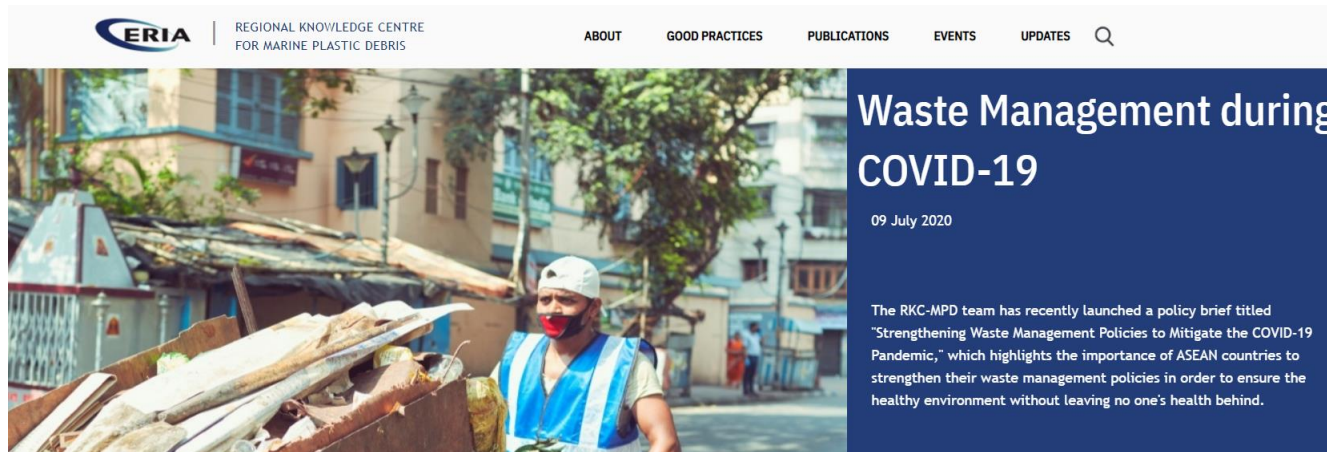


“How to Expand Waste Management Service to Rural Area?”

Regional Waste Management in Asian Countries



Website: <https://rkcmpd-eria.org/>

Michikazu Kojima
Research Fellow
Regional Knowledge Centre for Marine Plastic Debris
Economic Research Institute of ASEAN and East Asia

Chief Senior Researcher
Institute of Developing Economies, JETRO

The fate of all Indonesia's plastic waste, in each archetype (million tonnes per year, 2017)

	Mega Cities	Middle and Small Cites	Rural	Remote	Total
Total Generation	1.6Mt	1.8Mt	2.5Mt	0.9Mt	6.8Mt
Leakage into Sea, Lakes and Rivers	4%	8%	12%	15%	10%
Dumping on Land	1%	3%	8%	8%	5%
Open Burning	21%	45%	61%	64%	48%
Official dumpsites	3%	3%	14%	15%	9%
Managed Disposal	51%	29%	0%	0%	20%
Recycling	20%	12%	5 %	0%	9%

46.7% of leakage is from Rural Area. 69% of leakages is from Rural area and Middle and Small Cites

Source: World Economic Forum (2020) *Radically Reducing Plastic Pollution in Indonesia: A Multistakeholder Action Plan: National Plastic Action Partnership.*

How to Expand Waste Management Services in Rural Area?

- Rural area and Middle/Small cities are regarded as major source of leakage of plastics to the ocean.
- To reduce the leakage of plastic waste to the ocean, waste collection and disposal services should be expanded to middle and small cities, and rural area.
- But there are economies of scale in proper treatment and disposal facilities, such as waste-to-energy plant and sanitary landfill.
- To utilize economies of scale in waste management, some Asian municipalities started to formulate regional or inter-municipal cooperation on waste management.
- Contents of Presentation
 - Economies of Scale in Waste Management
 - Experiences to formulate inter-municipal cooperation around 1970 in Japan
 - Types of schemes regional waste management
 - Disadvantage of regional waste management and counter measures

