Environmental and sustainability issues of the Japanese dairy sector

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in

PRIMAFF

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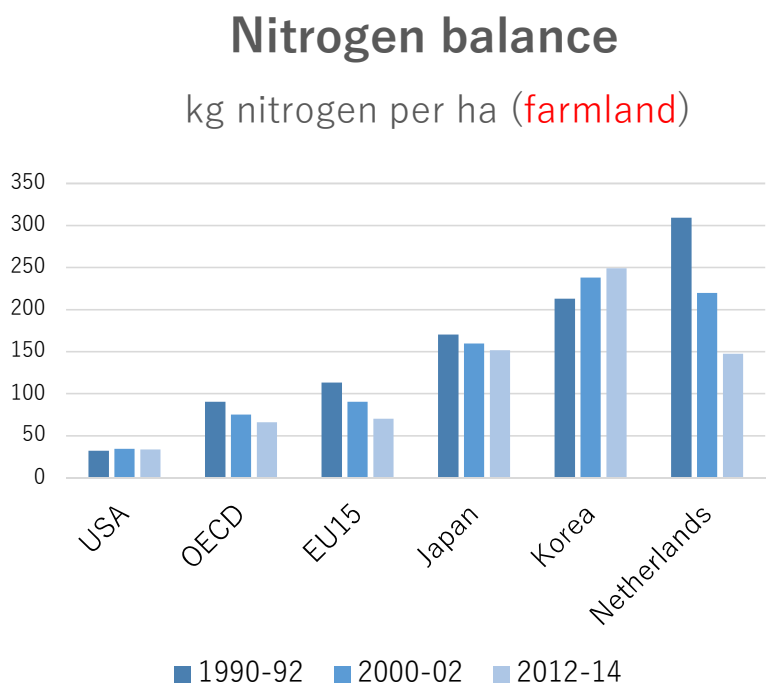
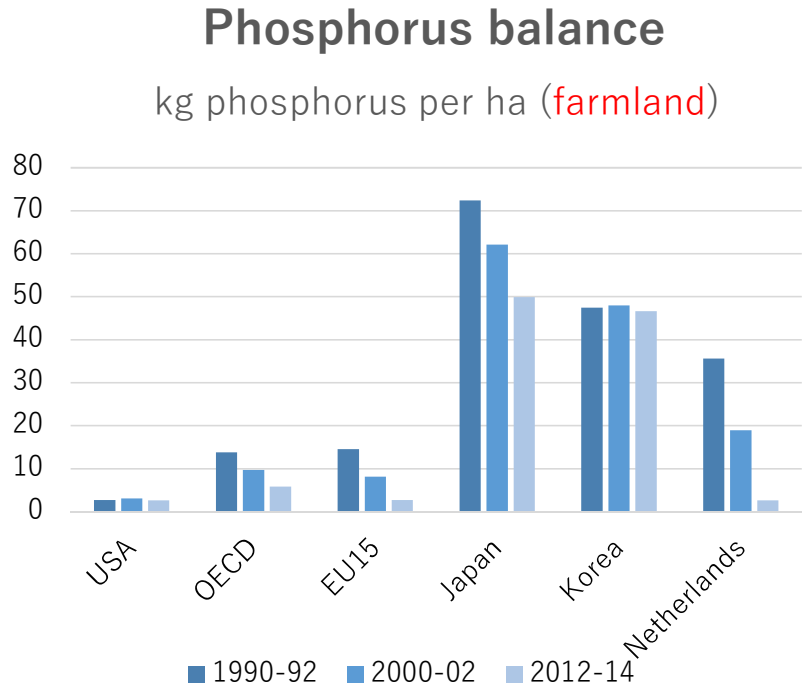
Introduction

- Published in May 2019
- Good overview of agriculture in Japan

- Chapter 3 introduces some environmental and sustainable issues

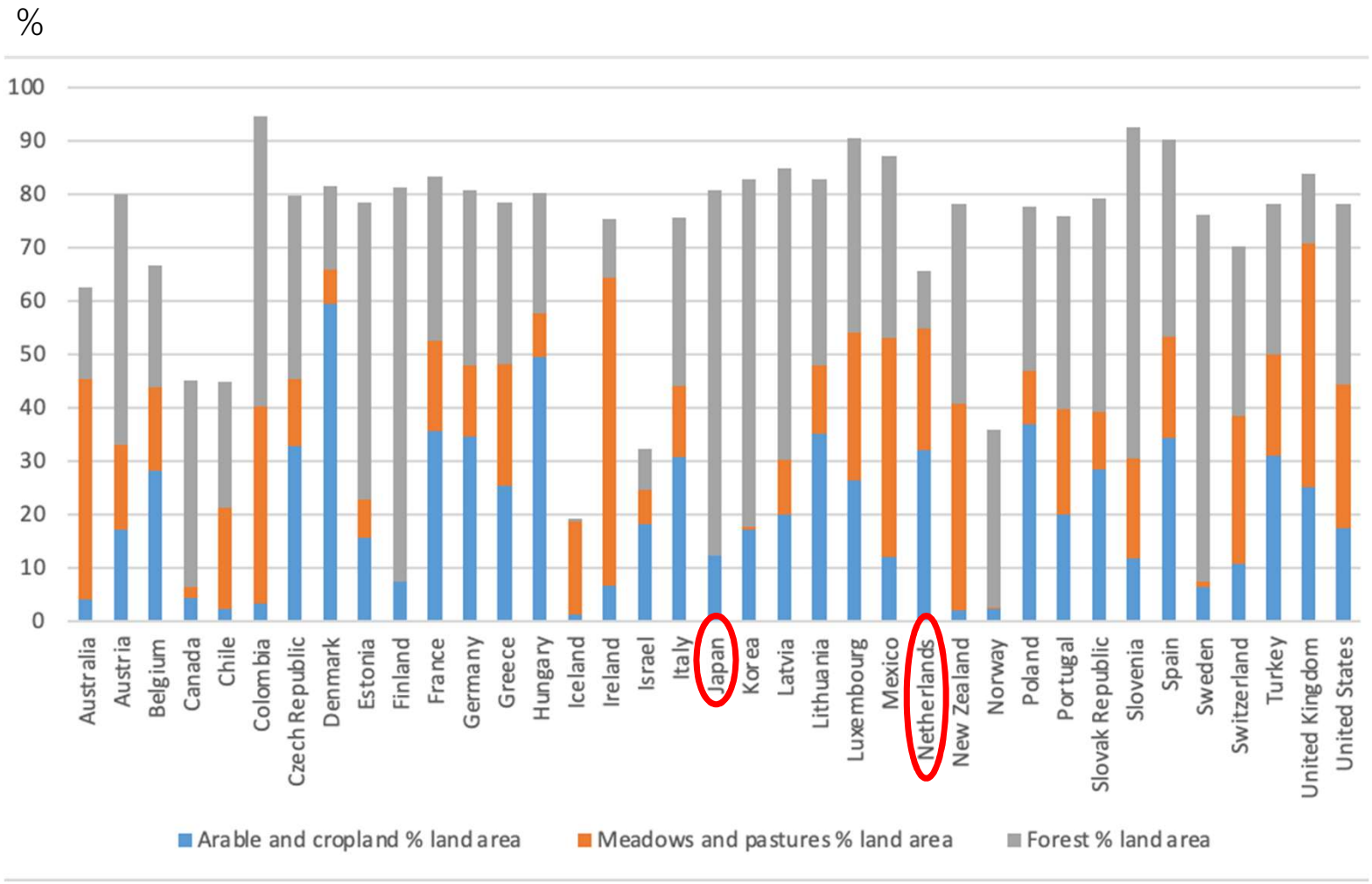
Environmental pressure from agriculture remains





