Methane to Markets

Enteric Fermentation and Rice Cultivation:
Options for the M2M Partnership

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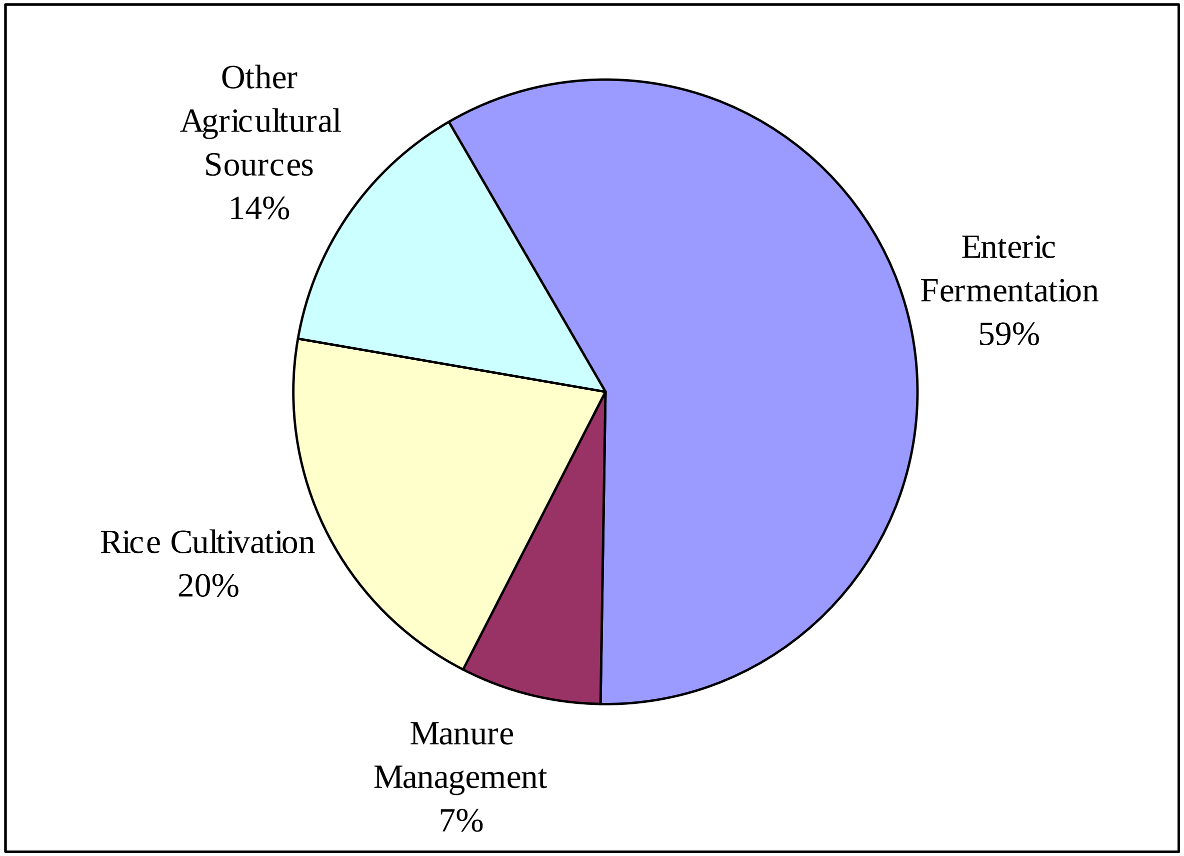
Background

- October 2007
  - M2M SC requested ASG to prepare a white paper outlining additional agricultural methane mitigation opportunities.
  - ASG paper focuses on rice cultivation and enteric fermentation, the largest sources of agricultural methane
- November 2008
  - UNFCCC's Ad-hoc Working Group on Long Term Cooperative Action (AWG-LCA) issued a report titled "Challenges and Opportunities for Mitigation in the Agricultural Sector"

The Agriculture (Ag) Sector

- Agriculture currently accounts for about half of global anthropogenic methane emissions, and 10-12% of global anthropogenic GHGs.
- Emissions from agriculture increased 17% from 1990-2005
- Food production is expected to double in the next 30 years, with corresponding increase in methane emissions.
- Policies and measures to mitigate emissions from agriculture require balancing a variety of goals including:
  - maximizing production and profitability,
  - ensuring food security,
  - mitigating other environmental impacts,
  - reducing GHG emissions.
- ***Reducing absolute global anthropogenic methane emissions will be challenging, but reductions in emissions per unit of production can be achieved.***

Global Methane Emissions from Agriculture (EPA 2006)



Total Global Emissions ~6.8 Gt CO2e/yr

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Sector Reduction Potential

- In 2030, the technical mitigation potential* for Ag will be 4.5 – 6 Gt CO2e (IPCC, 2007)
  - **9%** through improvements in rice management and livestock and manure management.