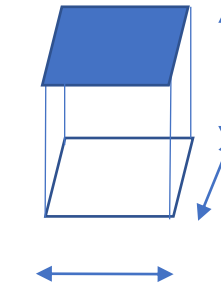
Economies of Scale in Landfill and Waste Treatment Facility

Reviews on Theoretical and Empirical Justification of Inter-Municipal Cooperation

- Bel and Warner (2014) reviews recent multivariate econometric studies on inter-municipal cooperation and cost. Among 8 studies, 7 studies deal with solid waste management, while 1 study on water, electricity, gas and waste. Among 7 studies on waste, 5 studies found inter-municipal cooperation saves cost significantly,
- Chapter 4 (Japan and Philippine data) and Chapter 7 (Indonesia data) in Kojima ed.(2020) statistically confirmed the economies of scale.
- Fujii (2005) pointed out that waste treatment facilities such as land fill and waste to energy plant have a characteristics of economies of scale. Optimal inter-municipal cooperation area is determined by balance between the treatment cost and the transportation cost.

Theoretical Explanation

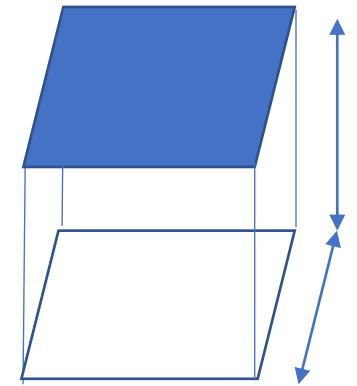
- Construction cost of incinerator or land fill site is basically proportional to surface area of the facility, in other words, the square of the length. The capacity of the treatment is proportional to volume, which is proportional to the cube of the length. (Fujii, 2005)



Length: L

$$\begin{aligned}\text{Area of surface} \\ &= 6L^2\end{aligned}$$

$$\begin{aligned}\text{Volume} \\ &= L^3\end{aligned}$$



Length: $2L$

$$\begin{aligned}\text{Area of surface} \\ &= 24L^2\end{aligned}$$

$$\begin{aligned}\text{Volume} \\ &= 8L^3\end{aligned}$$

In this case, capacity of treatment (volume) become 8 times, while construction cost increase 4 times.

Economies of scale in landfill site

- Larger landfills can be utilized to a greater height, that is, they contain a greater load per unit area of land. For example, assume a square land area on x^2 m. Landfilling is done up to a height of 'y' m above ground level (GL) and a depth of 5 m below GL. Side slopes of 1V:4H (above GL) and 1V:3H (below GL) are maintained. Then the area and total air space available for landfilling for different values of 'x' and 'y' are as following table.