Sources: OECD Agri-environmental indicator database

% of arable, pastures and forest



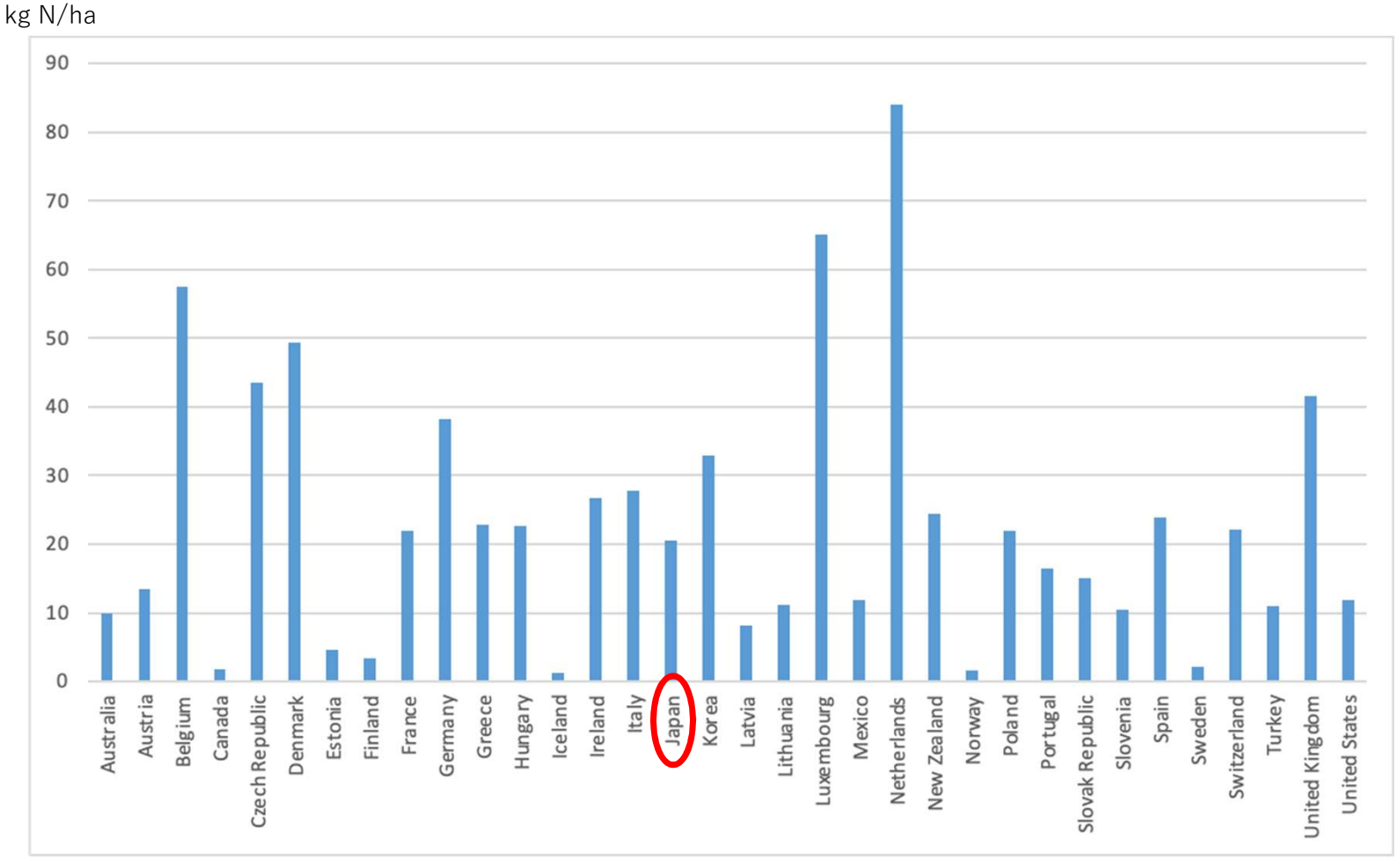
- JAPAN: Small portion of farmland (esp. grassland)

