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Technologies coping with global and local environmental issues related to livestock development

Masaki Shibata
Institute of Livestock Industry’s Environmental Technology,
Livestock Industry’s Environmental Improvement Organization,
Japan

Increase in the demand of livestock products in developing countries:

- Nutritional benefits to the people
- Provision of income and increase in economic stability

⇕

- Rapid expansion of livestock development likely causes global and local environmental problems

Current developments of technologies to solve such problems based on the Japanese experience

- Use of food waste for animal feed
- Development of technologies on animal waste treatment
- Development of technology on climate change

Use of food waste for animal feed

Economical and Ecological feed

"Ecofeed"

Traditional but new technology

Environmental burden

Incineration

Landfill

(40%)

Compost

(22%)

Industrial Food Waste
(11 million ton)

Use as feed (21%)

Promotion of the use as feed !!

Background

- Self-sufficiency of food 41% (Feed 26%)（2009)
  - Corn import 12 million ton per year
- Food Waste Recycling Law enforced (2001, revised 2007)
  - Ecofeed as first priority
- BSE incidence and Amendment of Feed Safety Law (2001)
  - Food waste can be fed to swine and poulrty
  - No animal materials for ruminants
- Council for improving self-sufficiency of feed (2005）
  - Feed self-sufficiency 24% → 35%
  - Concentrate feed self-sufficiency 10% → 14%
  - Producing ecofeed from food waste
    - 2.5 million ton → 5.1 million ton

Processing of food waste for ecofeed

Distribution

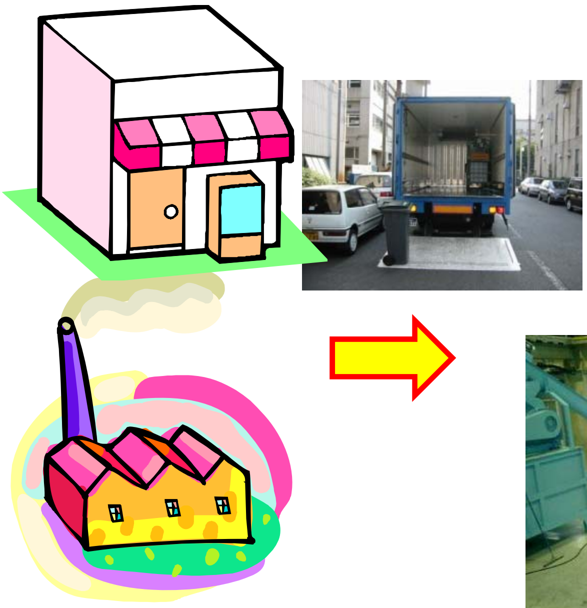
Wide area ↔ Small area

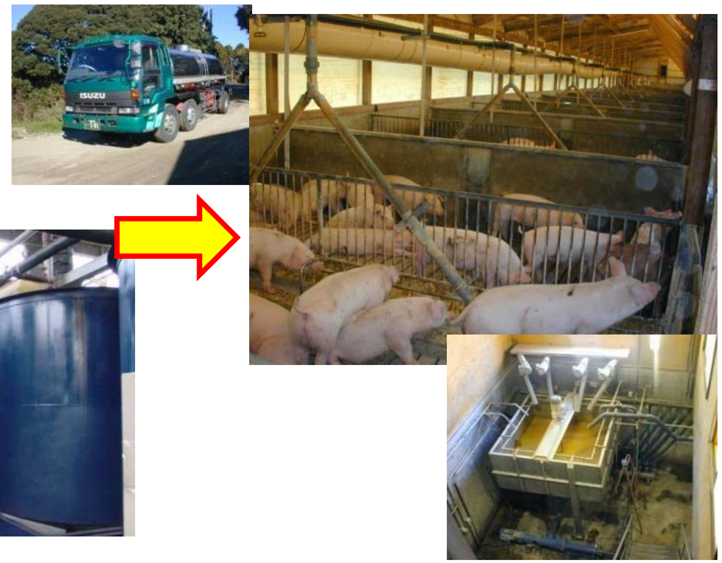
Dehydration

Silage

Liquid feeding

Fermented Liquid feeding system





Food industry

Soup center

Pig farm

Collection and formulation

Nutritive value

Feed formulation

Feed Preparation

Heat treatment

Use of organic acid

Inoculation of lactic acid bacteria

Incubation

Feeding system

Feeding system

Effect of animals

Nutritive value

Integration of Feed Producing Technology

Fermented liquid feeding

High moisture materials

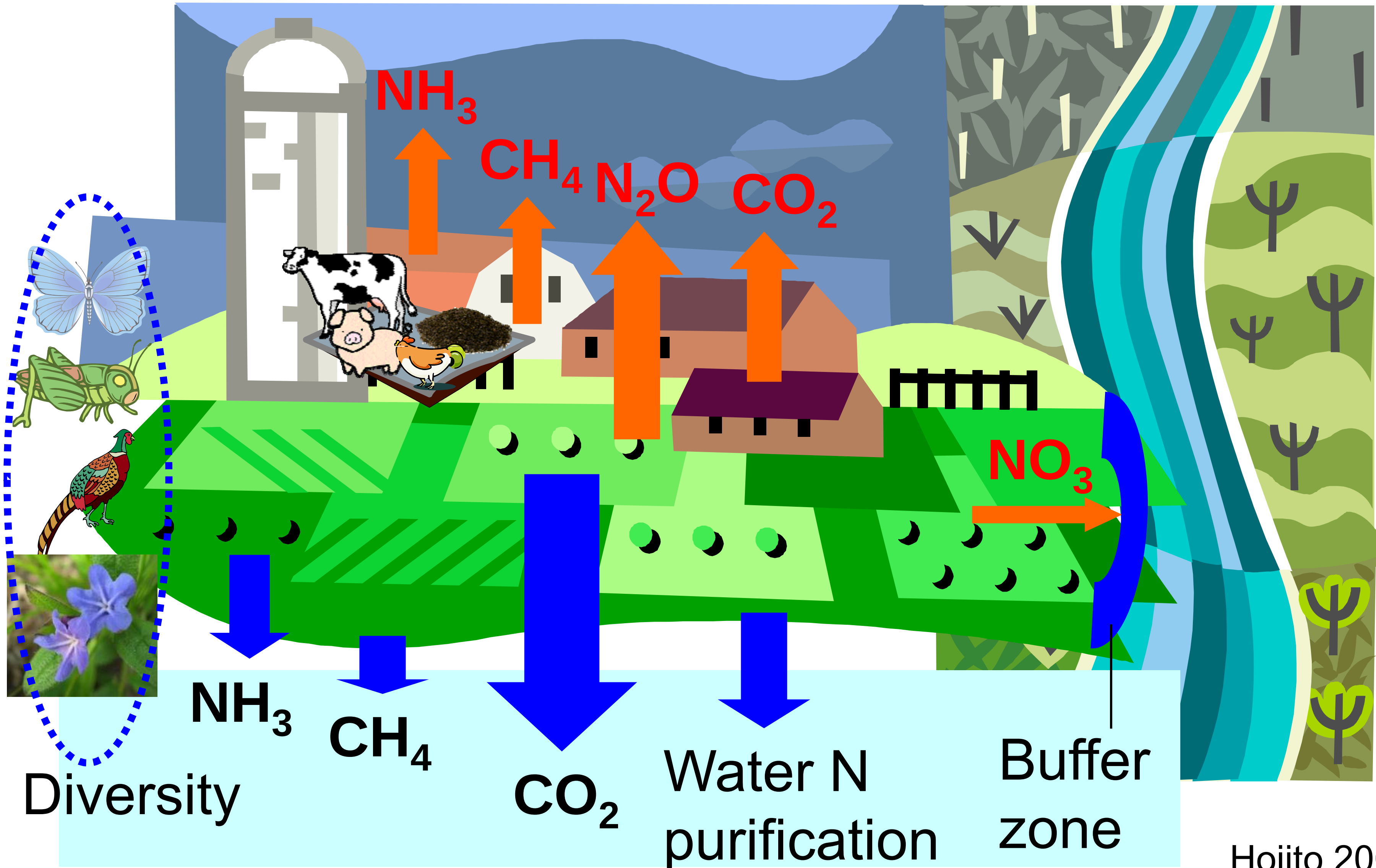
- Shochu (distiller's) residue
- Cheese whey & milk
- Vegitables residue
- Bio-ethanol residue

