Mitigation of Methane Emissions from Rice Paddy Fields in Japan

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Outline

- Methane Emissions from Rice Paddy Fields
- Mechanism of Methane Emissions
- Measures to Reduce Methane Emissions
- Policy and Measures to Reduce Methane Emissions from Rice Paddy Fields in Japan
- Potential and Challenges
- Conclusion

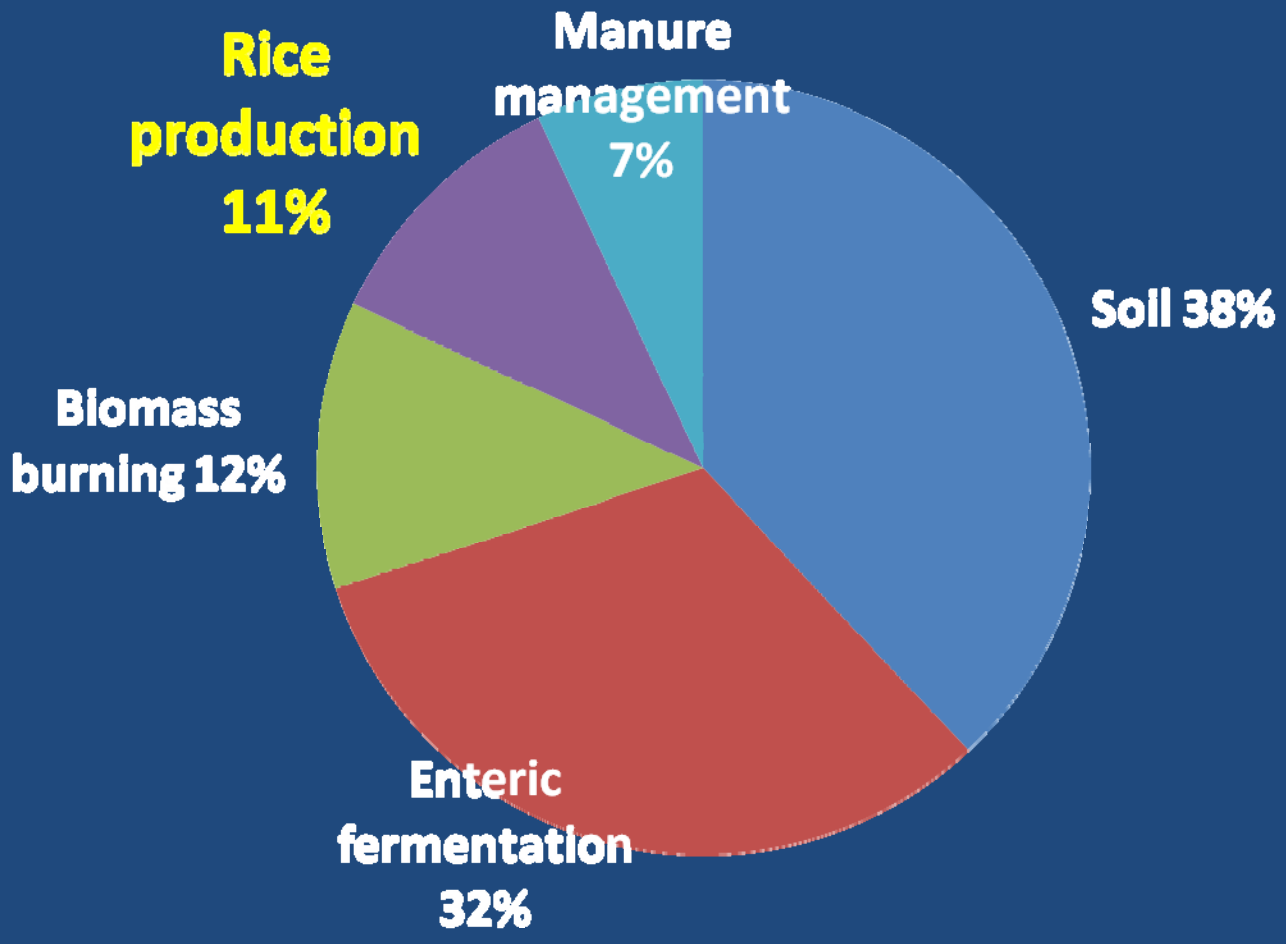
METHANE EMISSIONS FROM RICE PADDY FIELDS

