Exploring constraints for the further expansion of biogas systems in Japan

Masayasu ASAI & Takashi HAYASHI

Policy Research Institute,
Ministry of Agriculture Forestry and Fisheries (PRIMAFF)
Tokyo, Japan

7th Bioenergy Week and Study Tour for Capacity Building
25-27 June 2019
Manila, Philippines

Biogas development in Japan

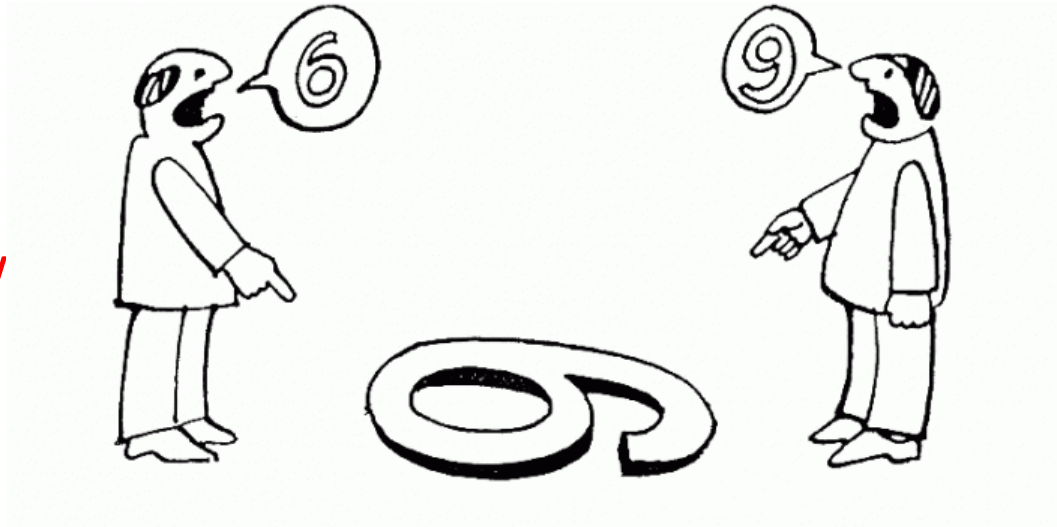
- The first construction boom was triggered by
  - 1997: "Kyoto Protocol" to reduce GHG emissions
  - 1999: "Manure Management Act" for appropriate manure treatment (actual implementation was from 2004)
  - 2002: "Biomass Nippon Strategy" to promote the use of biomass for energy and material production

- Now is the second boom due to
  - 2011: Disaster at the Fukushima nuclear energy plant
    - Public concerns over renewable energy increased
  - 2012: Introduction of Feed in Tariff (FIT)
    - A fixed purchase price for 20 years for biogas-generated electricity (39 JPY/kWh, before tax)
  - Various subsidies are available for plant construction
    - But, combined application with FIT is not available

Focus of our presentation

- Biogas system: High potential to fulfill multiple environmental and socio-economic goals
- Widespread of biogas systems require good collaboration among stakeholders

- Perception gap may become constraints
- Understanding of how stakeholders see the system is important!

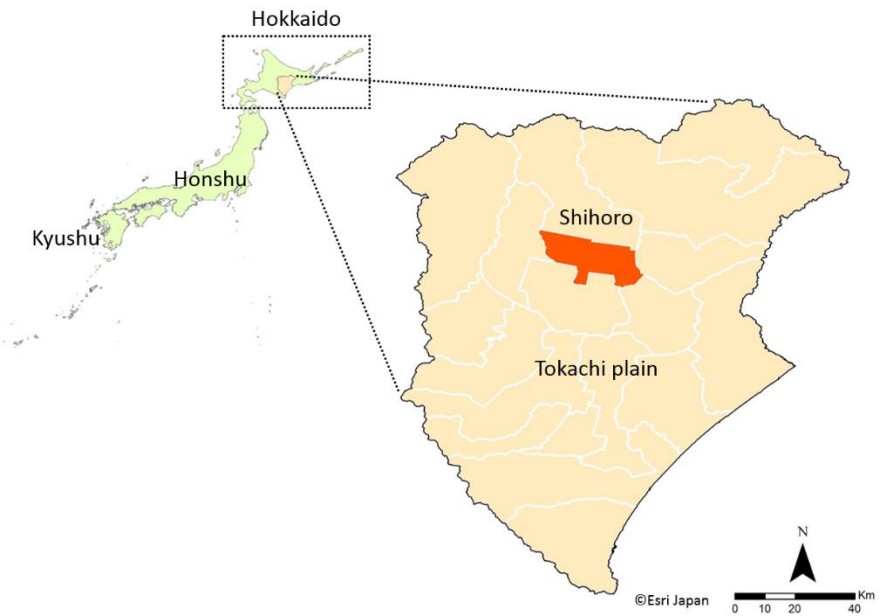


- Analyze similarities and differences in the perception by using "Mental model approach"

Study site and collecting data

Shihoro town in Hokkaido

- Large dairy farming → Slurry manure → Biogas plants
- 2003 : First installation of biogas plant
- Now : 11 on-farm biogas plants



22 stakeholders were interviewed : Dec 2016 –Jan 2017

- 7 dairy farmers, including 3 biogas plant owners
- 7 arable farmers, including 3 digestate users
- 8 non-farmers (farm cooperative, engineering company, municipality, consultant and university)

Eliciting Stakeholder Views (Mental models)

The interviewees were asked to create a mental model around two key questions:

1. What do you expect from biogas systems?
2. What are the barriers to and drivers for an expansion of the biogas system in Shihoro?