Soft grains

- Rice and wheat
- Corn cob mix

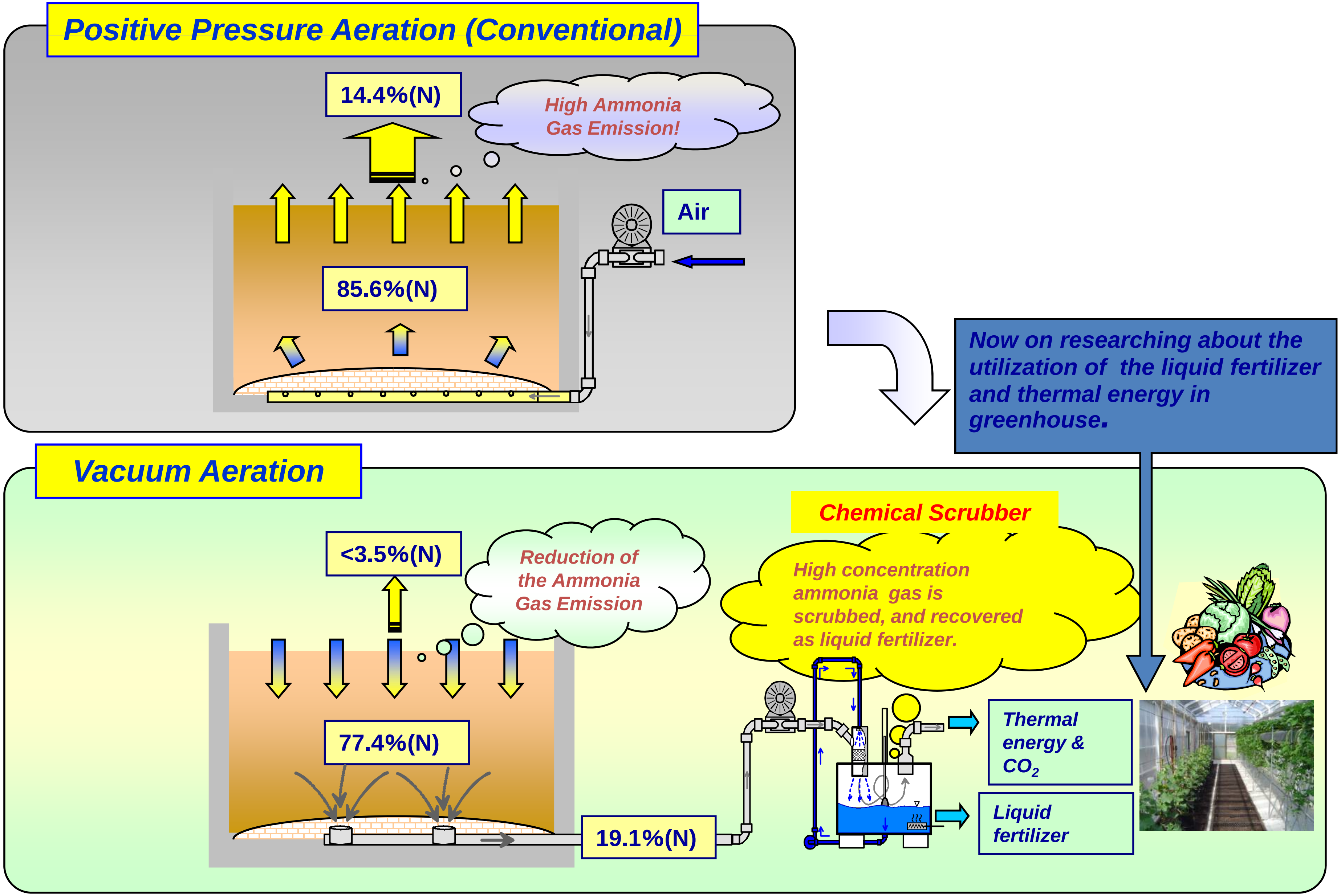
Structural reform of feed producing capacity

Animal production and environment



Hojito 2008

Introduction of the Vacuum Aeration System (VAS)