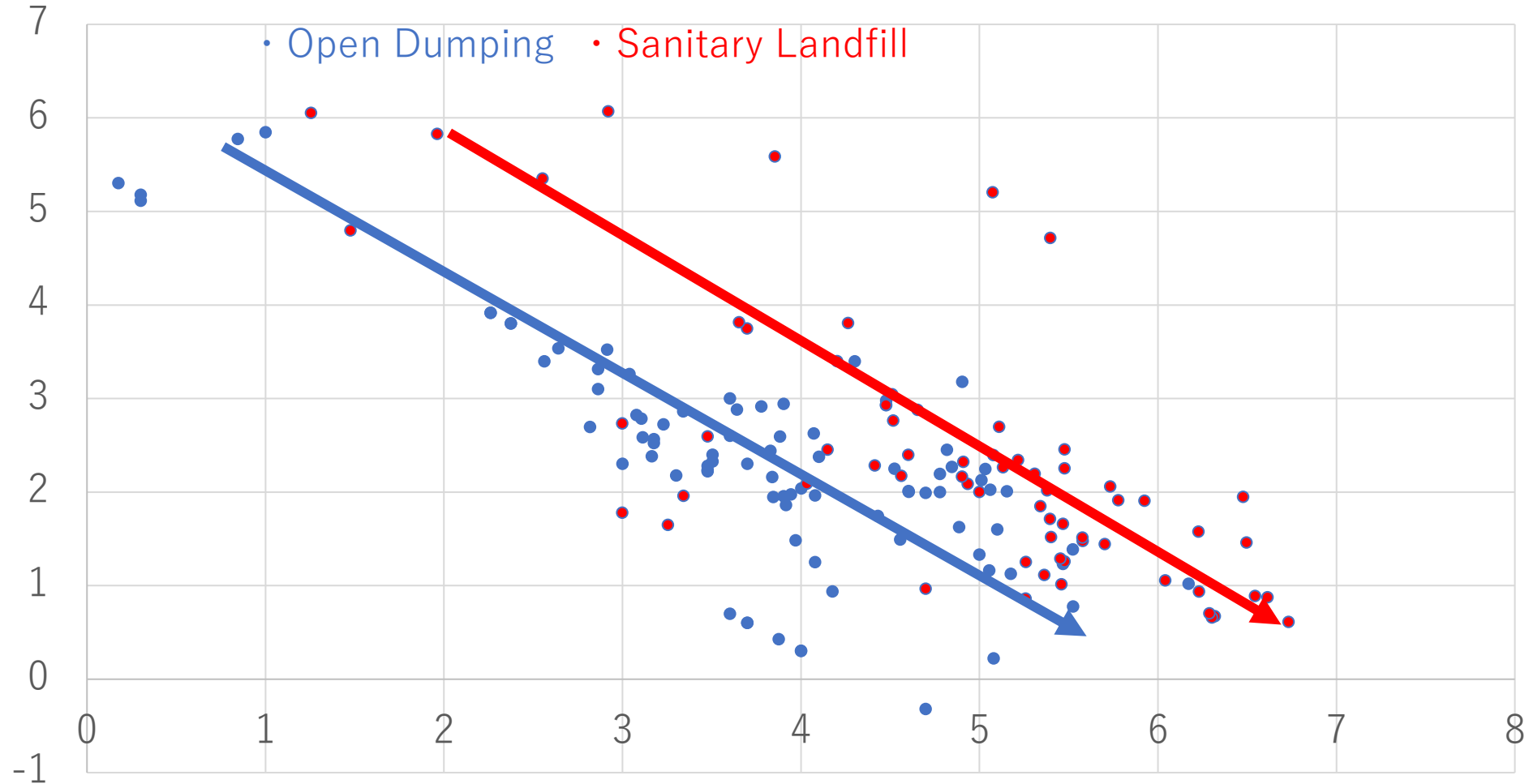
X (m)	Land Area (m ²)	Height above ground Y (m)	Air Space for landfilling	Factor increase in	
				Area	Air Space
100	10,000	10	82,000	1	1
300	90,000	15	1,302,667	9	17.5
500	250,000	20	4,771,333	25	67.3

Source: Ministry of Urban Development () *Guidance Note: Municipal Solid Waste Management on a Regional Basis*, India.

