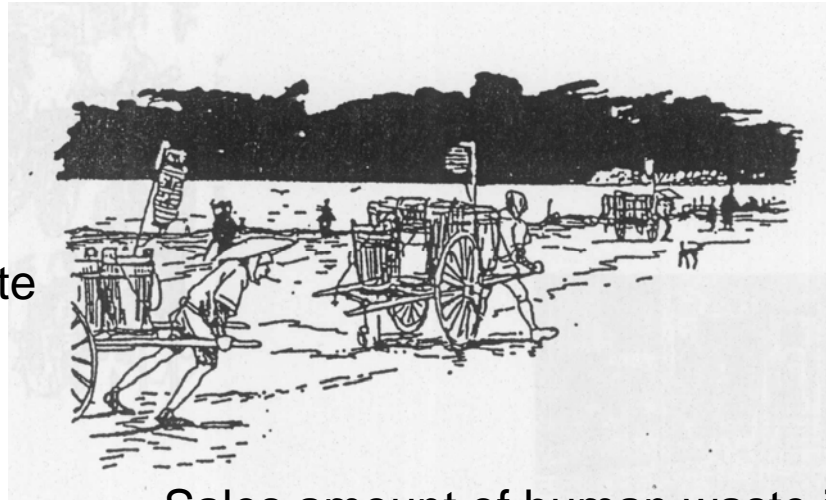
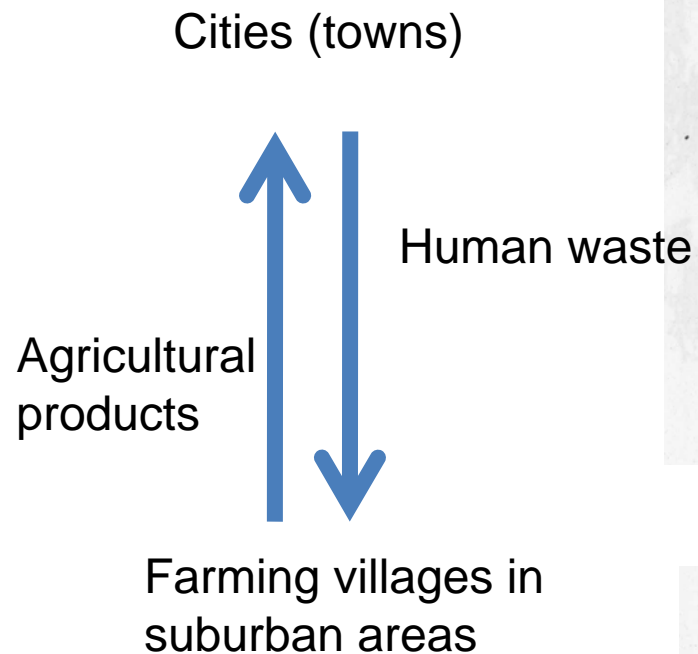


**Strategy for extending sanitation
services by an integrated
coverage with on-site and off-site
systems in Japan**

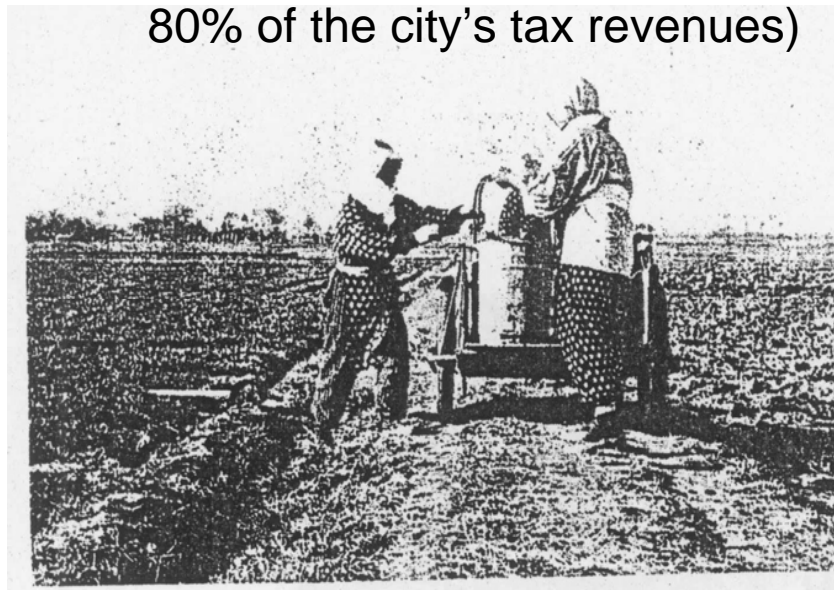
**Department of Urban Engineering, Graduate School
of Engineering, University of Tokyo**

Dr Hiroyuki Katayama

Human waste (night soil) in cities was a valuable fertilizer 100 year ago



Sales amount of human waste in the City of Kyoto was ¥80,000 in 1909 (Equivalent to 80% of the city's tax revenues)



ca. 1900.