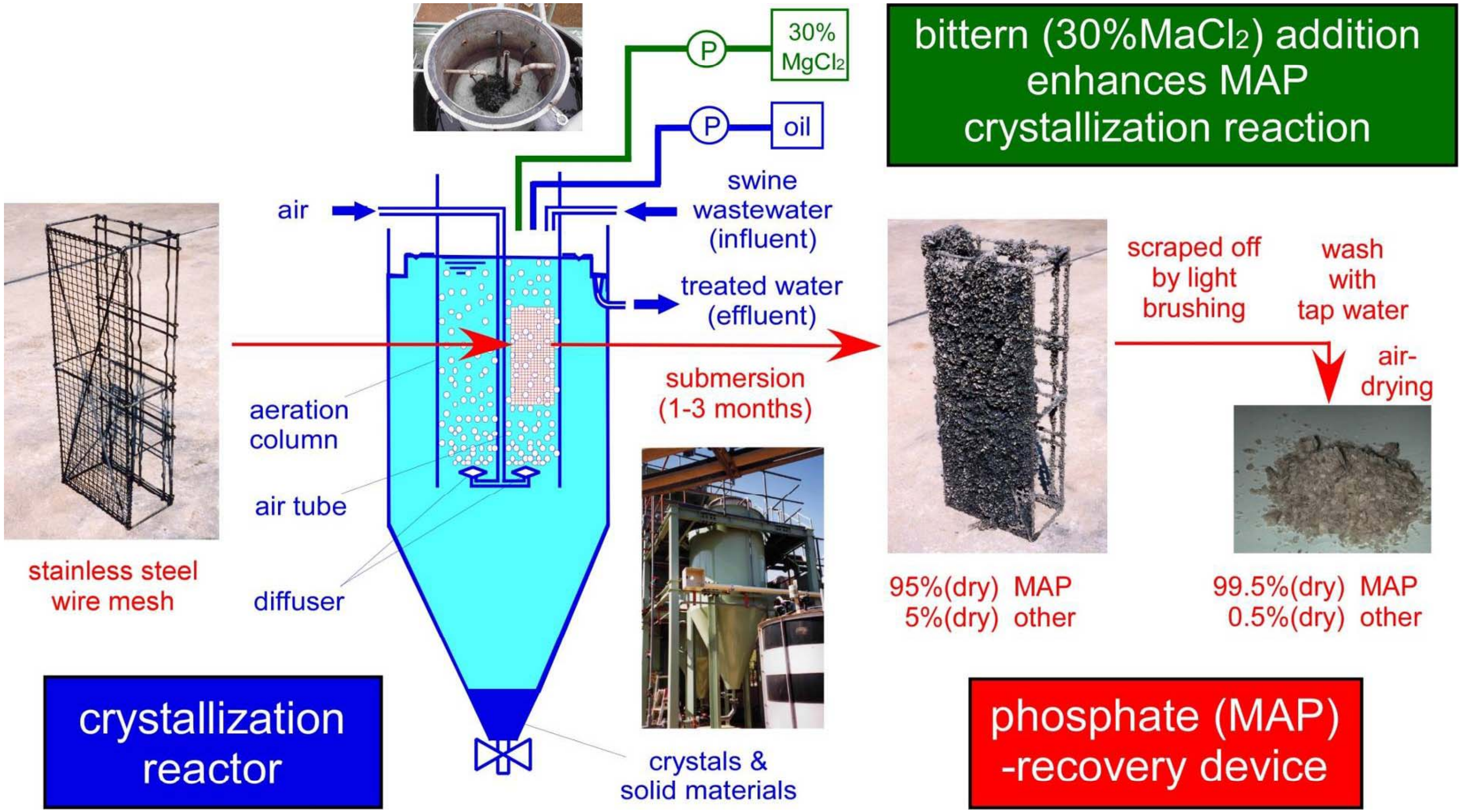


Abe et al. 2008

VAS Pilot Plant

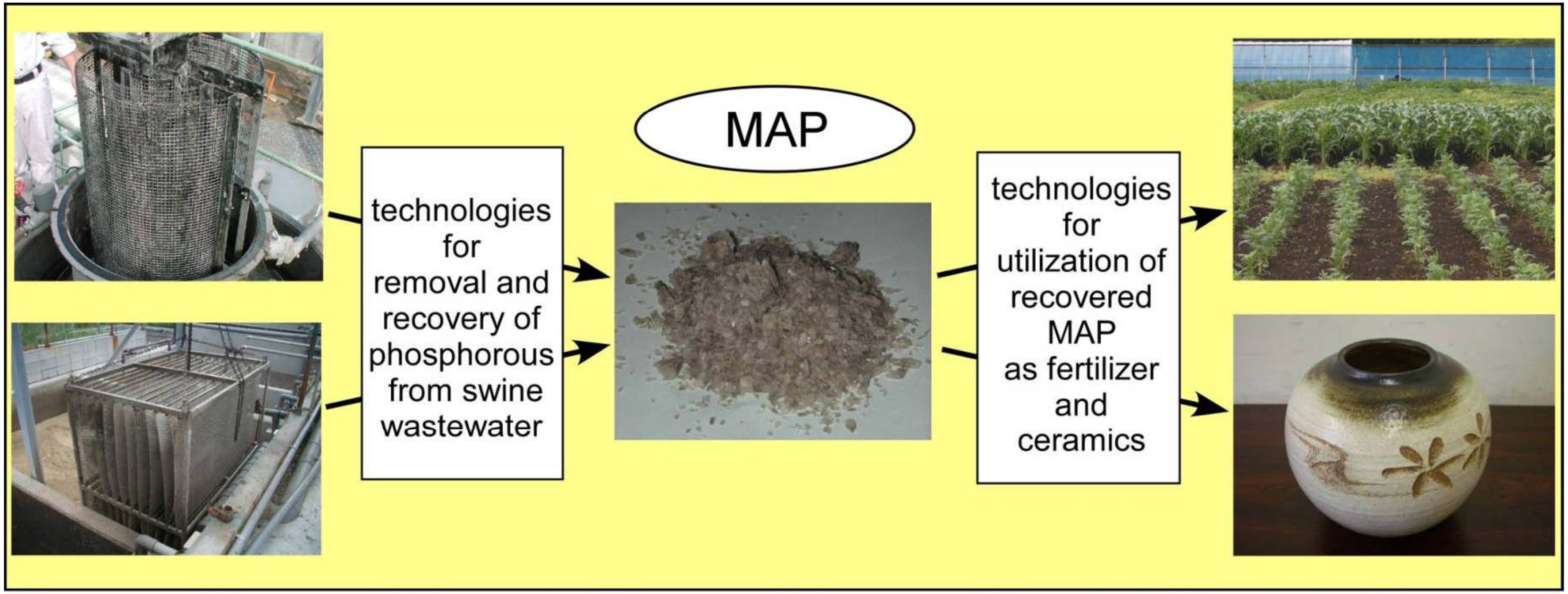
1) Organic matter decomposition is accelerated and thermophilic phase is finish within 4 weeks.
2) Ammonia gas emission from the surface of the pile is reduced to 1 - 10%.
3) 0.94kg of nitrogen is recovered from 1 ton of dairy cow feces by the chemical scrubber.
4) 2.95×10^5 kcal of thermal energy (estimated 23.8 L of kerosene in calories) is generated from 1 ton of feces.
5) CO2 gas is supplied continuously to the greenhouse.