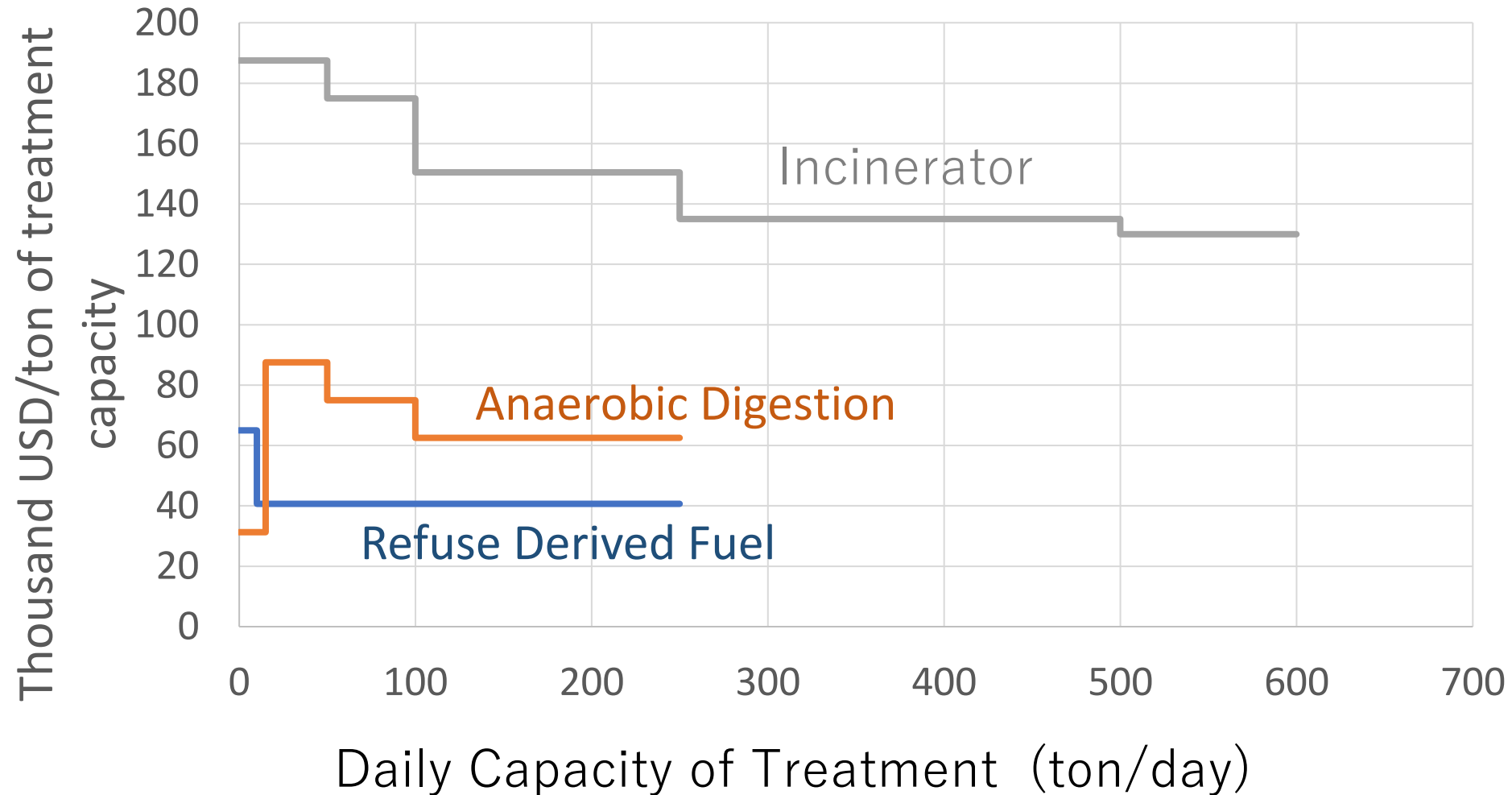
Unit Construction Cost of Open Dumping and Sanitary Landfill in a Country in Southeast Asia

Landfill Y axis: Investment Cost per Capacity (LOG10)

X axis: Total Capacity m^3 (LOG10)



Investment Cost of Waste Treatment Facility in a Country in ASEAN



Merits of Regional Waste Management

- By inter-municipal cooperation, it becomes feasible invest in larger and advanced facility for waste management. Otherwise each municipality may not be able to invest in environmentally sound facility.
- Illegal dumping will be reduced by implementing planned collection
- By inter-municipal cooperation, efficiency improve in cost, management, and operation, compared with single municipality collect and dispose waste.
- It was difficult for a municipality to install crushing machine for bulky waste. But by inter-municipal cooperation, it become feasible to invest in the equipment and collect non-burnable waste.
- By Shredding and compacting machine, lifetime of landfill can be extended and contributor, which prolong the lifetime of shredding and contribute to the environment.