  → Intensive farming

- N balance per farmland is relatively large

Sources: OECD Agri-environmental indicator database

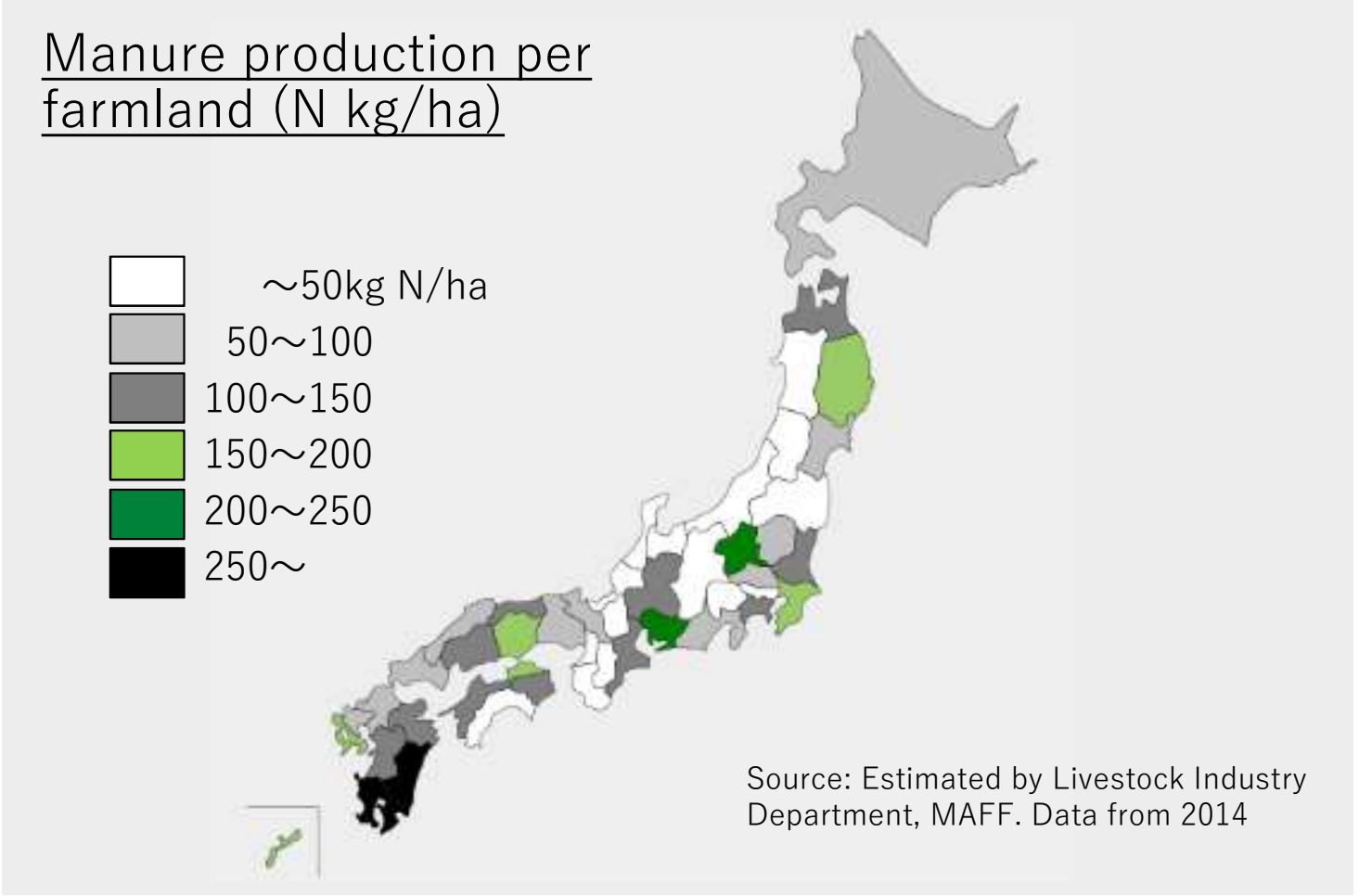
Nitrogen balance per land area



- N balance per land area is relatively small
- Agricultural impacts on environment are different among regions?

Sources: OECD Agri-environmental indicator database

Reginal differences: Manure production

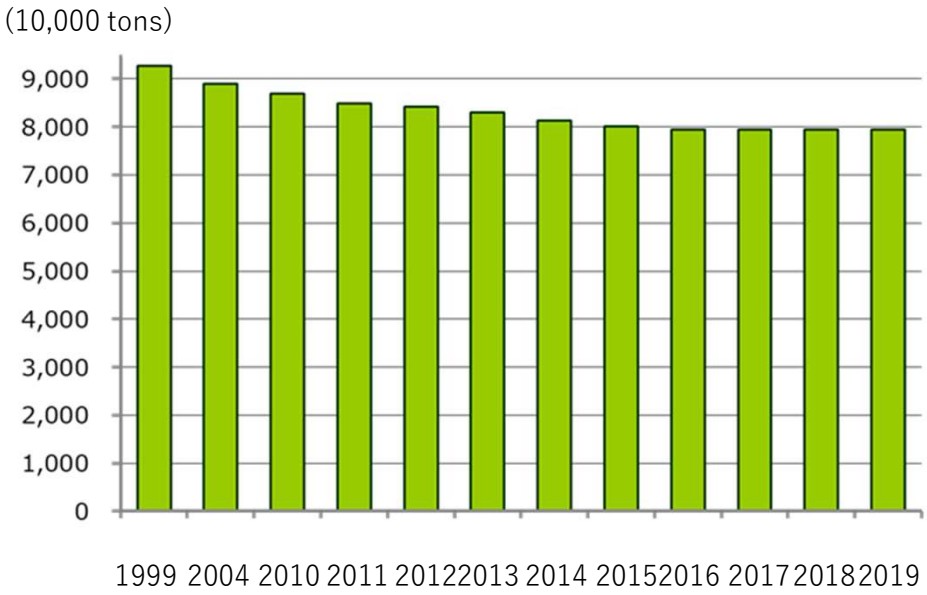


Total manure produced

Table: Total manure produced in 2019

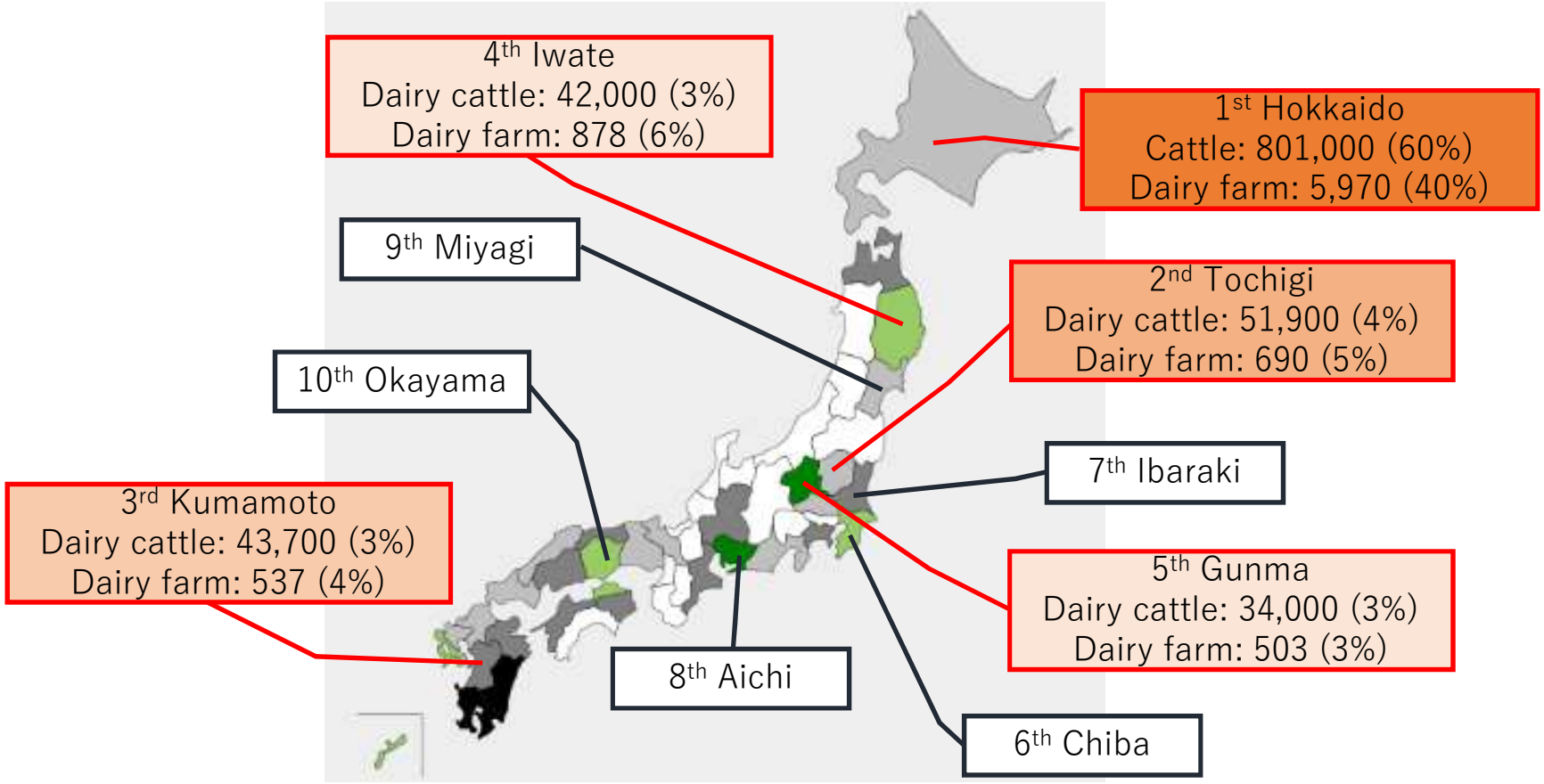
	National		Hokkaido	
	Animal (1000)	Manure (10,000 ton)	Animal (1000)	Manure (10,000 ton)
Dairy cattle	1,383	2,179 (27%)	801	1,261 (65%)
Beef cattle	2,510	2,312 (29%)	513	472 (24%)
Pigs	9,234	2,115 (27%)	692	158 (8%)
Layers	180,951	791 (10%)	6,657	29 (2%)
Broilers	122,228	554 (7%)	4,920	22 (1%)
Total		7,951 (100%)		1,944 (100%)