Summary of the technology for phosphate removal and recovery from swine wastewater



MAP : Magnesium Ammonium Phosphate

Phosphate recovery from swine wastewater



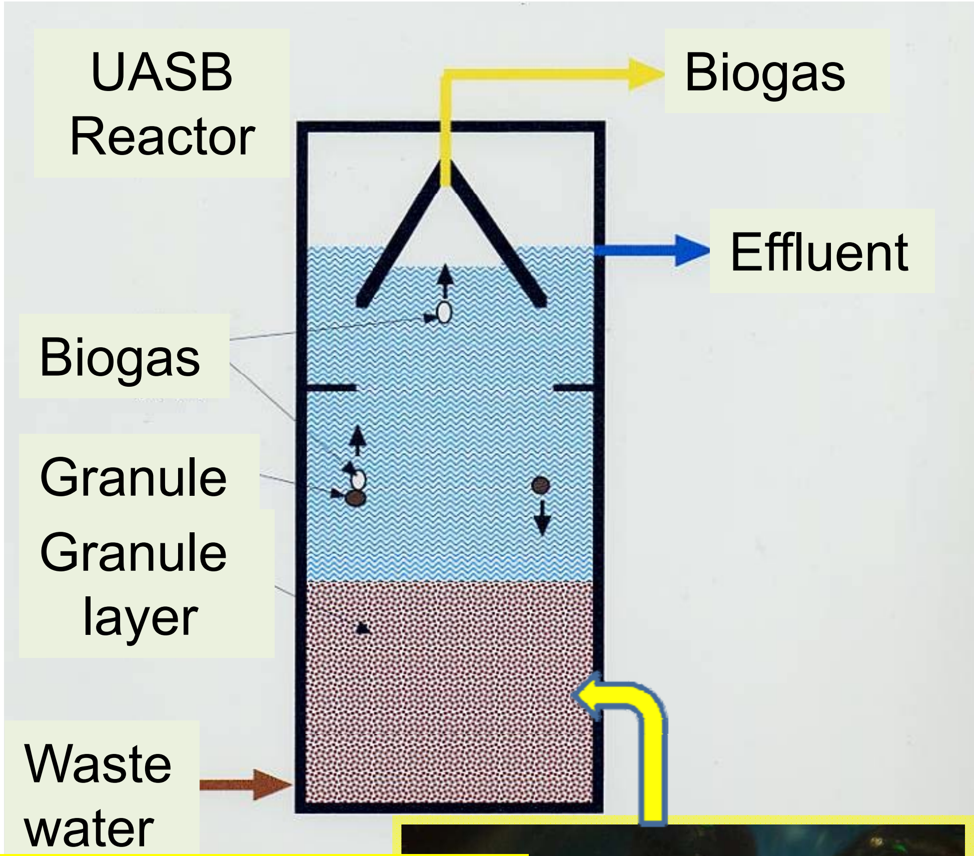
(1) removal of phosphorous for keep environment clean and conformity with law

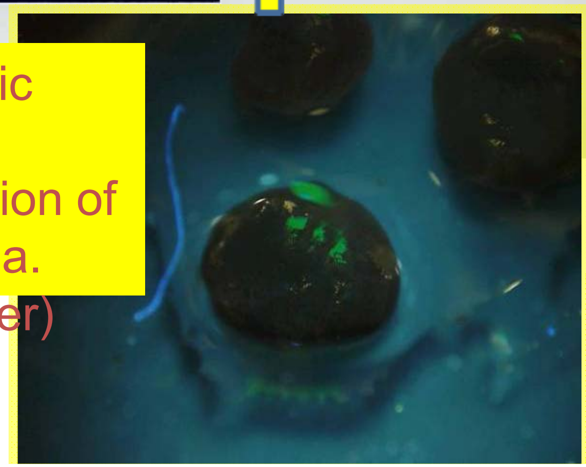
(2) recovery and recycle of phosphorous as resource

Suzuki et al., 2008

Upflow Anaerobic Sludge Blanket (UASB) Reactor

Tanaka & Suzuki, 2004





A granule of anaerobic bacteria,
including high concentration of methanogenic bacteria.
(2~4 mm in diameter)

Napier grass production under various application rates of cattle feces (Matsuo et al. 2001)