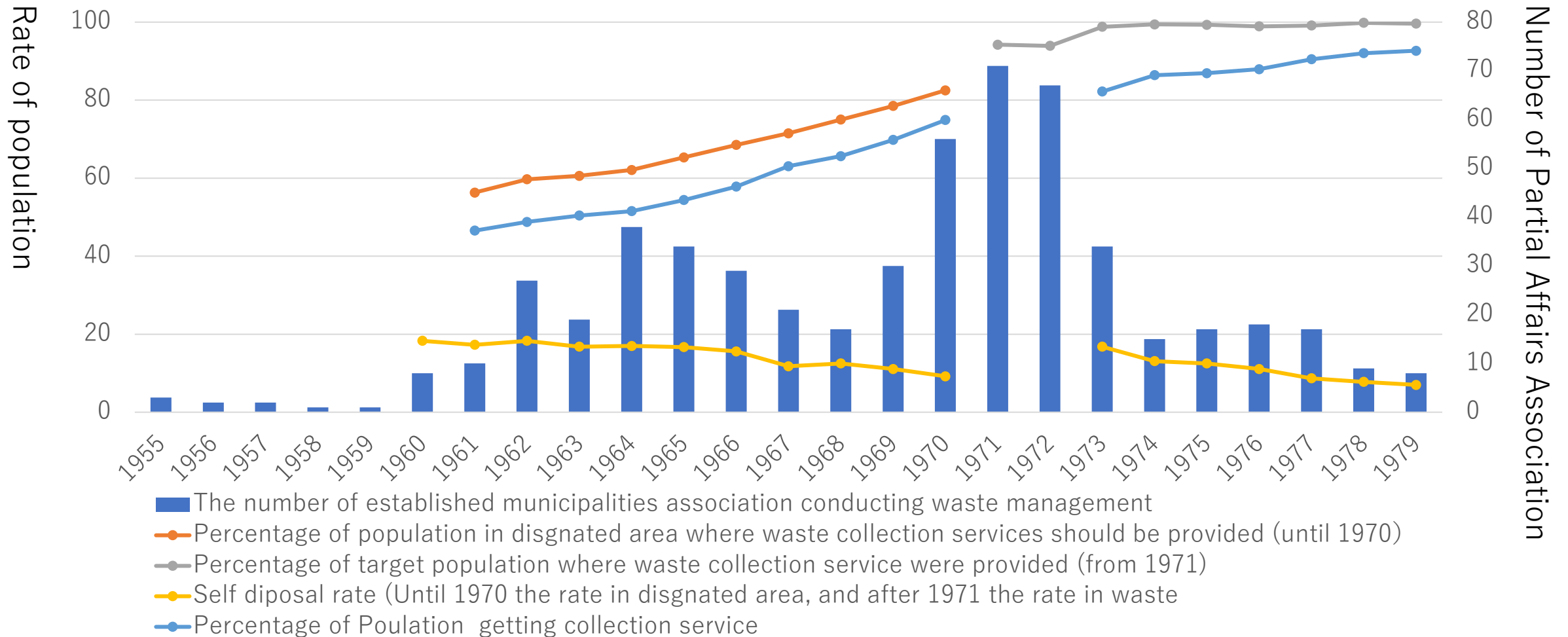
Based on the survey to municipalities conducted by central government, cited in Chiba Prefecture (1977)

Experiences to formulate inter-
municipal cooperation around
1970 in Japan

Japanese Experiences

- The Waste Cleaning Act was enacted in 1900, under pandemic of Plague. The area where municipality should conduct waste management was only cities.
- The Public Cleaning Act was enacted in 1954.
 - Waste management services should be provided in designated area.
 - The governor of prefecture can require municipalities, which was not the designated area, to conduct waste management.
 - In 1961, in terms of population, share of designated area is 56.3%, while 18.3% of them did not receive waste collection services.
- Water Pollution Control Act was enacted in 1970
 - Removed designated area for waste management. All municipalities, cities, towns and villages should conduct proper waste management.
 - Many cities, towns and villages formulated Partial Affairs Association to treat and dispose waste
 - In 1970, population in designated area is 82.5% of total population, while 9.2% in designated area did not get waste collection services. In 1980, population to be provided waste management services is 99.4% of total population, while 7.0% of them did not get waste collection service.

Number of Established Partial Affairs Association concerning Waste Management



Regional Waste Management in Chiba Prefecture in 1960s and 1970s.