Methane Emissions from Rice Paddy Fields –Global

- Agriculture accounts for 10-12% of total global anthropogenic GHG emissions
- Agriculture accounts for 50% of methane emissions
- Rice production accounts for 11% of total non-CO_2 emissions from agriculture
- South and East Asia accounts for 82% of total methane emissions from rice production

(IPCC 4th Assessment Report, Chapter 8 Agriculture)

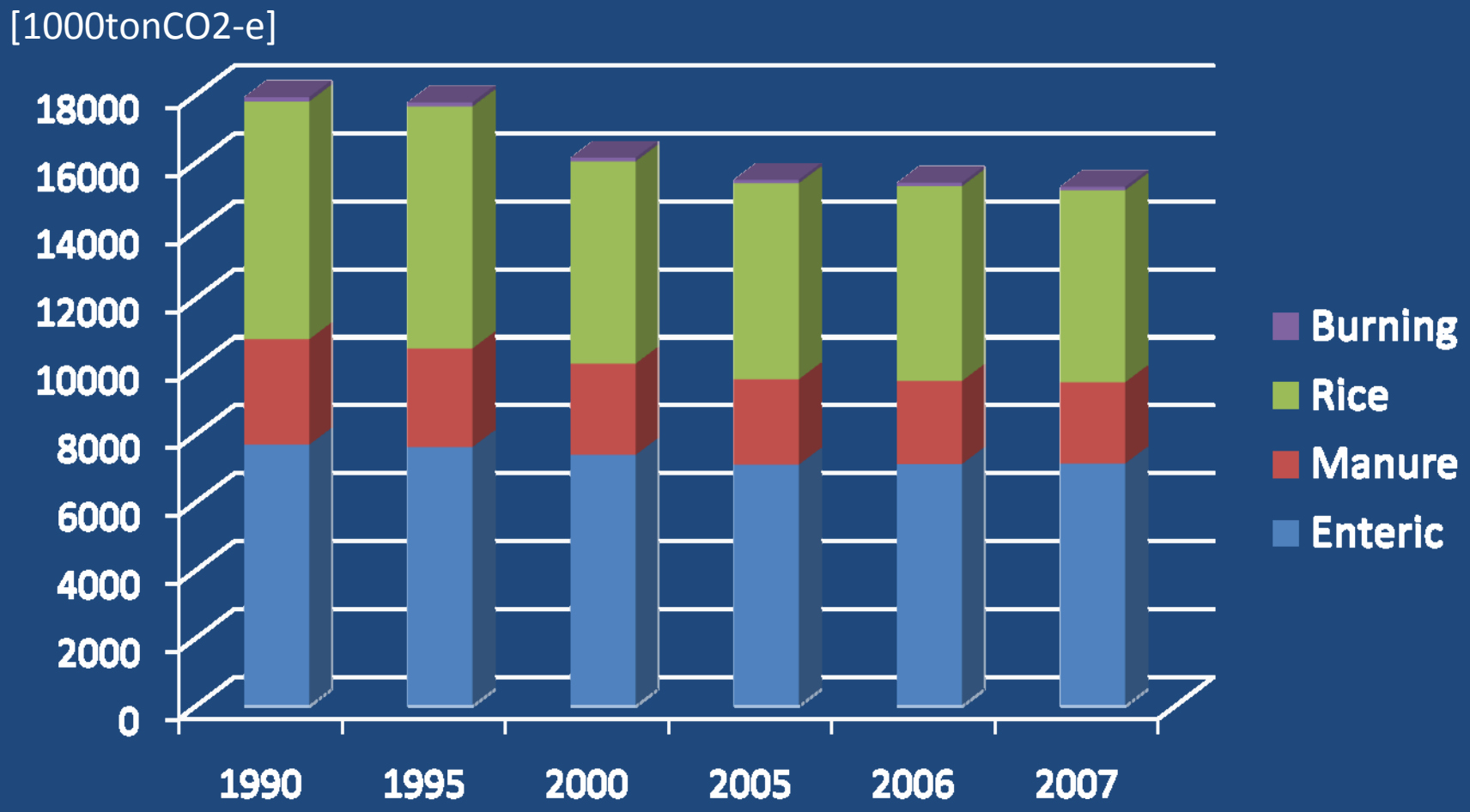
