Evaluation for GHG emission from slurry storage of dairy cattle

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Manure management contribute a major source of GHG

Main GHG source of Agri. / above 4% of GHG share

<table>
<thead>
<tr>
<th>Step in Animal Food Chain</th>
<th>Estimated Emissions¹</th>
<th>(Gigatonnes)</th>
<th>(Percentage of total livestock sector emissions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land use and land-use change</td>
<td>2.50</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Feed production²</td>
<td>0.40</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Animal production⁴</td>
<td>1.90</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>Manure management</td>
<td>2.20</td>
<td>31</td>
<td></td>
</tr>
<tr>
<td>Processing and transport</td>
<td>0.03</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

¹ Estimated quantity of emissions expressed as CO₂ equivalent.
² Excludes changes in soil and plant carbon stocks.
³ Includes enteric methane, machinery and buildings.
⁴ Note: ns = not significant.
Source: Adapted from Steinfeld et al., 2006.

Year's report of The State of Food and Agriculture (FAO 2009)
Reduce the environmental impact for neighbor, air (malodor, dust), public water (N,P and pathogen pollution).....

But not enough for GHG

...new issue.

So, We started GHG research practice 20 years ago each personal level and around 10 years ago restarted at national scale project.
Measurement system for Composting (Depo.) of dairy cattle feces

First Measuring equipment for Manure GHG in semi-actual scale

Manure Management

Chamber for compost gas evaluate

Blower

Exhaust (Relatively dirty air from manure)
Our research Staffs are here:
Animal Research Center,
Hokkaido Research Organization
Institute of Okayama Animal Production,
Prefectural Technology Center
Animal Husbandry Research Institute, Kumamoto
Ishikawa Prefectural Livestock Research Center
Saga prefectural livestock experiment station
Rakuno Gakuen University
Agricultural Research Center for Hokkaido Region, NARO
Institute of Livestock and Grassland Science, NARO

We continue to measure GHG at several location of Japan with same procedure.
This work was supported by grants from MAFF, Japan

- Financial Support & Coordinates of MAFF
- Scientific Coordinates
  >> Dr. Kazuyuki YAGI  >> Dr. Ichiro TANIYAMA
  >> Dr. Toshiaki IMAGAWA
- Permission to our measurement
  >> Farmer,  >> friendly households
- Collaboration
  >> NIAES, >> Hokkaido University
  >> Niigata University, >> Tokyo Institute of Technology
  >> All NARO Institute
Evaluation for greenhouse gas emission from slurry storage of dairy cattle.
- Not only for inventory data but for the development of greenhouse gas regulations and technologies. We developed a system for quantitative measurement of emissions. Takashi Osada¹, Keiko Minato

Mitigating strategy of GHG emission from dairy manure composting process.
- Trial to reveal the mechanism of N₂O emission from dairy manure composting piles to establish an effective strategy for its mitigation. Koki Maeda et al.

Nitratation Promotion Process for Reducing N₂O Emission from Swine Manure Composting
Consequential activity balance of ammonia-oxidizing bacteria (AOB) and nitrite-oxidizing bacteria (NOB) reduce NO₂ generation and N₂O and NO might be reduced in conclusion. Yasuyuki Fukumoto

Reduction of Greenhouse Gas Emissions from Livestock Manure Management by Feeding Low-Protein Diet
- Environmental evaluation of the technique of feeding low-protein is being implemented from a life-cycle perspective. Akifumi Ogino, Takashi Osada
Flow of Nitrogen in Livestock Manure, Japan

Livestock housing (658 Gg/y of N)

Solid part
- 270 - 310 Gg

Liquid part
- 37 Gg

Piled compost (Deposition)
- 158 Gg

Composting
- 95 Gg

Wastewater purification

Pit storage & spread

Forced aeration (Mechanical turn)

Manure Management
Manure Management

Major Manure management contribute a major GHG source

- Composting (Depo.) of cattle feces
- Composting (Forced) of hens feces
- Pit Storage of daily cattle slurry
- Wastewater M. of pig waste
Pit Storage of dairy cattle slurry

- Cost effective (mixture S&L)
- Good for recycling of materials (manure-feed-livestock)
- Need land enough to spread manure
- Think Odor, balance of N,P,K...
Dairy farm in Hokkaido with slurry system (1/2)
Manure Management

Dairy farm in Hokkaido with slurry system (2/2)