Number of Association with Waste Treatment/Disposal Facility

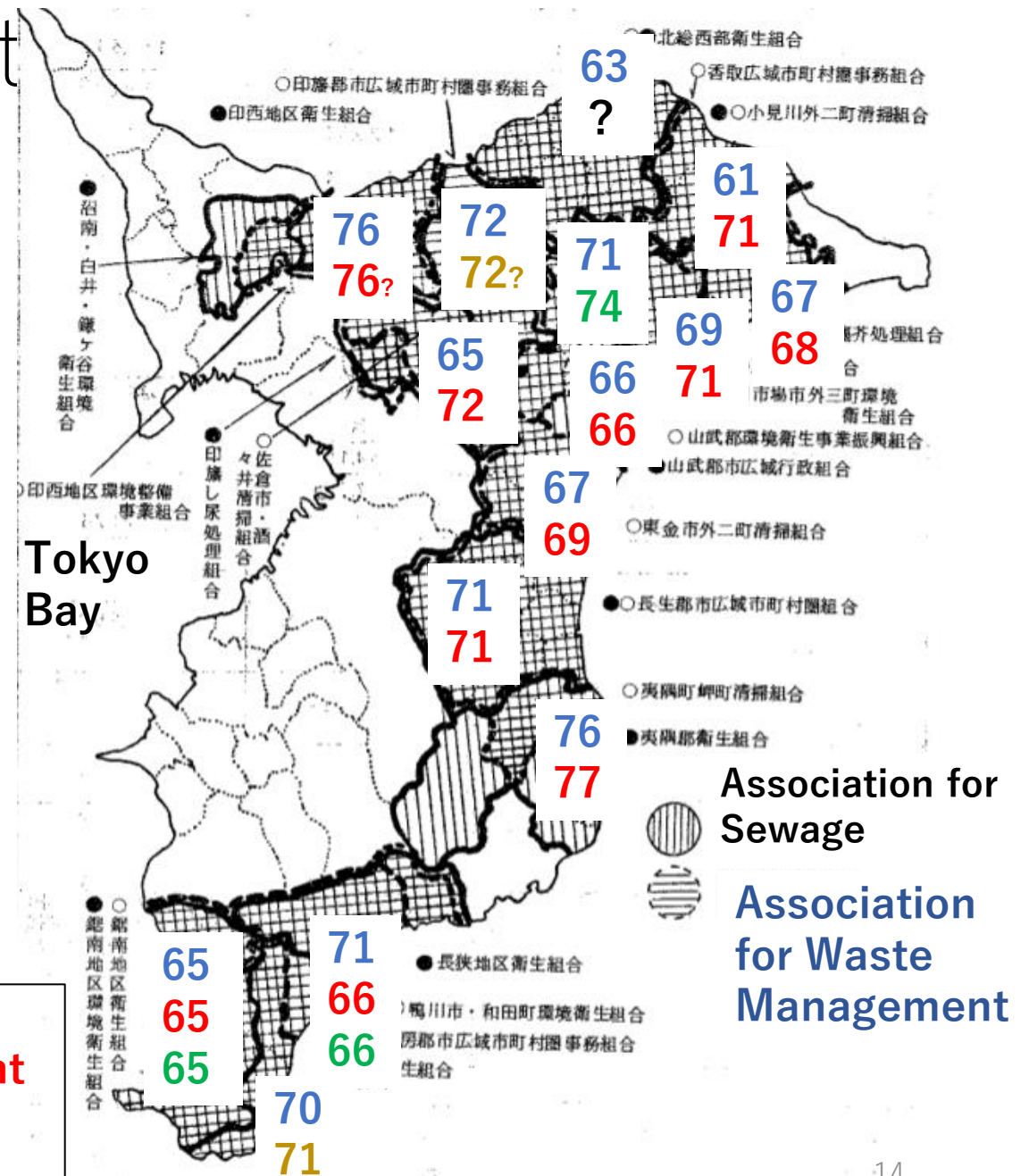
	1960 -64	1965 -69	1970 -74	1975 -79
No. of Association	0	6	7	2

Number of municipalities in an association: 2-11.

Number of Partial Affairs Association consisting of cities and town/villages: 10.

Number of Partial Affairs Association consisting of town/villages: 5.