- Economic mitigation potential** for Ag overall in 2030
  - At **$20** per ton CO2e is estimated to be **1.5-1.6** GtCO2e/yr
  - At **$50** per ton CO2e is estimated to be **2.5-2.7** GtCO2e/yr
  - At **$100** per ton CO2e is estimated to be **4-4.3** GtCO2e/yr

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Enteric Fermentation Basics

- Ruminant animals contain bacteria in their digestive systems that break down cellulose resulting in more energy availability for the animal.
- Methane emissions from the rumen represents wasted feed energy.
- Major strategies for reducing emissions in near and long term include:
  1. Improving feed efficiency
     - In areas where forage is poor and animals have nutrient deficiencies mitigation strategies can lead to increased production
     - Will most likely lead to reductions in emissions per unit product but increases in emissions per animal
     - Improved feed efficiency may lead to greater N2O emissions from manure
     - Best practices must be adapted to site specific variations to improve feed/forage quality
  2. Changing the ecology of the rumen to reduce methane formation
  3. Improving herd management
- *Strategies should consider corresponding N_2O emissions as well as life cycle emissions of feed processing.*

Mitigation Options for Enteric Fermentation per Production Unit

	Near Term	Long Term
Improving Feed Efficiency	•Improving quality of forage/feed •Intensive grazing •Mechanical feed processing •Nutrient feed supplements •Administering hormones	•Supplementing feed with fats and oils •Supplementing feed with propionate precursors •Supplementing Feed with secondary metabolites
Changing Ecology of Rumen	•Administering antibiotics	•Administering anti-methanogen vaccines
Herd Management	•Balancing herd supply versus demand •Improving reproductive productivity and efficiency •Improving genetic characteristics •Increasing animal longevity	•Decreasing animal-based protein consumption

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Barriers to Mitigation Technology and Practice Deployment

- Cost
- Lack of Training
- Local Availability of Mitigation Technologies
- Policy and Cultural Barriers

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Organizations Working on Enteric-Climate Connection

- Food and Agriculture Organization (FAO)
- Commonwealth Scientific and Industrial Research Organization of Australia (CSIRO)
  - Developing a vaccine (could reduce emissions 30% but success is not certain)
- EU's Livestock Environmental and Development (LEAD) Initiative
- Livestock Emissions and Abatement Research Network (LEARN)
  - International research network to facilitate the development of cost effective GHG mitigation options
  - Active program of conferences on measurement

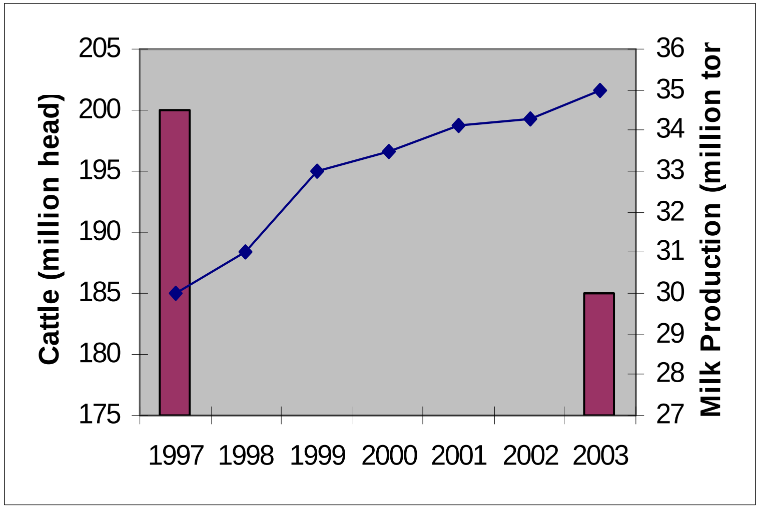
Options for M2M Engagement

- Assist in developing of more detailed inventory information in developing countries
- Work to develop and/or promote methodologies that could be approved by CDM
- Along with partnering organizations, develop, disseminate, and provide capacity building for best practices that reduce methane emissions but also improve profitability and improve sustainability of ruminant livestock.

Case Study: India

- Methane from cattle represent about 65% of India's total methane emissions
- 70% of cattle are owned by small farmers and landless laborers, and feed on poor feed/forage.
- Regional programs to improve herd management have reduced the number of cattle in India by 15% between 1997-2003 while boosting milk production.
- Analysis indicates that cost-effective feed additives could reduce emissions by 10-20%.
- Effect of these additives on N20 emissions from cattle remains uncertain.