-Development of sustainable agriculture in Northeast Thailand (JIRCAS)-

Site: Khon Kaen Animal Nutrition Research Center, Khon Kaen, Northeast Thailand

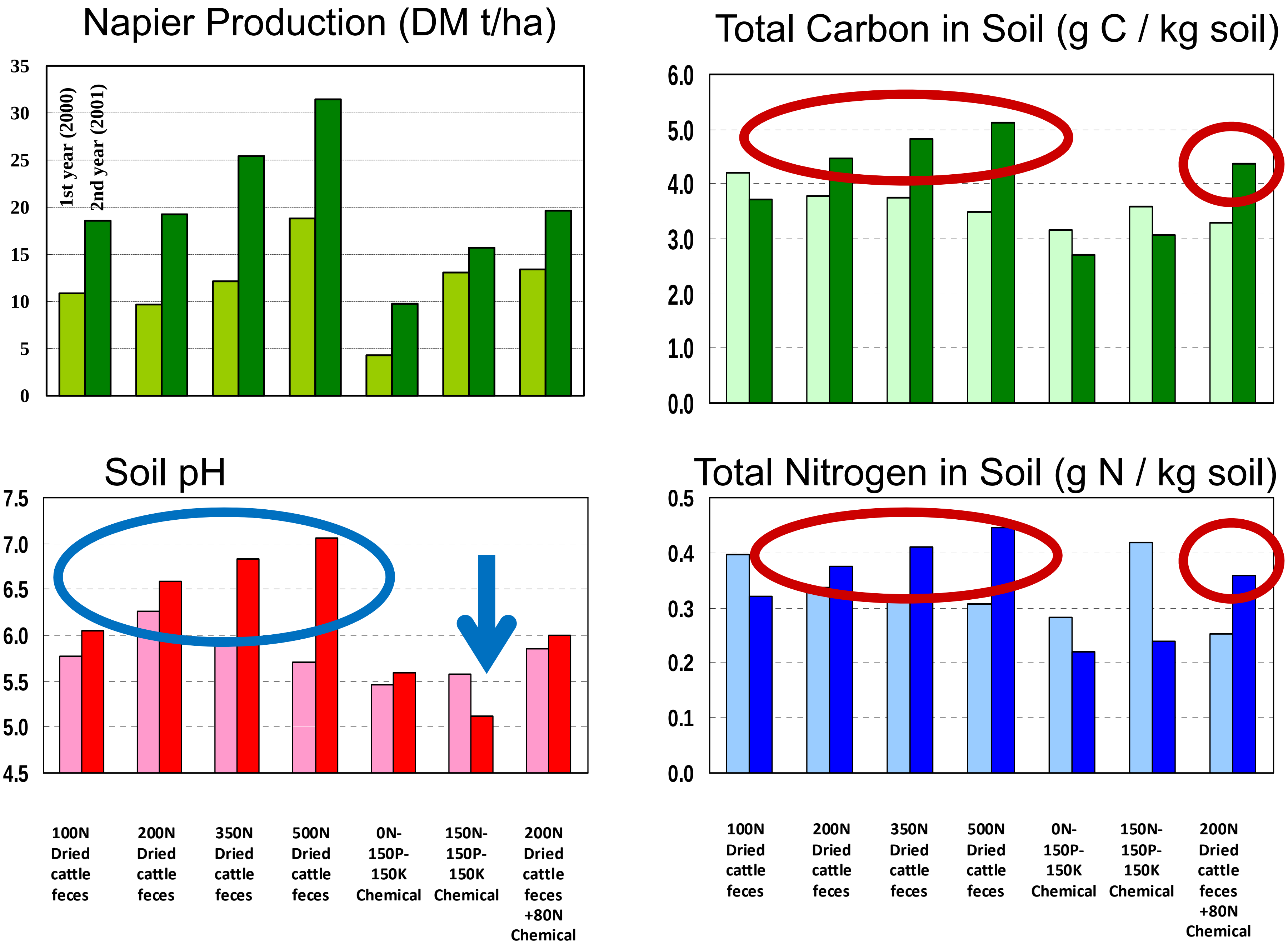
Crops: Napiergrass

Fertilizer application:

- Dried cattle feces: 100 kg N/ha
- Dried cattle feces: 200 kg N/ha
- Dried cattle feces: 350 kg N/ha
- Dried cattle feces: 500 kg N/ha
- Chemical: 0-150-150 kg N-P_2O_5-K_2O/ha
- Chemical: 150-150-150 kg N-P_2O_5-K_2O/ha
- DCF: 200 kg N/ha + AS: 80 kg N/ha

Comparison of soil fertility between Thailand and Japan

	Northeast Thailand	Japan
Total Carbon (g C / kg soil)	3.6	32.7
Total Nitrogen (g N / kg soil)	0.31	2.75
Available Phosphorus (mg P / kg soil)	19	83



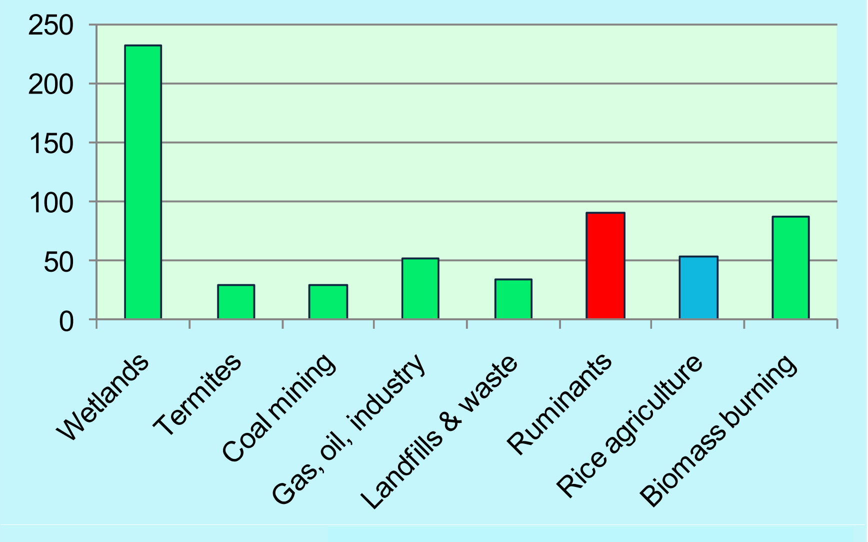
Napier Production (DM t/ha)
1st year (2000)
2nd year (2001)
35
30
25
20
15
10
5
0
Total Carbon in Soil (g C / kg soil)
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Soil pH
7.5
7.0
6.5
6.0
5.5
5.0
4.5
Total Nitrogen in Soil (g N / kg soil)
0.5
0.4
0.3
0.2
0.1
0.0
100N Dried cattle feces
200N Dried cattle feces
350N Dried cattle feces
500N Dried cattle feces
0N-150P-150K Chemical
150N-150P-150K Chemical
200N Dried cattle feces +80N Chemical
100N Dried cattle feces
200N Dried cattle feces
350N Dried cattle feces
500N Dried cattle feces
0N-150P-150K Chemical
150N-150P-150K Chemical
200N Dried cattle feces +80N Chemical


Crop-Animal Integration
Animal waste: precious resource
Improvement of soil fertility
Improvement of crop-animal production and its sustainability
Improvement of farmer’s income

Research issues of global warming in animal production

Methane(CH_4) and nitrous oxide (N_2O) are potential greenhouse gases produced from animal production system.

In the Kyoto Protocol (1997), our country promises greenhouse gas 6% reduction.