Fig: Changes in the amount of livestock waste generated in Japan



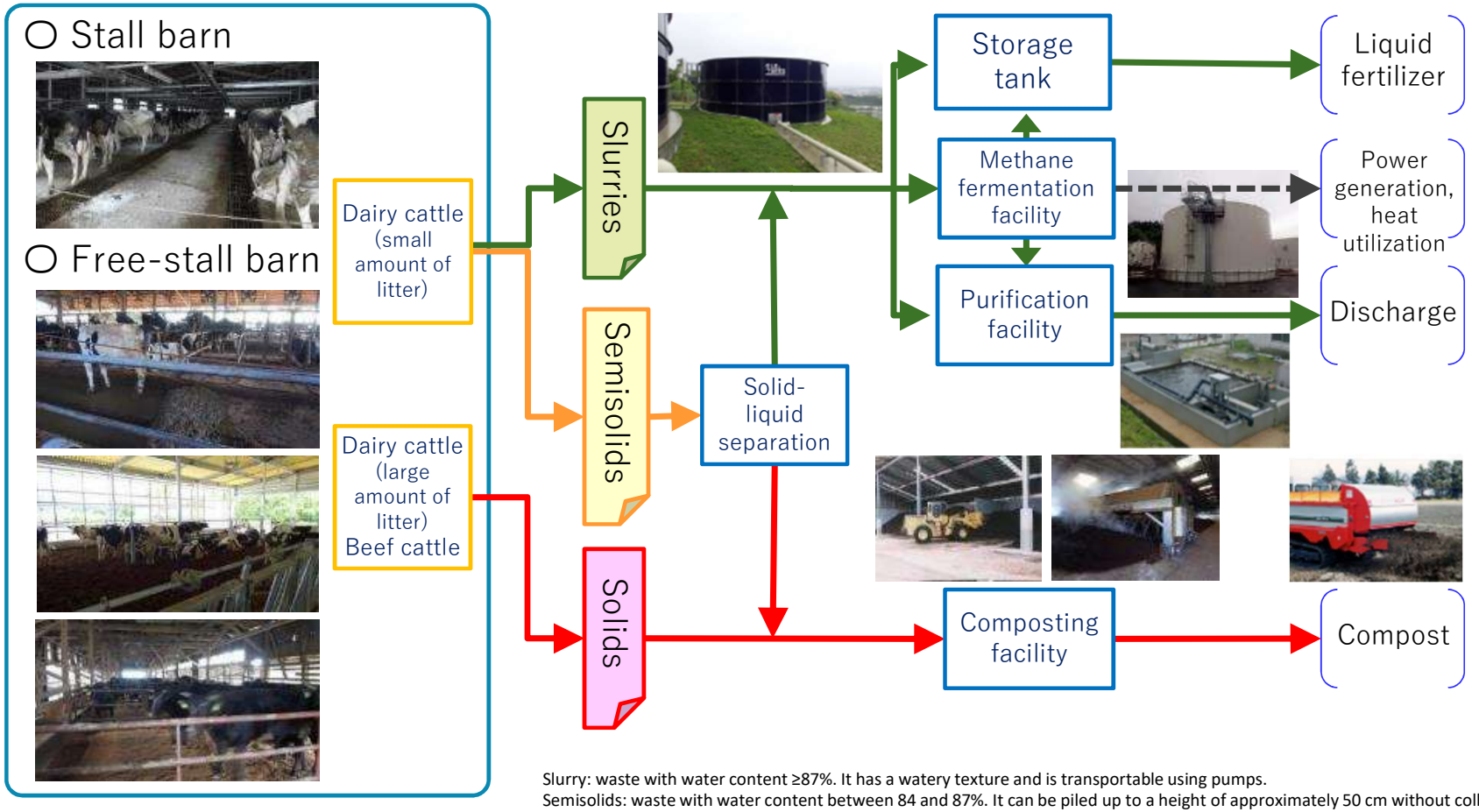
Source: Estimated from “Livestock Farming Statistics,” MAFF

Top 10 dairy producers (prefectures) in 2019



Source: Estimated from “Livestock Farming Statistics,” MAFF

Cattle manure processing (dairy and beef)



Slurry: waste with water content ≥87%. It has a watery texture and is transportable using pumps.
Semisolids: waste with water content between 84 and 87%. It can be piled up to a height of approximately 50 cm without collapsing.
Solids: waste with water content <84%. It can be piled up to a greater height.

Composting manure

- In 2015, 87% of livestock waste was recycled as fertilizers or other sorts of resources (MAFF, 2018)
- Compost is the most popular way of processing
  - Effective soil amendment material, high in potassium
- Composting is done individually and/or collectively
  - There are about 350 compost centers where number of livestock farmers bring their manure for processing
- Challenges
  - Long transportation from livestock-concentrated areas to areas of demand

Manure processing in Hokkaido

Source: Hokkaido (2020) Environmental aspects of Livestock production in Hokkaido http://www.pref.hokkaido.lg.jp/ns/tss/28/kankyo/02.05_kankyo-meguru.pdf

- Almost all manure (97%=about 19M ton) was used for
  - 65%→compost
  - 18% → liquid fertilizer
  - 6% → grazing

- Manure application within or outside farm
  - 71% of manure is used on-farm
  - 26 % bring to e.g. arable farmers/composting centers
  - 3% send out for purification (biological treatment)
- Collective action of manure processing is increasing
  - More contractor companies are emerging
- About 30% of dairy farms have adopted free-stall barn
  - More slurry manure in large dairy farm (free-stall)→ Not suitable for composting

Environmental problems related to dairy sector

- MAFF collect public complains related to livestock-environmental problems

- Top 3 complaints related to dairy in 2019
  1. Odor (240 out of total 389 cases)
  2. Water quality (75 cases)
  3. Sanitary insect (50 cases)
  - Large farms (>300 cows) tend to receive more complains

- Manure and sustainable challenges
  - Disposal problem: how to use efficiently?
  - GHG emissions: how to reduce?