Year of Establishment of Association
Year of Operation of Incineration Plant
Year of Treating Bulky Waste
Year of Operation of Landfill



Types of schemes regional
waste management

Types of Regional Waste Management

	Types	Example	Explanation
Inter-municipal cooperation	Regional Government Scheme	Waste-To-Energy plant planed in West Jawa, Indonesia.	Regional government make agreement with local governments in the region and accept waste from them.
	Leading Municipality Scheme	Waste to Energy Plant in Phuket, Thailand and Kitakyushu city in Japan.	A municipality hosting waste treatment or disposal facility make agreement with and receive waste from other municipalities.
	Municipalities' Association Scheme	Partial Affairs Association in Japan	Local governments formulate association to treat and/or dispose waste jointly.
	Private Sector Leading Scheme	Some private landfills accepting ashes from Waste-to-Energy plants in Japan. Some private landfills and RDF Plants in Thailand.	Private sector operates waste treatment and disposal facility which accept waste from multiple local government.

JAPAN(1)

- Local Autonomy Act enacted in 1947
 - Partial Affairs Association
 - Wide Area Union (introduced in 1994 revision)
- The number of Partial Affairs Association, Wide Area Union and alike dealing with municipal solid waste and/or human waste reached 459 in the of end of year 2016. Among 1320 Partial Affairs Associations and alike in Japan 34.8% are dealing with solid waste and/or human waste.
- After Japan made tighter emission standard on Dioxin, Central government urges local governments to manage their waste jointly.

Japan (2) Fujisan Eco Park Incineration Center

- Gotemba City (population: 88 thousands) and Oyama Town (18 thousands) formulated Administrative Association in 1976. In the same year, first waste incineration plant was constructed. The current incineration plant has operated since 2015, which can treat 143 ton of waste per day.
 - Type of Incineration: Stoker Type
 - Power Generation 2.5MW



Fujisan Eco-Park Incineration Center,
September 2019.

INDIA

- The legal framework on waste management for India was established in 2000, by enacting “Municipal Solid Wastes (Management and Handling) Rule, 2000”. Although the legal framework was developed, many municipalities, especially small urban local bodies, were not able to develop disposal infrastructure, such as sanitary landfills, because of lack of technical and financial capacity (Ministry of Urban Development, 2011). Some state governments in India started to manage municipal solid waste on a regional basis.
- Gujarat State is a leading case of inter-municipal Cooperation. A study conducted by Gujarat State showed that if each urban local bodies (ULB) developed their own treatment and disposing facilities, the cost of waste management would be 25USD/ton. On the other hand, decentralized treatment at ULB and 36 regional landfill sites are able to reduce the waste management cost to 9.4 USD/ton. Until 2015, 93 vermicomposting plants out of 159 ULBs, and seven (7) regional landfills for 37 ULBs had been constructed (UNEP 2015).

Indonesia

- Landfills in Central Jawa and Bali received waste from multiple municipalities.
 - These landfills were registered as Clean Development Mechanism. By reducing methane gas, the scheme aimed to earn revenue from developed countries, which are required to reduce emission of Greenhouse Gasses.
- West Jawa government is in the process to develop waste-to-energy plant near Bandung.
 - The provincial government of West Jawa will contract with private companies, while provincial government also contract with Bandung city and surrounding municipalities on receiving waste from these municipalities.

Incentives and Challenges to Establish Regional Waste Management

- To formulate inter-municipal cooperation, central government should consider some policies to support formulating inter-municipal cooperation in the field of waste management.
 - First, the legal status should be considered.
 - Second financial incentive to formulate inter-municipal cooperation.
- There are some challenges to maintain inter-municipal cooperation.
 - The first challenge is change of political leader. Mayor and chief of local-municipalities may be changed.
 - The second challenge is cost sharing mechanism. Local municipalities should share the operation cost of waste to energy plant or sanitary landfill. There are possibilities not to reach agreeable condition among municipalities.

Disadvantage of Regional Waste Management and Counter Measures

To protect environment

- Larger waste treatment facilities and landfill site may imply more nuisance to the neighbors.
 - Proper control of odor, air pollution, and wastewater should be guaranteed.
 - The increase of traffic of garbage trucks is also nuisance along access road.
- Otherwise, neighbors oppose the construction of such facilities.
- It is important to ensure the protection of the environment.
 - The emission and effluent data should be open to the public.
 - Access road should be properly prepared, to reduce traffic jam.
 - If possible, some facilities should be open to the public, such as swimming pool, spa or other facilities.
 - In Japan, it is gradually recognized that waste to energy plant can be a center for supporting residents at disaster, because the facility generate electricity.