Non-CO_2 Emissions from Agriculture



Methane Emissions from Rice Paddy Fields –Japan

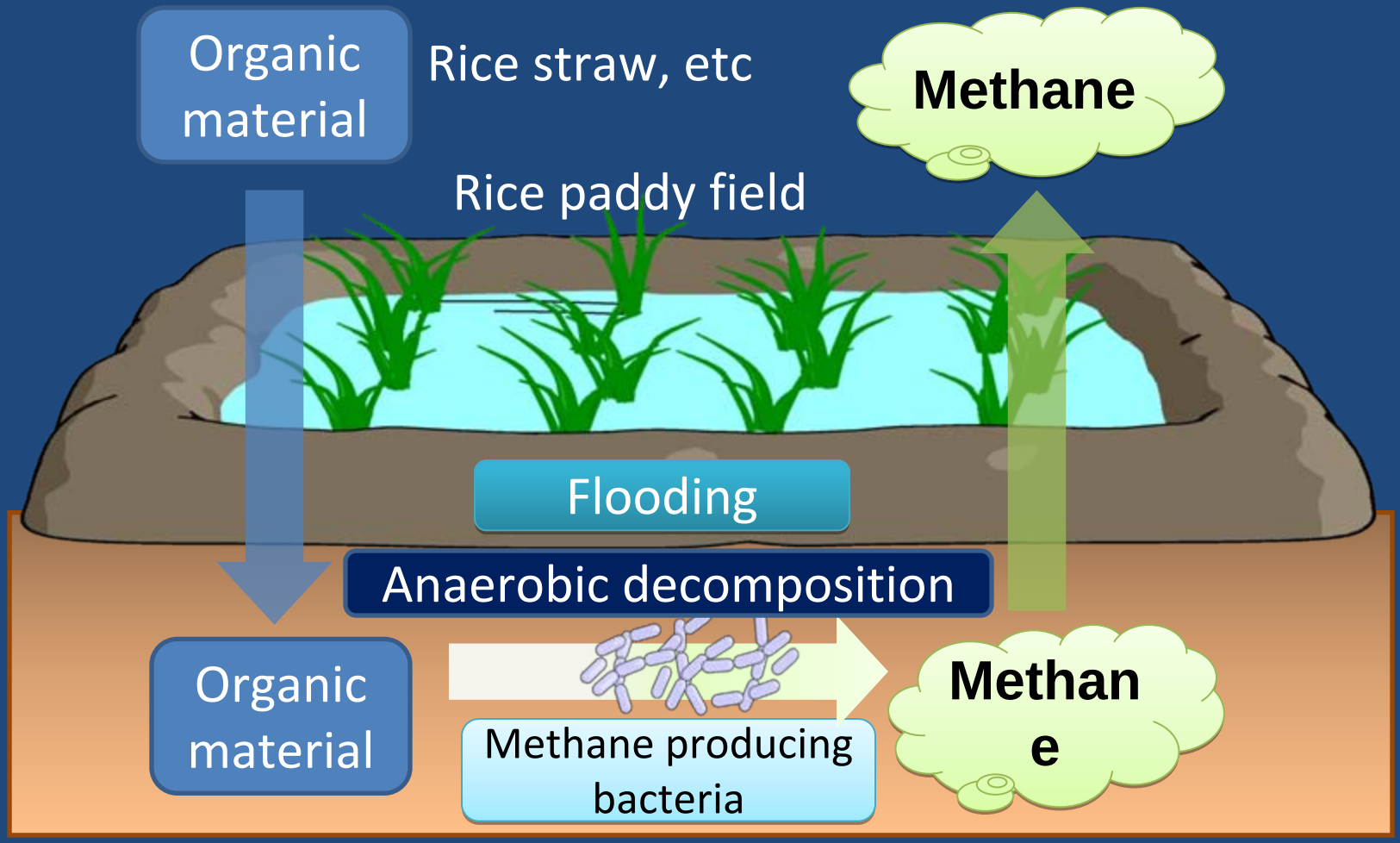
- Agriculture accounts for 2-3% of total GHG emissions
- Agriculture accounts for 68% of total methane emissions
  - Enteric Fermentation 31%
  - Rice Cultivation 25%
- Methane emissions from agriculture in 2007 decreased by 15% from 1990 level
  - Enteric Fermentation -7%
  - Rice Cultivation -19%