Slurry are spread after mixing or agitation in their own grass land for fertilizer or stored slurry tank until suitable season.
E (mg/hour) = 
(conc. of outlet air (mg/m^3) - conc. of inlet air (mg/m^3)) \times \text{ventilation rate (m}^3/\text{hour})
A capacity of 530L and covered 1.04 m² of the slurry surface. **Exhaust air** from the chamber through the outlet port at the center of the top **at rate of 0.4 m³/min**

**Fresh air was supplied** to the room at a height of **about 0.15 m** above the slurry surface **through six injection** passed through the relay tub placed on top of the chamber.
Manure Management

GHG emission measurement system for Slurry storage tank (3/4)

- **CH4**
  - A: (g/m²/day)
  - B: (g/m²/day)

- **NH3**
  - A: (g/m²/day)
  - B: (g/m²/day)

- **N2O**
  - A: (g/m²/day)
  - B: (g/m²/day)

Dimensions:
- W: 23m
- D: 4.5m
Manure Management

GHG emission measurement system for Slurry storage tank (4/4)
Manure Management

GHG emission measurement system for Slurry storage tank -Results-

Storage Tank: 23m diameter / 4.5m depth
Store 150 heads of milking cow slurry around 180 days
20-30kg of CH₄ & a few N₂O emit./day
We developed a system for the quantitative measurement of emissions from major manure treatment systems using a large dynamic chamber in an experiment.

Not only the compost, but the emission factor of each treatment system should be evaluated under each country's procedure and general conditions, because those factors might be widely varied.

It is important that every country has the measurement technique of GHG emission, not only for inventory data but for the development of greenhouse gas regulations and technologies.
Manure Management

Composting (Forced) of hens or pig feces (1/2)

- High Cost
- High quality, recycling materials (high price: around 500 yen/package (20L))
- Think concentrated odor problem
Composting (Forced) of hens or pig feaces (2/2)

Measurement system for Composting (Forced) of hens feaces

Gas monitor for GHG measure

BG sample

Exhaust air sample

Pressure monitor

Sensor

Sensor

Turning

Blower

Blower

Exhaust

Composting facility

Deodorization facility
• High Cost (same as sewage)
• High reliability for removal and good for environment.
• Think N recycle
Manure Management

Chamber for wastewater treatment system

Gas monitor for GHG measure

Measurement system for Wastewater purification of pig waste

Inlet (Fresh air, BG)

Exhaust (Relatively dirty air from manure)

Blower for Exhaust

Aeration for activated sludge treatment

Blower
Manure Management

See you in Poster section at coffee break!

Research project on “Development of mitigation technologies to climate change in the agriculture sector”
A New “Milk Roadmap” in Japan—A Trial Focused on milk production—
Takashi Hinata, Yoshiaki Kimura
Central Agricultural Experiment Station, Hokkaido Research Organization

Summary
- To reduce GHG emissions in Japan, manure management is one of the most effective ways.
- The Milk Roadmap is in action for all farms and will cover all areas.
- Success factors: reduced costs, improved sustainability, increased milk production.

Manure Management

Model simulation of NO₂ accumulation during swine wastewater treatment
Hirofumi Kawahara, Yuiyoichi Wakiya, Kohei Yamamura, Takashi Osada
National Institute of Livestock and Grassland Science

Summary
- The model was used to simulate the accumulation of NO₂ in swine wastewater treatment.
- The results showed that the model could simulate NO₂ accumulation in wastewater treatment.

GHG mitigation in animal manure management by feeding strategy and its evaluation from life-cycle perspective
Makoto Shiraishi, Takashi Sawamoto, Kojiro Nemoto, Motoo Nakayama, Tatsuku Inaba
Hokkaido University, Hokkaido University, National Research Institute of Biological Resources, Hokkaido University

Summary
- GHG mitigation strategies can be implemented to reduce emissions.
- The study evaluated the impact of feeding strategies on GHG emissions.

Development of Mitigation Technologies of GHG Emissions from Animal Waste Treatment
Makoto Shiraishi, Takashi Sawamoto, Kojiro Nemoto, Motoo Nakayama, Tatsuku Inaba
Hokkaido University, Hokkaido University, National Research Institute of Biological Resources, Hokkaido University

Summary
- The study developed and evaluated mitigation technologies to reduce GHG emissions from animal waste treatment.
- The technologies were tested in animal waste treatment processes and evaluated for their effectiveness.

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