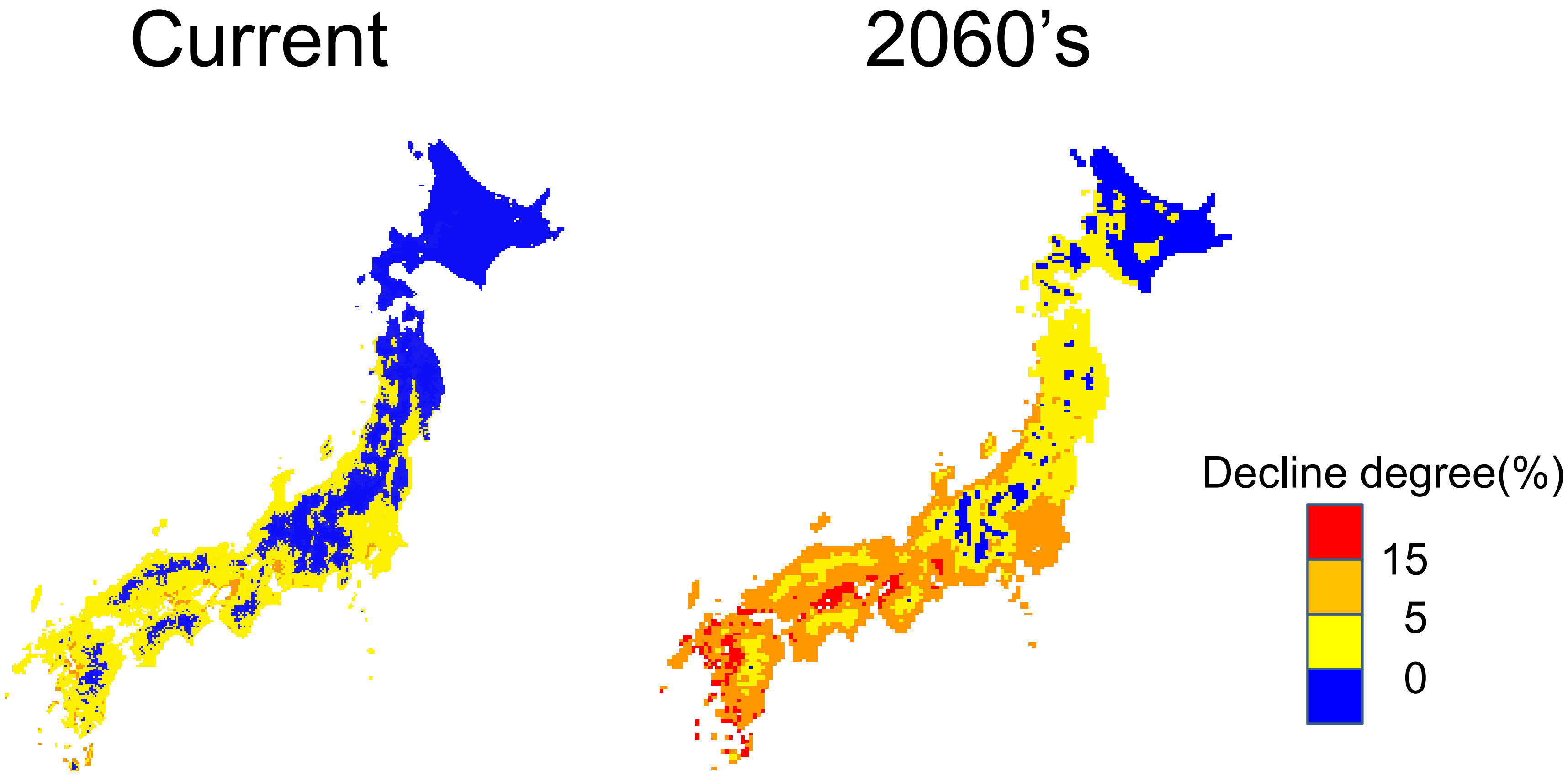


Mikaloff Fletcher et al., 2004

Agriculture is main methane gas source.

1. Development of the technology to estimate CH4 emission from ruminant accurately and to reduce the amounts of the gases emitted from animal production.
2. Development of the technology to estimate greenhouse gas emission from animal waste treatment
3. Evaluation of the effect of increase in ambient temperature on animal production

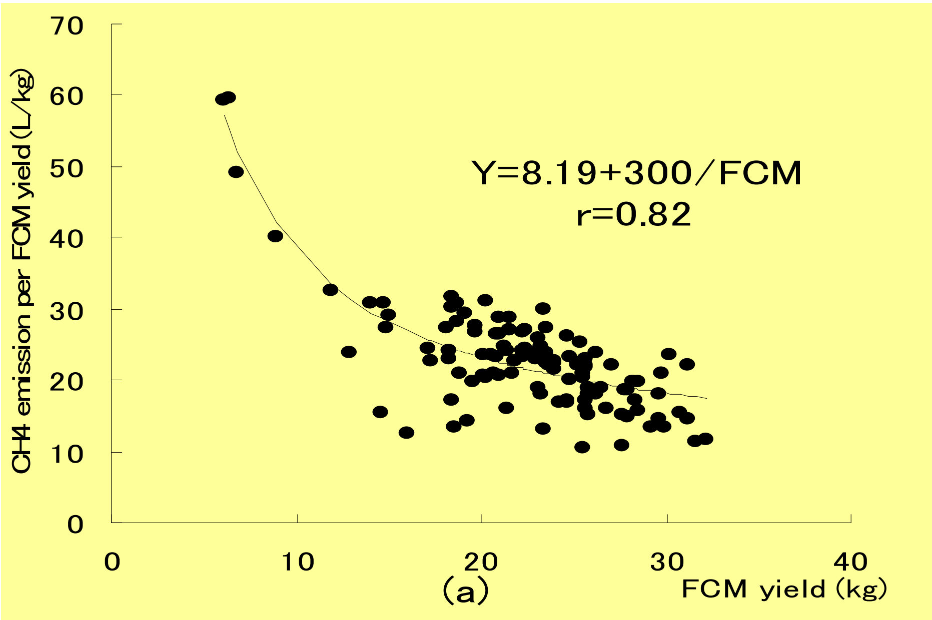
Spatial distribution of the declining degree of broiler meat production in current and 2060's August.



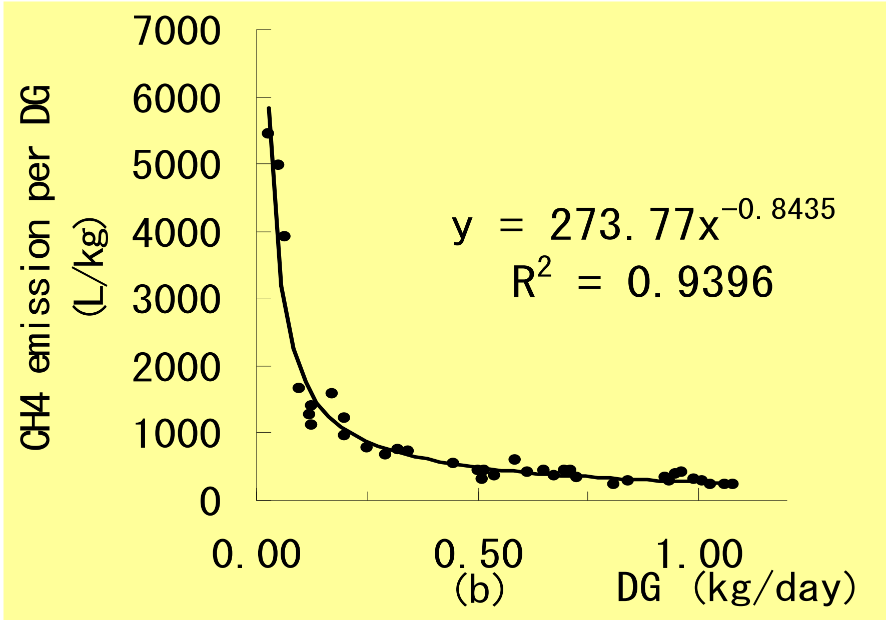
By the combination of the database of "Climate Change Mesh Data (Japan)" and the data on the relation between ambient temperature and meat production, geographical differences of the climate change on meat production in Japan were examined. (Yamazaki et al. 2006)

