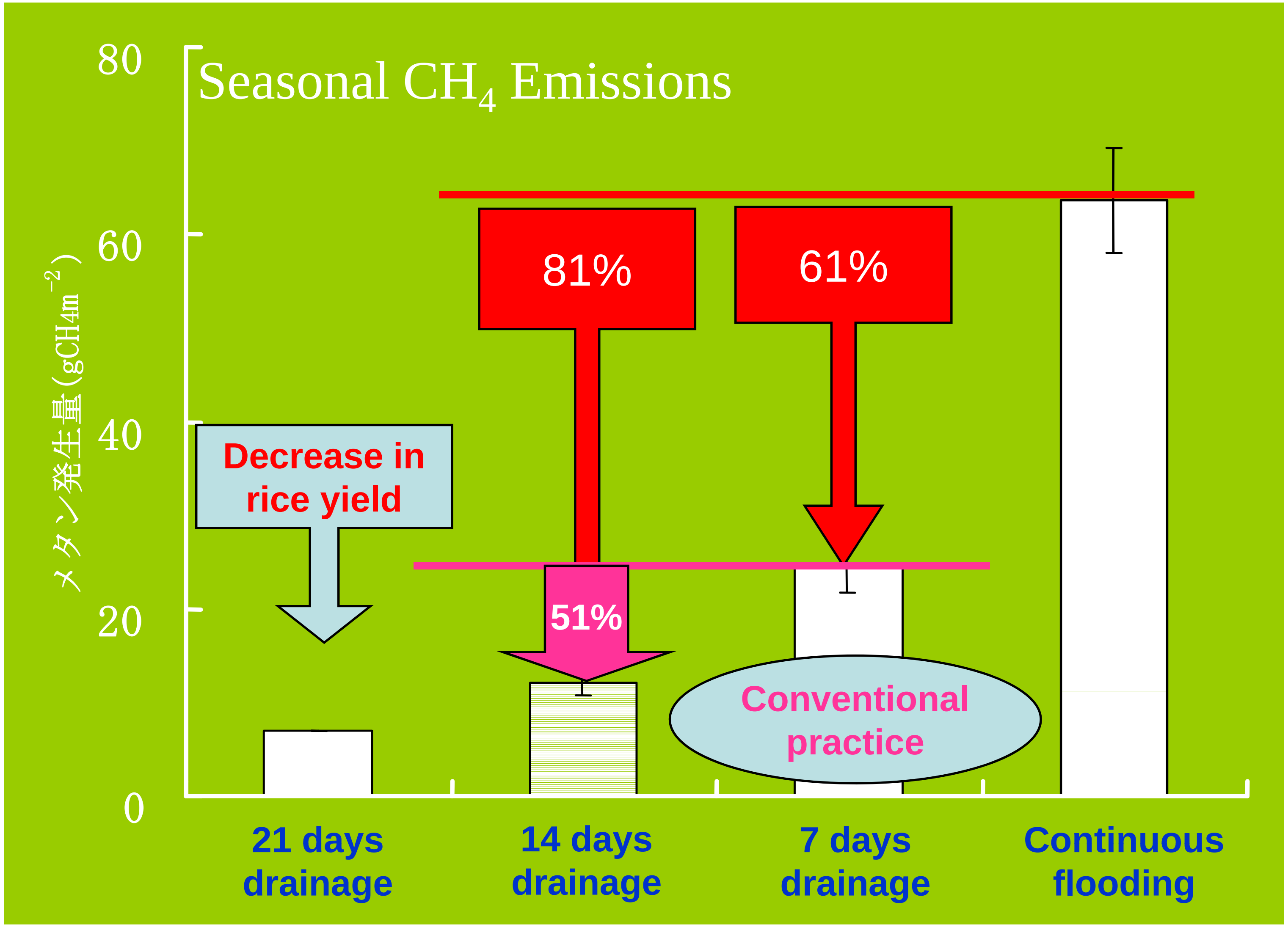
Fukushima, Japan

Prolonged Mid-Season Aeration to Reduce CH_4 Emissions



Fukushima, Japan

Mid season drainage at different period



National Inventory for Japan

Summary for Soil Emissions

Present state:

- Tier 2/Tier 1 for N_2O from soils
- Tier 2 for CH_4 from rice
- Tier 1 for CH_4 & N_2O from residue burning

Further improvement:

- CS-EF for N_2O from organic amendment and crop residues/legumes
- Tier 3 for CH_4 from rice by the DNDC model
- introducing factors for mitigation

GHG studies can contribute to sustainable development

For example:

- C sequestration in agricultural soils

=> can enhance soil fertility and crop production

- Improved water management for CH_4 mitigation

=> can increase rice production

- Various N_2O mitigation options

=> can reduce other environmental impact by reactive N losses

Roles of Soil Scientists

- **to develop the alternative systems for sustainable agriculture**
- **to promote the international agreements on reasonable land use**