Not in My Back Yard (NIMBY)

- Regional waste management facility may be opposed by people living near the facility.
- It is important that facility should protect surrounding environment by various pollution control measures.
- Not only the facility, but also access road should be wider than other road, to reduce the traffic jam, due to garbage truck.
- Kitakyushu City, Japan receive waste generated in surrounding municipalities, under following condition:
 - The volume of waste from other municipalities is not so much, comparing remaining capacity of waste treatment of Kitakyushu city.
 - Use transfer station and bigger trucks to reduce number of trips.
 - Waste reduction and recycling program, which is same level of Kitakyushu city. Etc.

Transportation Cost

- Another demerit of regional waste management increase of transportation cost of waste.
- To reduce transportation cost, transfer station can be used.
 - Segregating wastes
 - Reduce water in waste



Compactor and Trucks at Transfer station in Indore, India, April 2018

Transfer Station in Guangzhou, China

- A part of municipal waste collected in Guangzhou are sent to transfer station. Recyclable waste are removed and sent to recycling facility. Water contents are reduced. Collected wastewater is treated. The rest of waste are sent to waste to energy plant or landfill.



A transfer station in Guangzhou China, June 2011.

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Edited by
Michikazu Kojima

IDE-JETRO

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- Ch.1 Regional Waste Management in Asia
- Ch.2 Inter-Municipal Cooperation and Regional Waste Management in Japan
- Ch.3 Inter-Municipal Cooperation on Solid Waste Management in Japan: Its Challenges and Implications for ASEAN Countries
- Ch.4 Cost Efficiency of Regional Waste Management and Contracting Out to Private Companies
- Ch.5 Promoting Local Collaboration on Waste Management: Lessons from Selected Cases in the Philippines
- Ch.6 Internal and External Factors in the Development of Regional Waste Cooperation in the Greater Bandung Region
- Ch.7 The Effect of Local Government Separation on Public Service Provision in Indonesia: A Case of Garbage Pickup Services in Urban Areas
- Ch.8 Clustering and Public–Private Partnerships: The Tools of Municipal Solid Waste Management Reformation in Thailand

Conclusion

- To reduce leakage of plastic waste to the ocean, it is necessary to expand waste management services not only in mega cities, but also rural area and small/medium cities is one
- To achieve environmentally sound management of municipal solid waste, local governments should conduct proper treatment and disposal of waste. Technology such as waste to energy plant and sanitary landfill is often too costly for small municipalities. Inter-municipal cooperation may be able to save some cost, because of economies of scale in some waste management facilities, such as landfill and waste to energy plant.
- A few countries in Asia, such as Japan, India, Indonesia, Thailand, have initiative to formulate inter-municipal cooperation. But most of Asian countries have limited experiences and legal arrangement to conduct regional waste management.
- It may be good to share the experiences within the region.

References (1)

- Bel, Germa and Mildred E. Warner (2015) “Inter-municipal Cooperation and Costs: Expectations and Evidence” *Public Administration*, Vol.39, No.1, pp.52-67
- Fujii, Minoru (2005) “Advantage and Disadvantage in Regional Waste Management” *Waste Management Research* Vol.16, No.6. pp. 328-333. (in Japanese with English abstract)
- Kojima, Michikazu (ed.)(2019) *Toward Regional Cooperation of Local Governments in ASEAN*, IDE-JETRO.
<https://www.ide.go.jp/English/Publish/Download/Ec/201903.htm>

References (2)

- Kojima, Michikazu (ed.)(2020) *Regional Waste Management – Inter-municipal Cooperation and Public and Private Partnership*
<https://www.eria.org/publications/regional-waste-management--inter-municipal-cooperation-and-public-and-private-partnership/>
- Ministry of Urban Development (2011) “Guidance Note: Municipal Regional Waste Management on a Regional Basis”, India.
- Ministry of Urban Development(2016) *Municipal Solid Waste Management Manual Part II: The Manual*, India.