Research for control of greenhouse gas emission

Methane reduction by improvement of productivity



Kurihara et al., 1997



Terada et al., 1997

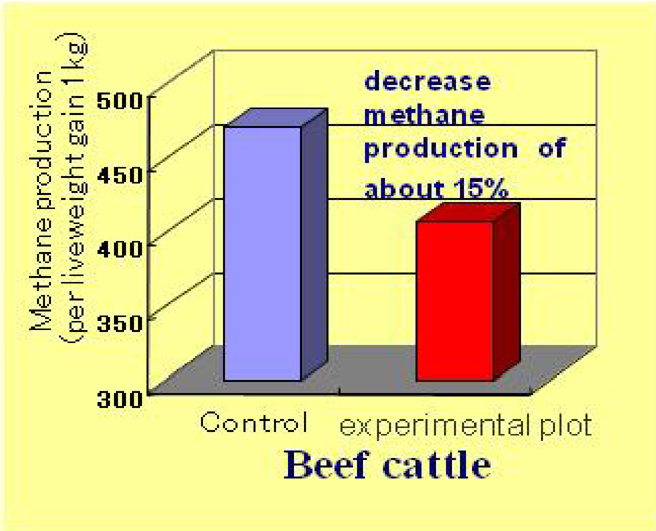
(a) CH_4 emission per kg fat corrected milk(FCM)

(b) CH_4 emission per kg daily gain (DG)

The relationship between productivity and methane (CH_4) emission

Methane Reduction by feeding management

Feeding calcium salts of fatty acid



Cost analysis of feeding calcium salts of fatty acid to beef cattle (Yen)

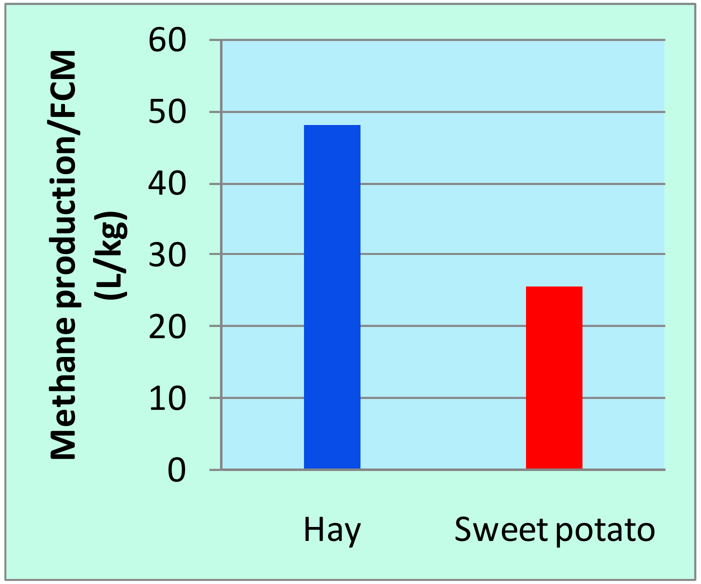
	Control	Experiment	Difference
Feed cost	86035	119841	33806
Carcass price	482820	517400	34580

Shiba et al., 2003

Feeding sweet potato

Feed intake (kg/day)

	Hay	Sweet potato
DM intake	6.9	8.6
Hay	6.9	3.1
Sweet potato	-	5.5

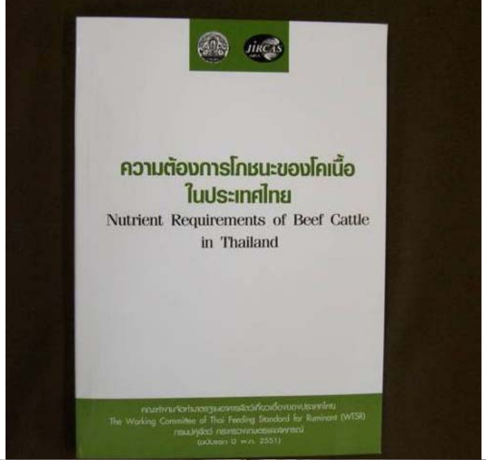


Methane production per fat-corrected-milk (FCM) yield

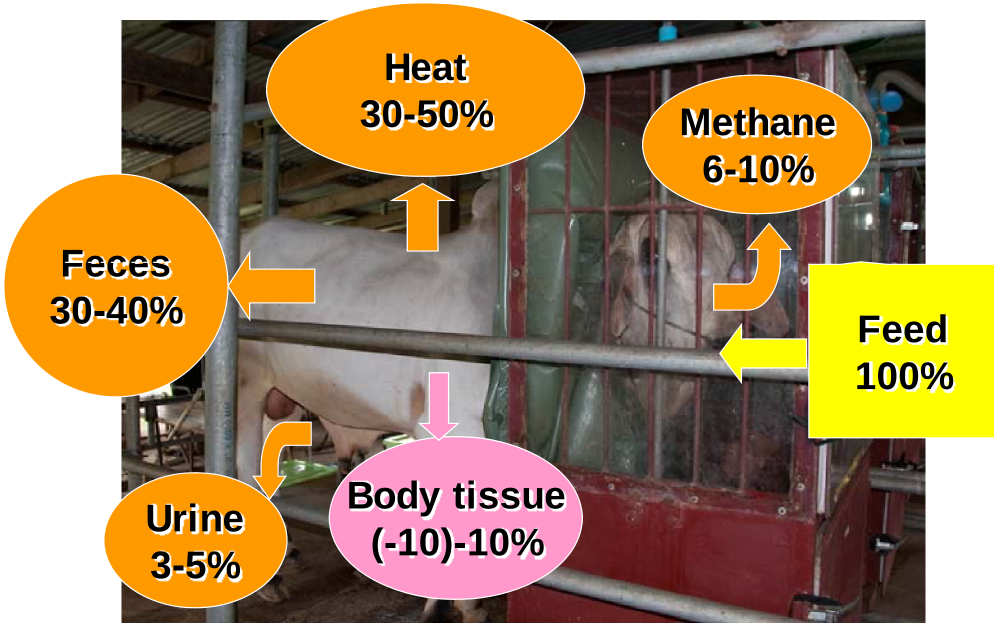
Shioya et al., 2001

Collaboration between JIRCAS & Dept. Livestock Development of Thailand

Establishment of a Feeding Standard of Beef Cattle and a Feed Database for the Indochinese Peninsula