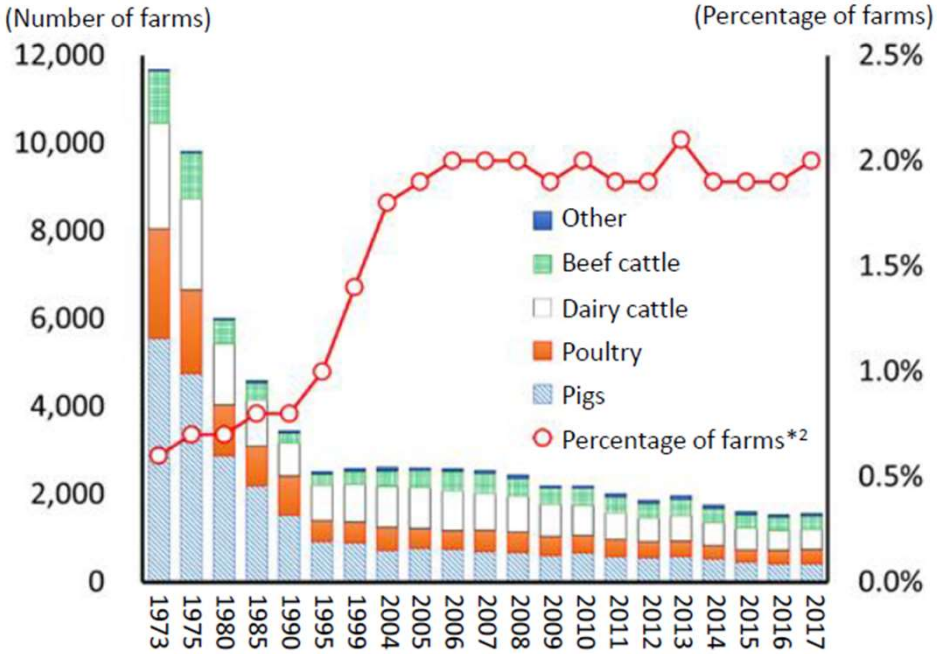
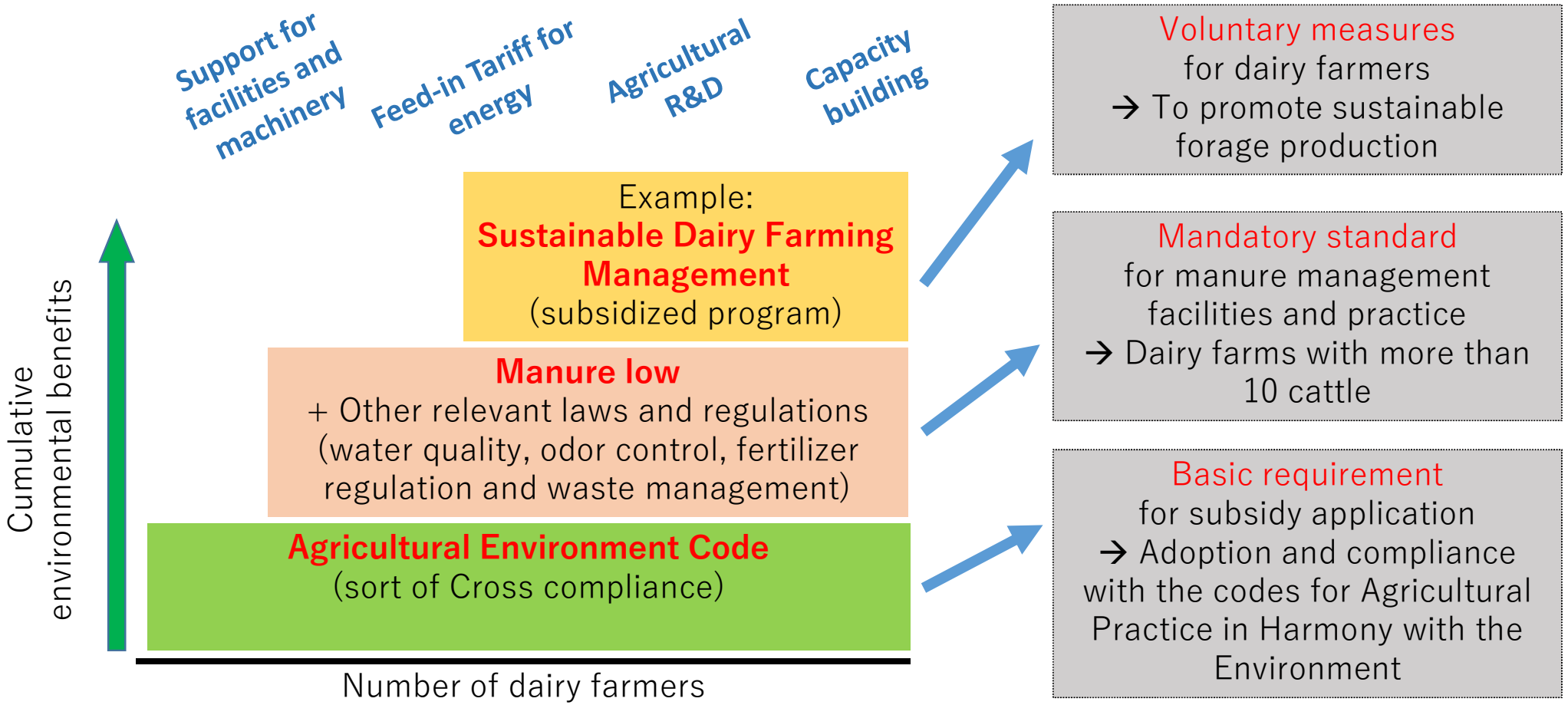


Fig. Changes in the number and percentage of livestock farms that received complaints

Source: Estimated by Livestock Industry Department, MAFF.