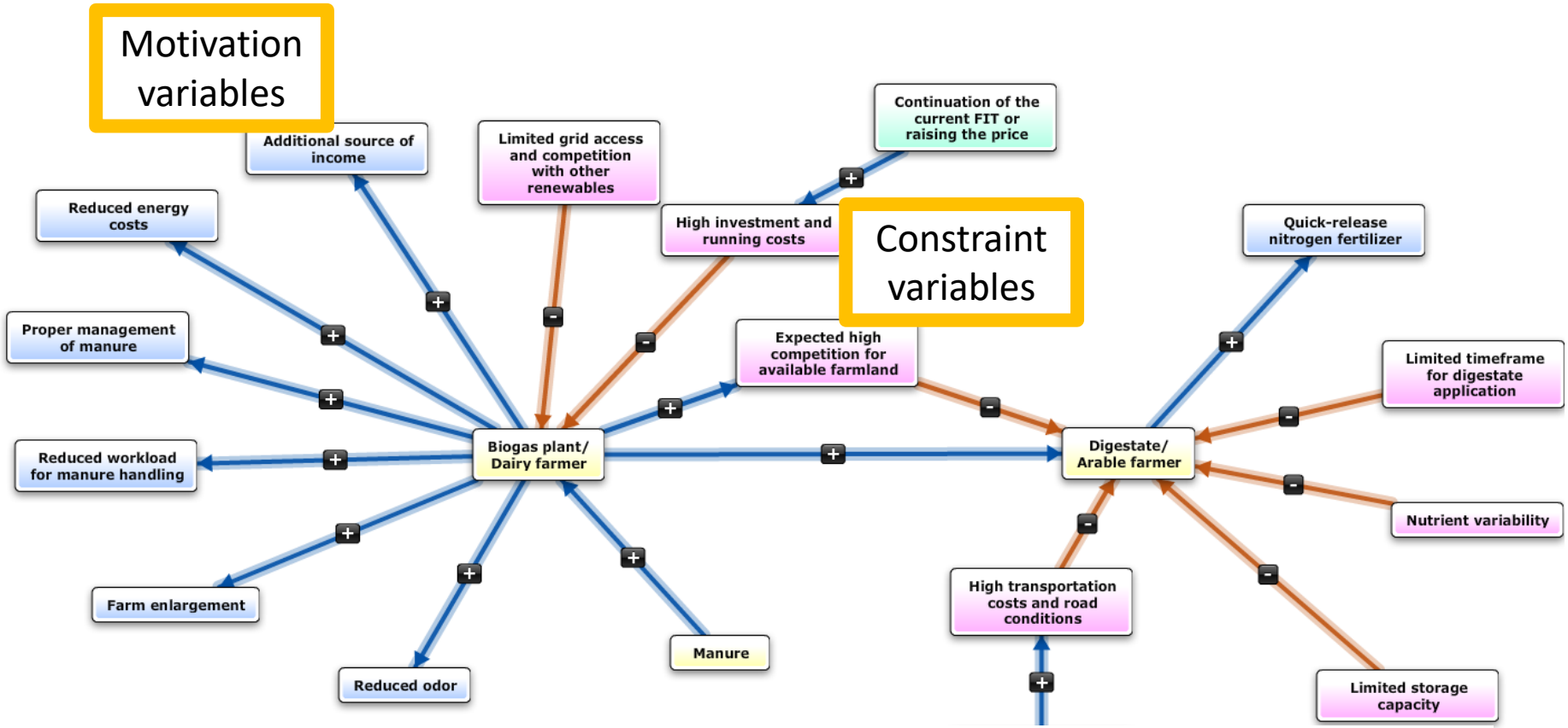
List variables that play important roles for the key questions

Make appropriate connections with directional arrows and indicate whether the relationship is positive or negative.