Methane Emissions from Agriculture in Japan



MECHANISM OF METHANE EMISSIONS FROM RICE PADDY FIELDS

Mechanism of Methane Emissions from Rice Paddy Fields



MEASURES TO REDUCE METHANE EMISSIONS FROM RICE PADDY FIELDS

Measures to reduce Methane Emissions from Rice Paddy Fields

- Water management
  - Mid-season drainage (“Nakaboshi”)
  - Intermittent flooding
  - Underdrainage
- Organic material management
  - Reduction of organic material amendment such as rice straw
- Crop management
  - Development of new varieties

Water Management

- Activity of methane producing bacteria is inhibited under oxidizing condition of paddy soil by water management

Mid-season drainage (“Nakaboshi”)

In mid-June, for 5-7days

Intermittent flooding

From July, 3 days flooding with 2 days drainage

Water Management Practice on Rice Paddy Field in Japan

Rooting stage	Deep flooding
Tillering stage	Shallow flooding
Productive tiller stage	Mid-season drainage
Reproductive stage	Deep flooding
Grain filling stage	Intermittent flooding
30 days after heading	Drainage

Mid-season Drainage

Effect of Mid-season Drainage

- Controlling nitrogen absorption
  - Reducing non-productive tiller
  - Increasing lodging resistance
- Keeping oxidative soil condition
  - Maintaining / promoting root activity

Increasing productivity and quality of rice

Decreasing methane emissions

Effect of Intermittent Flooding

- Keeping oxidative soil condition
  - Maintaining / promoting root activity
  - Smooth ripening
- Increasing soil bearing capacity
  - Smooth operation of agricultural machineries

Increasing productivity and quality of rice

Decreasing methane emissions

Organic Material Management

- Methane emissions depend on the type and amount of organic amendment applied
  - Rice straw, animal manure, green manure, compost, agricultural waste
- Methane emissions from fermented amendments are significantly lower than non-fermented amendments
  - Compost, residue of biogas pits
  - Contain much less easily decomposable carbon

Effect of Application of Compost

- Providing rice with plant nutrition
- Retaining plant nutrition
- Promoting plant growth
- Developing aggregate structure of soil

Increasing production stability and quality of rice

Decreasing methane emissions and sequestrating carbon

Conversion of Rice Straw Application into Composted Manure Application

Methane emission factor for intermittently flooded paddy fields

[gCH_4/m^2/year, (%)]

Type of soil	Straw amendment	Various compost amendment	No-amendment
Lowland soil	19.1(100) ⇨	15.3(80)	12.2(64)
Gley soil	17.8(100) ⇨	13.8(78)	11.0(62)