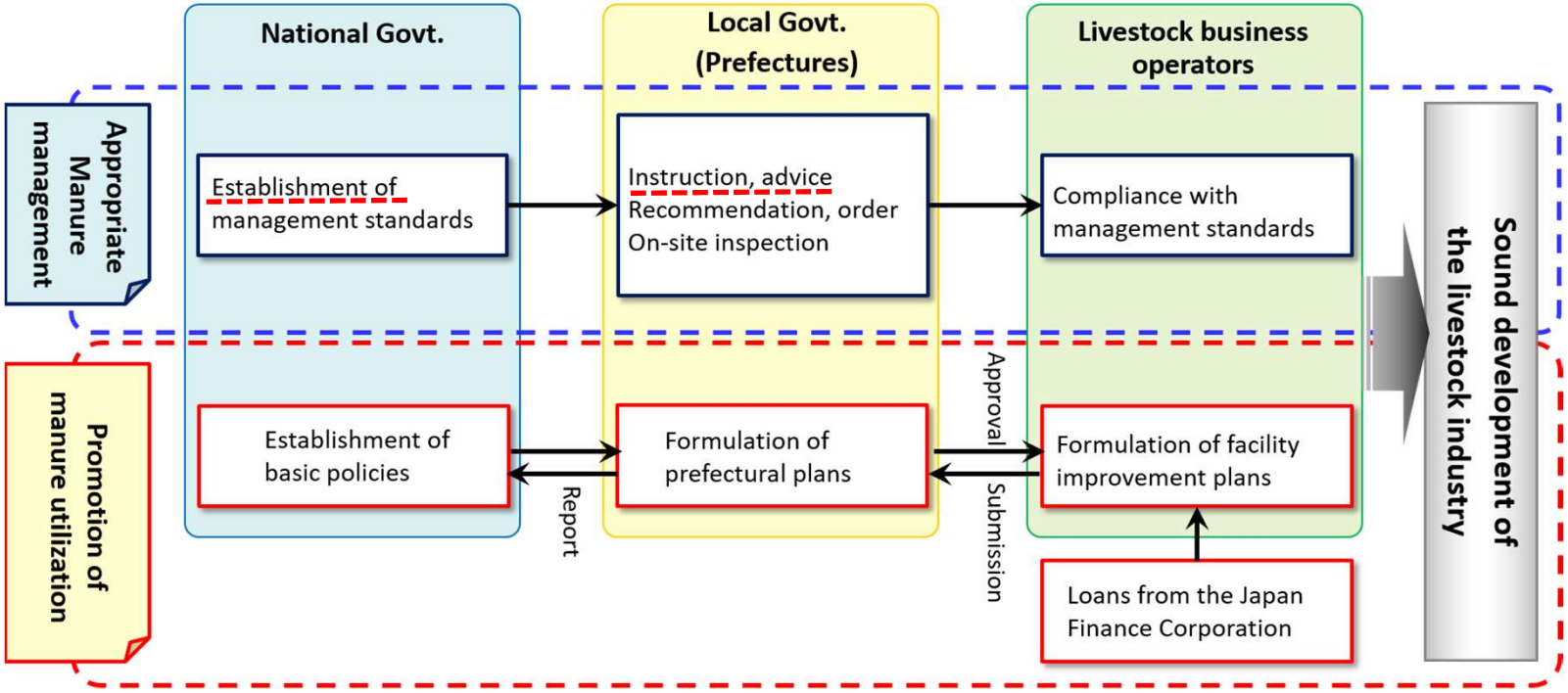
Legislation framework*

* The figure is not officially proposed by MAFF, and constructed by author's personal view. Please do not refer the figure.



Manure Law: Implementation system

- The Act on Proper Management and Promotion of Use of Livestock Manure
  - Established in 1999, and put into full effect in 2004
- Two objectives: 1) Appropriate manure management
  2) Promotion of manure utilization



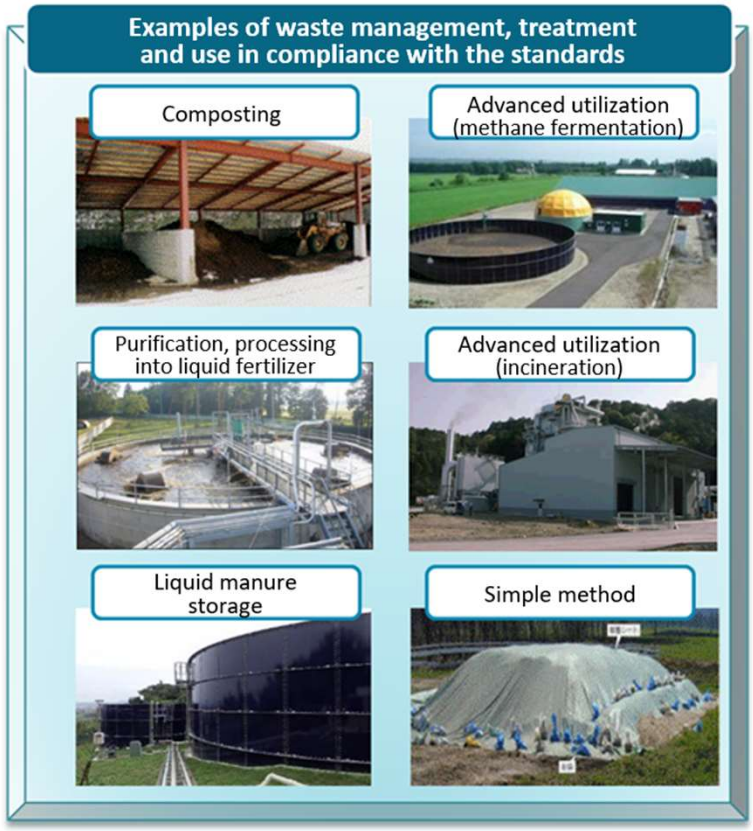
Manure Law: Management standards and practices

1. Storage facility
- Solid manure: build on e.g. a concrete pad to prevent leaching, plus covering & sidewalls
- Liquid manure: constructed using materials impermeable to manure

2. Manure management practices
- Proper treatment under the facility
- Constant facility check + repair if necessary
- Record keeping

Standards apply to farms with:
- ≥10 cows or horses
- ≥ 100 pigs
- ≥ 2000 chickens

Almost all livestock farms are in compliance



Manure utilization: Basic promotion policy

- In accordance with the Manure Law, MAFF formulates a basic policy to promote manure utilization
- The current policy was drawn up in 2020 to meet the following 2030 goals:

1. Promote manure composting and its use

- Encourage self-forage production
- Respond to needs by arable fartmers
- Pelletizing manure for better tranportation and less intensive workload

2. Promote energy generation from manure

- Use manure as a valuable resource for energy generation
- Apply e.g. FIT to obtain additional income
- Energy local production for local consumption

3. Encourage active engagement in tackling livestock-related environmental problems

- Improve farmers' awareness towards their environment and impacts of livestock production.
- Encourage keep facilities in a good condition by proper maintenance/repair
- Encourage Multi-stakeholder approach

Rules for manure application: Minimizing the loss of nutrients

- Agricultural Environment Code (sort of Cross compliance)
  - Farmers are obliged to follow application standards: N and P
  - Each prefecture provide guidelines for best nutrient practice for crop and soil type (e.g. application period and amount)

- At national level, there is no regulation for manure, such as Harmony rules in Denmark
- But some local government set their own regulation
  - Ex. Betsukai town in Hokkaido: Dairy farm with >2.13 cattle/ha need a permission

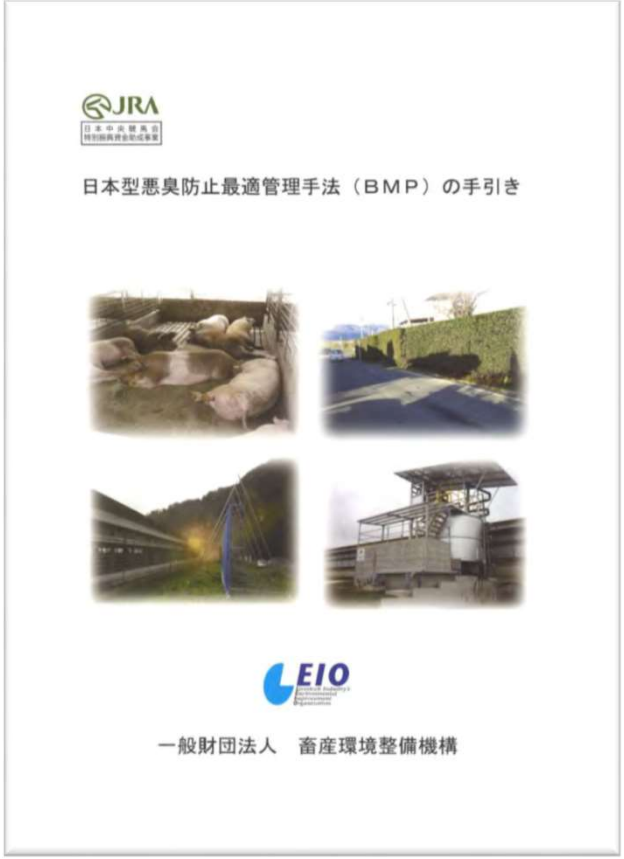
Odor control

The Act of Offensive Odor Control

- A local govt. sets the regulatory standards (e.g. Odor index)
- When they detect an offensive odor at a level exceeding, a farm owner has to improve the situation

For practical control

- For instance, LEIO made “A Guideline for Best Management Practices (BMP)” and R&D on
  - Stables (bio-filter, bedding materials etc.)
  - Storage facility (composting, digestion etc.)
  - Manure application (injection, timing etc.)