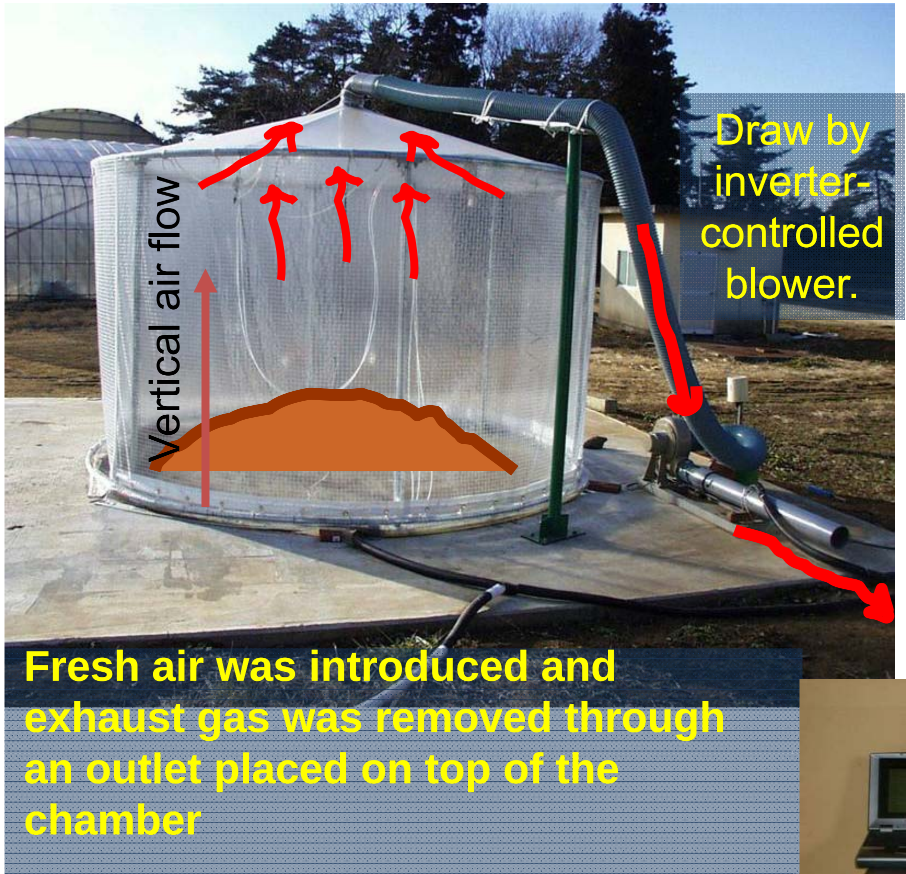


Distribution of gross energy consumed



Measurement system of green house gas from animal waste treatment

From composting

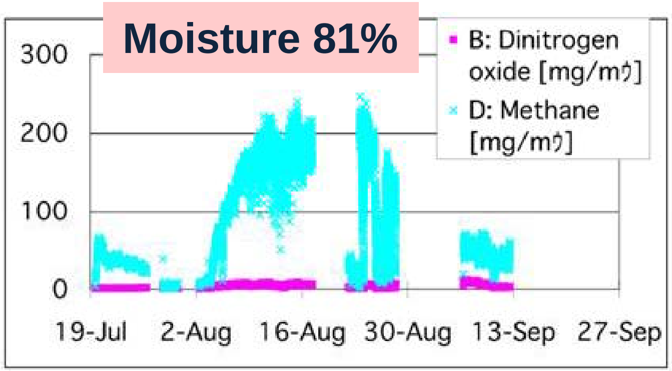


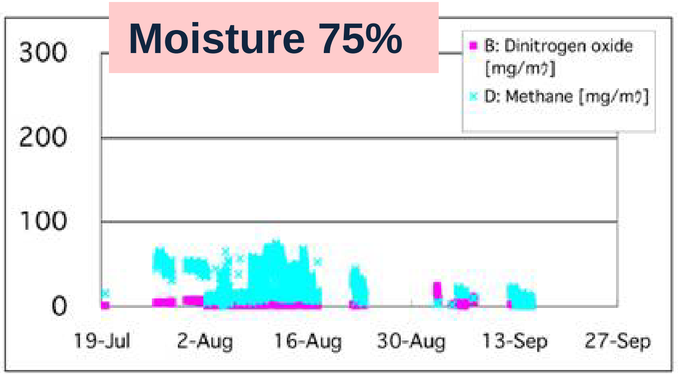
From slurry storage

National Institute of Livestock and Grassland Science, Hokkaido Animal Research Center, Okayama Prefectural Center for Animal Husbandry & Research, and Kumamoto Prefectural agricultural Research Center

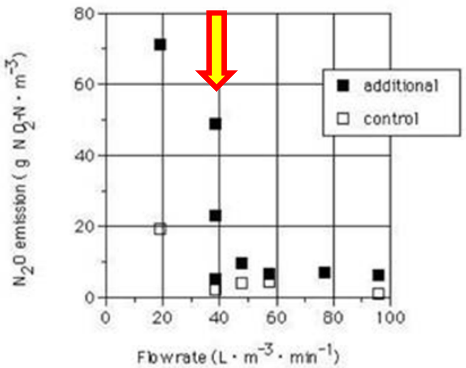
Reduction of GHG from animal waste treatment

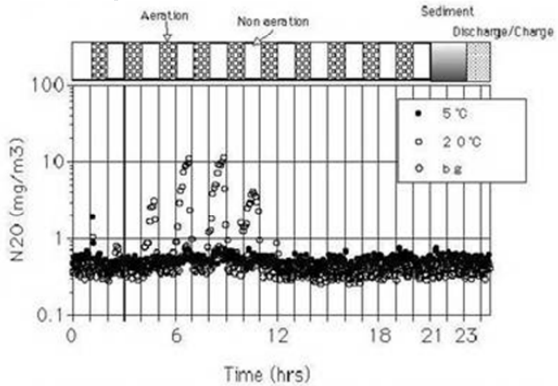
- CH_4 & N_2O emission can be reduced by decreasing moisture content of the pile manure (Osada et al., 2005) .

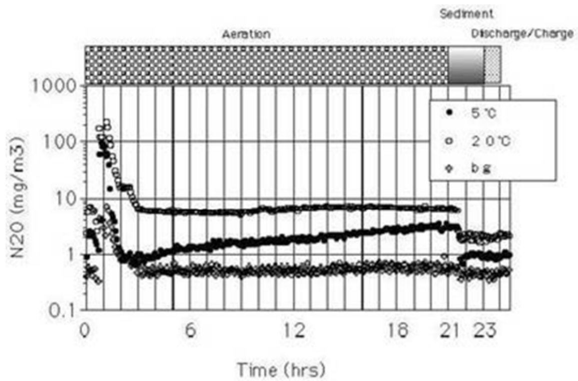




- CH_4 and N_2O emission from composting can be lowered by strong forced aeration (Osada & Kuroda, 2000).







- N_2O emission from wastewater treatment can be reduced with Intermittent aeration (Osada, 2003).

Conclusion

- Importance of resource-recycling type animal production
  - The use of locally available feed resources
  - Upgrading of animal waste treatment and its recycle use
- Transfer of technologies to developing countries
  - Modification of technologies suit to the field
- Importance of collaborative research on sustainable animal production
  - Resource-recycling animal production
  - Technological development for the mitigation of global warming

We are sharing common risk

Transboundary problems to be solved