Cattle Population and Milk Production 1997-2003



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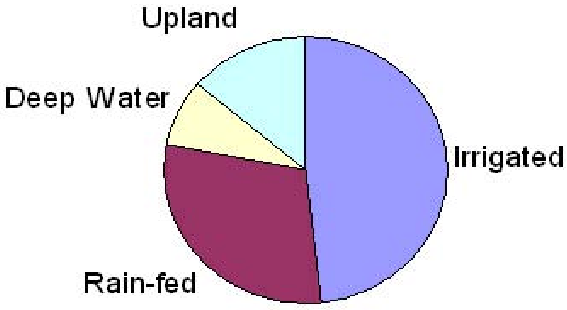
Rice Cultivation Basics

- Rice is critical to the health and well being of the majority of the world's population
  - 90% of rice paddies are in Asia, 60% in India and China alone.
- Methane emissions are affected by:
  - Length of time paddies are flooded
    - Draining fields can reduce methane but can cause higher N_2O emissions
  - Soil amendments
  - Tillage
  - Rice cultivar (genetics)
  - Soil characteristics
  - Climate

Global Water management systems For rice cultivation



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Rice Mitigation Strategies

- Mid-season drainage of rice paddies
  - Can cause increased emissions of N2O
- Direct Seeding
- Chemical Fertilizers
- Use of Different Rice Cultivars
- Improved Tillage and Crop Management Practices

Rice Cultivation Mitigation Potential

- Demand is expected to grow sharply in the future (10% by 2015)
- In 2010, 11% of emissions could be reduced at no cost.

	2010		2020	
	$0/ton	$30/ton	$0/ton	$30/ton
Reduction Potential (MTCO2eq)	109	226	114	238

Barriers to Rice Mitigation Options

- Reduced Yield and Field Fertility
- Limited Applicability to Different Types of Rice Fields
- Technical Capacity
- Costs
- Conflict with Cultural Practices
- Large Number of Farmers Involved

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Key Organizations Working on the Rice-Climate Connection

- International Rice Research Institute (IRRI)
  - The premier international rice research organization with staff in 14 countries in Asia and Africa.
  - Mission is to reduce poverty and hunger, improve the health of rice farmers and consumers, and ensure that rice production in is environmentally sustainable.
  - Engaged in many research projects related to methane emissions from rice
- Consultative Group on International Agricultural Research (CGIAR)
- International Water Management Institute (IWMI)
  - Supports research on mid-season drainage and other water conservation techniques
- Food and Agriculture Organization (FAO)
  - International forum where countries can debate policy
  - Sponsored the 2004 International Year of Rice and has been supporting tech transfer in rice production since
- Indian Agricultural Research Institute (IARI)
  - Credited with devising collection devices for measuring methane flux from rice fields.
  - Recent projects include evaluating methane and nitrous oxide emission from rice growing regions of India and assessments of mitigation options.
- GEF Small Grants Programme (SGP)

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Options for M2M Engagement

- Assist in developing more detailed inventory information in developing countries
- Along with partnering organizations, develop, disseminate, and provide capacity building for best practices that reduce methane emissions (and are N_2O neutral) as well as improve crop yield and water use efficiency.

Case Study: Vietnam

- Agriculture in Vietnam contributes about 30% of the national GDP
- GEF/SGP project pilot project
- 12 training courses for 20 irrigation workers and 100 households on water management regimes for rice paddies
- Reduced methane emissions and increased yields
- Success based on good coordination and harmonization with local agricultural extension work
- Could be replicated elsewhere in the country

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Barriers to Project Development

- In addition to barriers to technology and best practice deployment, there are also unique barriers to project development for these sources compared to other M2M sectors, including:
  - Development of baseline scenarios (high site level specificity, etc.)
  - Uncertainties in persistence of reductions and monitoring protocols
  - Methane mitigation strategies may lead to higher emissions of other GHGs (eg N_2O)
  - No methane use opportunities
- As a result, no rice or enteric projects have been approved through the CDM.

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Observations and Conclusions

- Enteric fermentation and rice cultivation are very significant sources of methane emissions.
- As compared with current M2M sectors, there is more uncertainty in the quantification of the magnitude and persistence of emission mitigation measures.
- There are best practices that can be implemented in the near term that can also improve production and/or deliver substantial environmental co-benefits.
- As compared with current M2M sectors, there is greater regional variability in best practices and approaches.
- Developing better inventories and methodologies for quantifying reductions is critical for both sectors.
- The organizations and experts for these sectors are quite different from those in the current Ag Subcommittee and from each other.
- Coordinating with these organizations and experts and leveraging their efforts with these sources is critical.

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Questions for Discussion

- Does the Steering Committee wish to engage in mitigation efforts from these sources and direct further work to identify how M2M could play a role?
  - Ex. Promoting inventory development, co-benefit best practice programs

- Should M2M attend the UNFCCC workshop to observe and report back on potential opportunities for engagement?

- Should the ASG and interested Steering and Agriculture Subcommittee delegates prepare a proposal on how to modify the TOR to include new Agriculture sources for review at the next Steering Committee meeting?