BMP guideline made by LEIO
(Institute of Livestock Industry’s Environmental Technology)

Amending the Act of Fertilizer Regulation to stimulate crop-livestock integration

- In 2012: Mixed compost compound fertilizer
  - To promote compost use, mixture of inorganic fertilizers with compost derived from animal manure (max 50% in content)
- From December 2020: New category "designated compound fertilizer" is added
  - Production and sales conditions became simple
  - The balance between compost and inorganic fertilizers can be changed according to demand/soil conditions by/of crop farm
  - >50% content from compost (>50% dry matter) is now possible

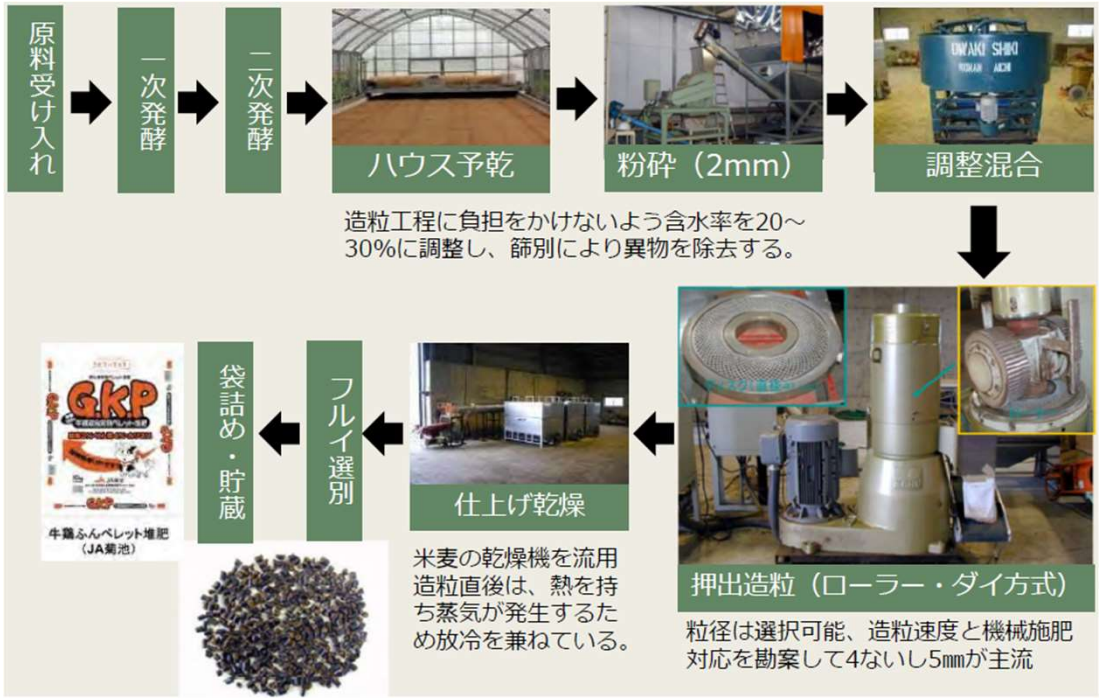
Fig. Change in amount of compost applied to paddy field

Source: MAFF statistics bureau

Promoting Crop-Livestock Integration in regional scale

Manure pellet

- R&D (by NARO) and pilot studies in regions where livestock areas and arable areas are located in a distance
- Example
  - Kumamoto in Kushu: Collaboration among farm cooperatives
  - By building territorial crop-livestock integration, high costs of processing might be covered



Source: Arakawa (2019)
https://www.maff.go.jp/j/chikusan/kankyo/taisaku/pdf/2019_sympo_arakawa1.pdf

Manure for energy generation

- Anaerobic digestion (AD), incineration
- Feed-in Tariff (FIT) from 2012
  - 39 yen/kWh for AD (as of 2020)
  - 17 yen/kWh for incineration
  - FIT is going to be reviewed by FY2020

- Most manure-based biogas plants are located in Hokkaido
  - Large dairy producer → More slurry → Not suitable for composting
  - Around 80 plants are running in Hokkaido