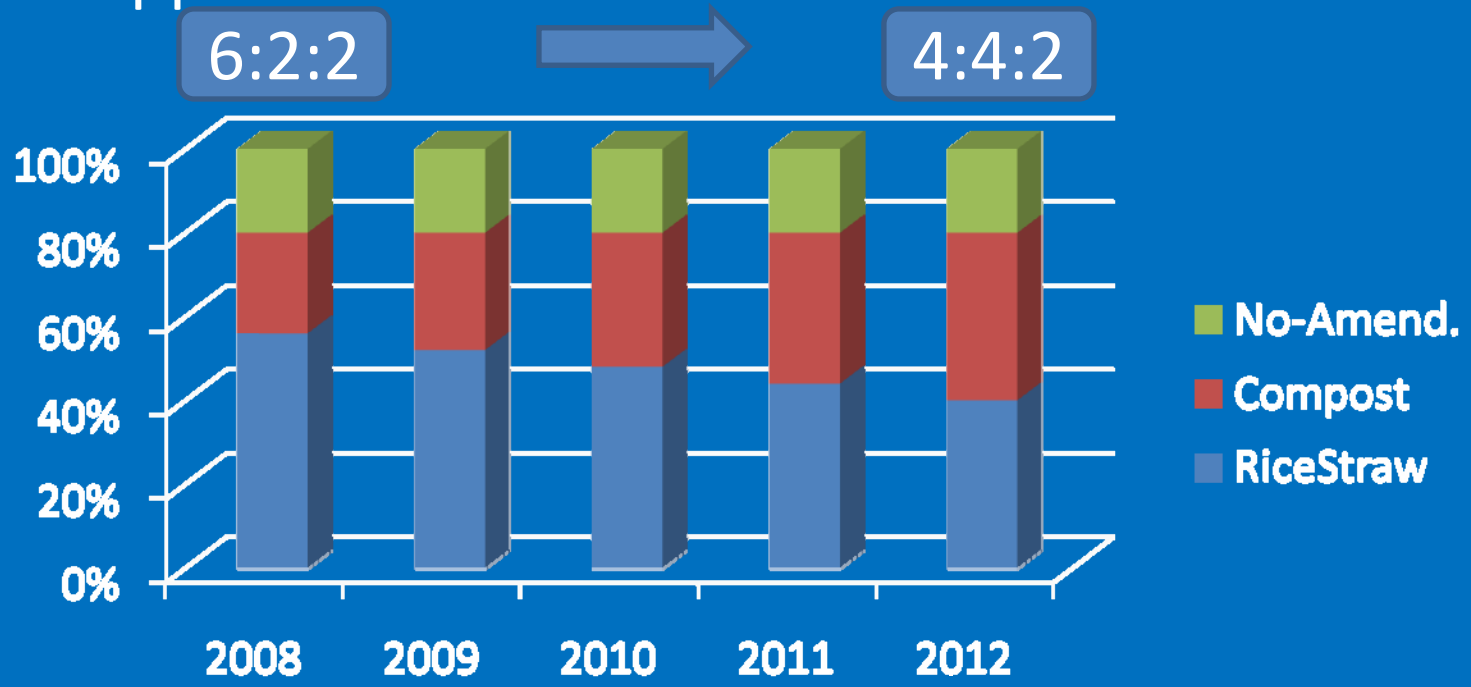
Decrease approximately 20%

POLICY AND MEASURES TO REDUCE METHANE EMISSIONS FROM RICE PADDY FIELDS IN JAPAN

Organic Material Management

Kyoto Protocol Target Achievement Plan

Target for conversion of rice straw application into composted manure application



Exchange of Rice Straw and Composted Animal Manure

Crop farmers

Rice straw

Composted manure

Livestock farmers

Composted Manure and Application

Composting process

Applying composted manure

Water Management

- Mid-season drainage and intermittent flooding is conventional practice in Japan
  - No additionality
- Extension of the duration of mid-season drainage can significantly reduce methane emissions according to the condition such as climate, soil, rice variety.
- Methane emission factor for extension of the duration of mid-season drainage for National Inventory Report is not available

Extension of Duration of Mid-season Drainage

"Study on New Water Management Technique to Reduce Methane Emissions"

- Demonstrating possible water management such as extension of duration of mid-season drainage, considering impact on productivity and quality of rice
- Developing emission factor for National Inventory Report
- Disseminating the new water management technique

Location of Demonstration









Result of Demonstration Study

Place : Fukushima prefecture

Method : Extending duration of mid-season drainage for 1 week/2 weeks longer than conventional practice

Result :

	1 week	2 weeks
Methane emissions	-34%	-58%
Yield	-2%	-18%

- N_2O emissions were negligibly small
- Quality of rice increased

POTENTIAL AND CHALLENGES

Potential and Challenges -Potential

- Potential for mitigation of methane emissions from rice paddy fields to be marketed in Asian countries is huge
  - CDM (Clean Development Mechanism), Emissions Trading, etc.
- Formulation of projects for reducing methane emissions from rice paddy fields by water management such as intermittent flooding is very important

Potential and Challenges -Challenges

- Quantitative assessment of methane emissions and potential for mitigation
- Cost-effect analysis for the project
- Monitoring/Verification for the activity
- Infrastructure for water management
- Institution for water management
- Organizer of the project

CONCLUSION

Conclusion

- Methane emissions from rice paddy fields is one of the major sources of non-CO2 GHGs from agriculture
- Water management and organic material management are significant for reducing methane emissions from rice paddy fields

Conclusion

- Mid-season drainage and intermittent flooding are effective for increasing productivity and quality of rice as well as reducing methane emissions in Japan
- Mitigation of methane emissions from rice paddy fields by water management has huge potential to be marketed

Thank you for your attention

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