Evaluate the whole map

Total time: Avg. 55 min (min 35-max 90 mins)

An example of a mental model for a dairy farmer with a biogas plant



1. Blue lines indicate positive relationships (motivation variables), and red lines represent negative relationships (constraint variables)
2. Citation frequencies of motivation and constraint variables were compared among "Dairy farmers", "Arable farmers" and "Non-farmers"

Motivation variables identified in mental models and their citation frequency

* Only display citation frequency over 3

Category	Variables	Citation Frequency	Dairy Farmers No. (% [1])	Arable Farmers No. (% [1])	Non-Farmers No. (% [1])
Biogas plant	Additional source of income	12	5 (71)	3 (43)	4 (50)
	Reduced energy costs through self-provision (e.g., hot water)	10	3 (43)	3 (43)	4 (50)
	Utilization of available resources	8	2 (29)	3 (43)	3 (36)
	Reduced workload for manure handling	7	2 (29)	1 (14)	4 (50)
	Farm enlargement as biogas plants can handle additional amount of manure produced	7	4 (57)	1 (14)	2 (25)
	Proper management of manure (reduced pollution/contamination risk)	5	4 (57)	1 (14)	2 (25)
Digestate	Reduced odor from spreading digestate compared with compost	14	4 (57)	4 (57)	6 (75)
	Reduced fertilizer costs through digestate substitution	11	3 (43)	3 (43)	5 (63)
	Recovery of fermentation residuals in agriculture	6	1 (14)	1 (14)	4 (50)
	Quick-release nitrogen fertilizer	6	1 (14)	2 (29)	3 (38)
	High fertilizer value for grassland	5	1 (14)	2 (29)	2 (25)
	Reduction of weed seeds	4	2 (29)	1 (14)	1 (13)
Local community	Environmental benefits	13	5 (71)	4 (57)	4 (50)
	Improved energy security	9	2 (29)	3 (43)	4 (50)
	Improved understanding of residents toward dairy farming	6	3 (43)	0	3 (38)
	Being well-known as an “ecological town”	4	0	1 (14)	3 (38)
	Creation of new jobs	4	0	0	4 (50)

1: Orange indicates the percentage of respondents is higher than 50%, while yellow indicates response rates between 30 and 50%.

Constraint variables identified in mental models and their citation frequency.

* Only display citation frequency over 4

Category	Variables	Citation Frequency	Dairy Farmers No. (% [1])	Arable Farmers No. (% [1])	Non-Farmers No. (% [1])
Biogas plant	High investment and running (e.g., repair) costs	15	7 (100)	3 (43)	5 (63)
	Limited grid access and competition with other renewables (solar PV)	9	2 (29)	1 (14)	6 (75)
	Dependence of feed-in tariff on political circumstances/Lack of long-term perspective	6	3 (43)	0	3 (38)
	Insufficient government support, late payment, and high competition to be supported	5	1 (14)	1 (14)	3 (38)
	High manure composition variability and its treatment	4	3 (43)	0	1 (13)
Digestate	Expected high competition for available farmland to spread digestate	10	5 (71)	3 (43)	2 (25)
	High transportation costs and road conditions	9	2 (29)	6 (86)	1 (13)
	Limited timeframe for digestate application (e.g., depending on weather and seasonal conditions)	8	1 (14)	6 (86)	1 (13)
	Unclear impacts on yield/limited knowledge and practices	6	1 (14)	5 (71)	0
	Requirement of spreading equipment and its cause of soil compaction	6	0	5 (71)	1 (13)
	Preference of composted manure over liquid digestate	6	2 (29)	4 (57)	0
	Nutrient variability due to, for example, uncovered slurry tank and differences in feedstock	4	2 (29)	2 (29)	0
	Low acceptance rate among neighbors/poor linkages and communication with suppliers	4	0	3 (43)	1 (13)

1: Orange indicates the percentage of respondents is higher than 50%, while yellow indicates response rates between 30 and 50%.

Discussion

- Dairy farmers and non-farmers:
  - Focused on the input side of their business, concentrating their resources on energy production, but not on the digestate side
- Arable farmers:
  - Expressed their hesitation to accept digestate as an appropriate fertilizer due to several technical and non-technical constraints
- The current energy policy (FIT and construction subsidy)
  - → Incentives to dairy farmers to increase # of animals to produce more manure and to increase their turnover
  - BUT, further environmental risks may occur when proper handling and management of digestate is missing
- The energy policy must be implemented in cooperation with agri-environmental policies related to digestate use
  - E.g. improving the attractiveness of digestate for arable farmers

Future challenges towards more resilient energy system

- Sep 6, 2018: Huge earthquake in Hokkaido → Blackout
- Dairy industry took a heavy hit
- Biogas plants which used FIT were also all stopped
- Now: discussion for off-grid system

We appreciate to hear how other countries tackle with resilient challenges!!!

Source: Sankei news https://www.sankei.com/photo/daily/news/180913/dly1809130016-n1.html

For further information, please find our paper:

Asai M, Hayashi T, Yamamoto M (2019) “Mental Model Analysis of Biogas Energy Perceptions and Policy Reveals Potential Constraints in a Japanese Farm Community” *Sustainability* 11(1)

Thanks for your attention!

Masayasu ASAI

E-mail: masayasu_asai640@maff.go.jp