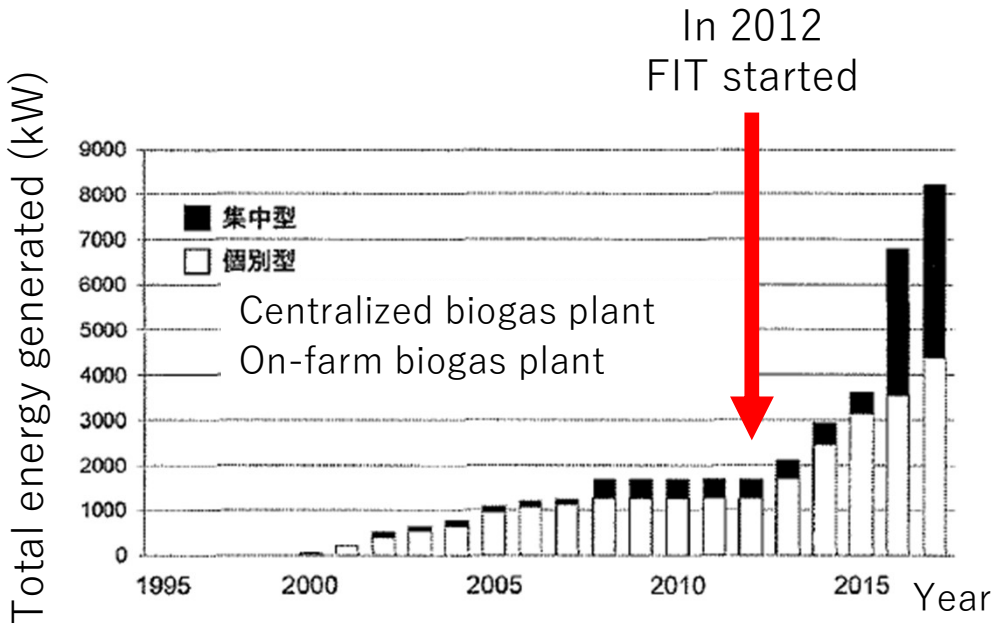


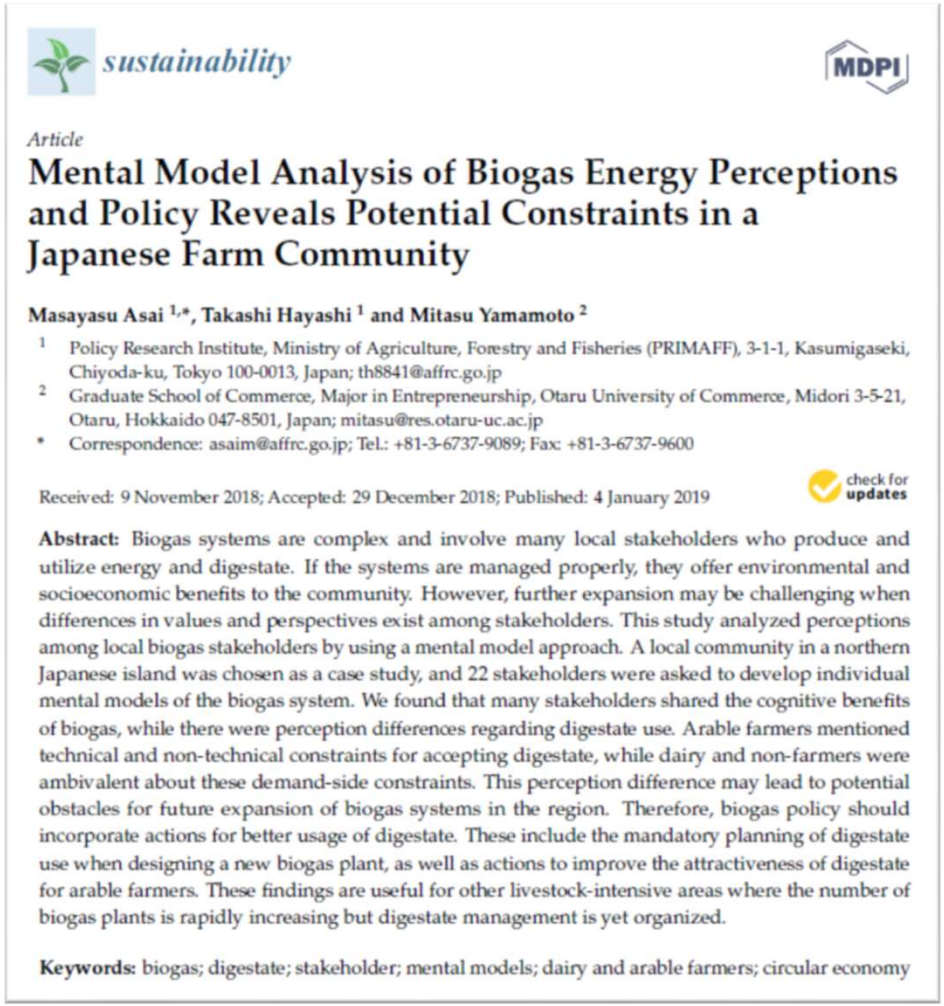
Fig. Energy generated by manure-based biogas plants in Hokkaido

Source: Iwasaki et al. (2017) Recent Development in Research and Technology Related to Agricultural Facilities: Livestock Manure-based Methane Fermentation Systems. *J. Soc. Agr. Struct. Jpn.* 48, 123–130. (In Japanese)

Future challenges of biogas promotion

Asai et al. (2019)

- Management of digestate (end-product after digestion)
- Crop farmers put less priority
  - Inorganic fertilizer > Compost >>> Digestate
- How to handle digestate when more biogas plants are constructed?
  - Main reason why it has been so difficult to construct biogas plant in main islands
  - Even in Hokkaido it is becoming a critical issue



sustainability

MDPI

Article

Mental Model Analysis of Biogas Energy Perceptions and Policy Reveals Potential Constraints in a Japanese Farm Community

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Abstract: Biogas systems are complex and involve many local stakeholders who produce and utilize energy and digestate. If the systems are managed properly, they offer environmental and socioeconomic benefits to the community. However, further expansion may be challenging when differences in values and perspectives exist among stakeholders. This study analyzed perceptions among local biogas stakeholders by using a mental model approach. A local community in a northern Japanese island was chosen as a case study, and 22 stakeholders were asked to develop individual mental models of the biogas system. We found that many stakeholders shared the cognitive benefits of biogas, while there were perception differences regarding digestate use. Arable farmers mentioned technical and non-technical constraints for accepting digestate, while dairy and non-farmers were ambivalent about these demand-side constraints. This perception difference may lead to potential obstacles for future expansion of biogas systems in the region. Therefore, biogas policy should incorporate actions for better usage of digestate. These include the mandatory planning of digestate use when designing a new biogas plant, as well as actions to improve the attractiveness of digestate for arable farmers. These findings are useful for other livestock-intensive areas where the number of biogas plants is rapidly increasing but digestate management is yet organized.

Keywords: biogas; digestate; stakeholder; mental models; dairy and arable farmers; circular economy

Voluntary measures: Sustainable Dairy Farming Management

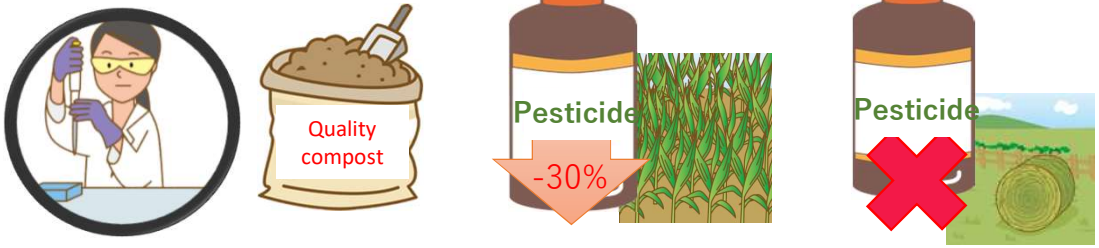
- Area-based payment for forage production
- Support dairy farmers who conduct practices contributing to “circularity”, “climate change” and “biodiversity”
  - Started from 2019*

  *similar program had been conducted before
- Applicants have to conduct at least 2 of 9 practices
  - They can apply individually or collectively
- About 5,200 application in 2019
  - About 80% were from Hokkaido

Contribution theme	Name of practices
Circularity	1. Proper compost application
	2. Domestic by-product utilization
	3. Slurry injection to soil
	4. Proper silage production
Climate Change	5. GHG emissions reduction (no tillage)
	6. Reduce chemical fertilizer use
	7. Crop diversification
	8. Free-range grazing
Biodiversity	9. Reduce pesticide use

Voluntary measures: Sustainable Dairy Farming Management

- “1. Proper compost application” and “9. Reduce pesticide use” were the most popular practices



- Free-range grazing is also popular in Hokkaido

- Slurry injection (mandatory practice in many EU countries) is not widely conducted yet

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Key challenges toward sustainable dairy system

*my personal opinion and not from MAFF

Changing awareness of farmers

- More efforts to improve their “circularity thinking”
- More regulations vs More burdens on farmers?

More data is needed

- Encourage analysis and registration of manure transport
- Promote data exchange between agencies

Innovation

- Digital opportunity (ICT, AI…)
- Technology development to tackle climate change
  - Ex. Slurry injection
- More farmers’ should be engaged in R&D process

Networking is the key

- Re-coupling of livestock and crop
- More involvement of third party (e.g. contractor companies)
- More support by consumers

Dank u wel!!

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