Public Health in 19th century

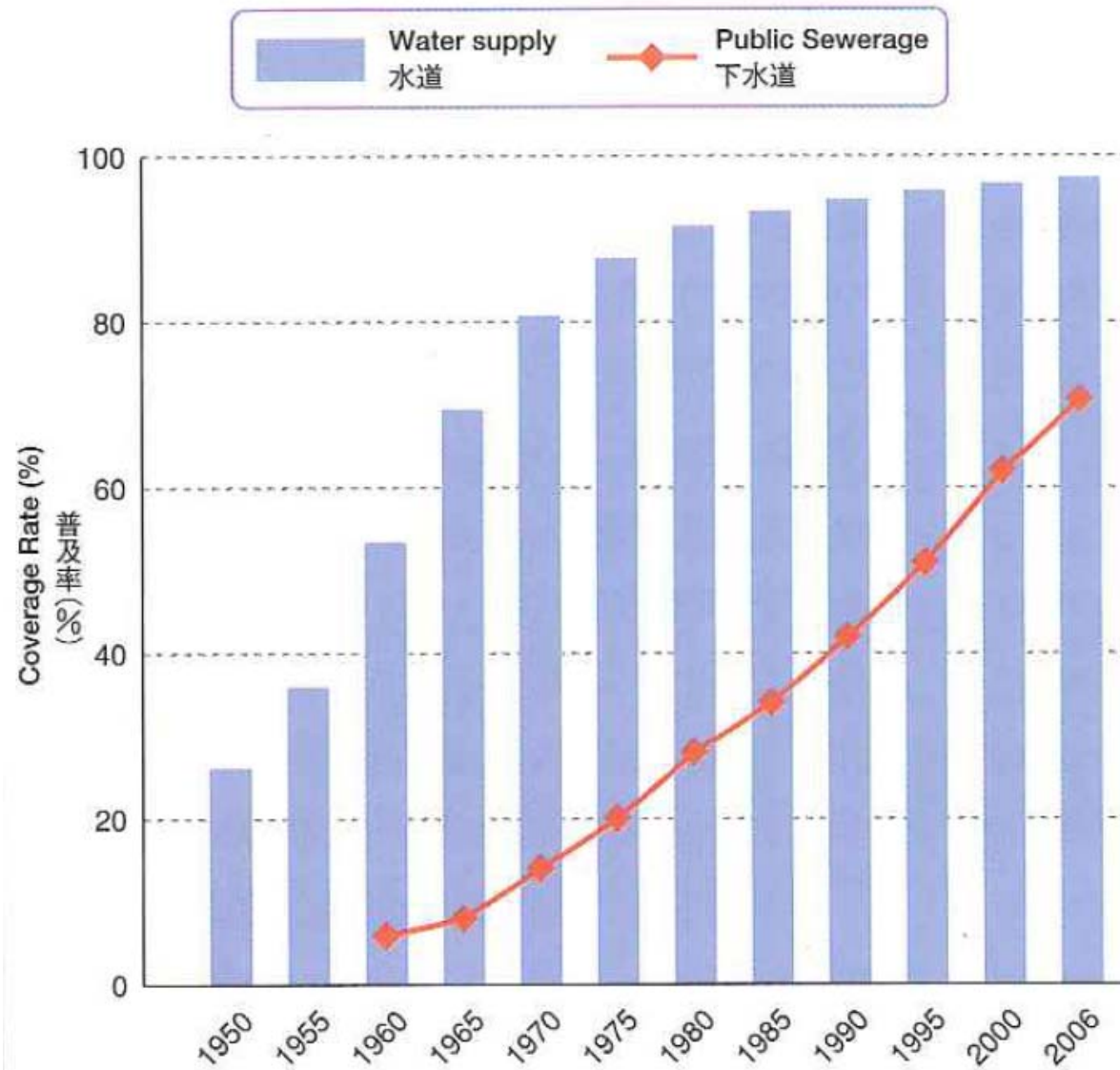
- Urbanization in European countries
- Movement of social issues and public health

	Miasma theory	Contagion theory
cause of disease	bad air	theory
Priority of civilization	Wastewater, Solid waste Poor law	Drinking water
Supporter	Edwin Chadwick, Max Josef von Pettenkofer	John Snow Robert Koch

Impact of Cholera outbreaks

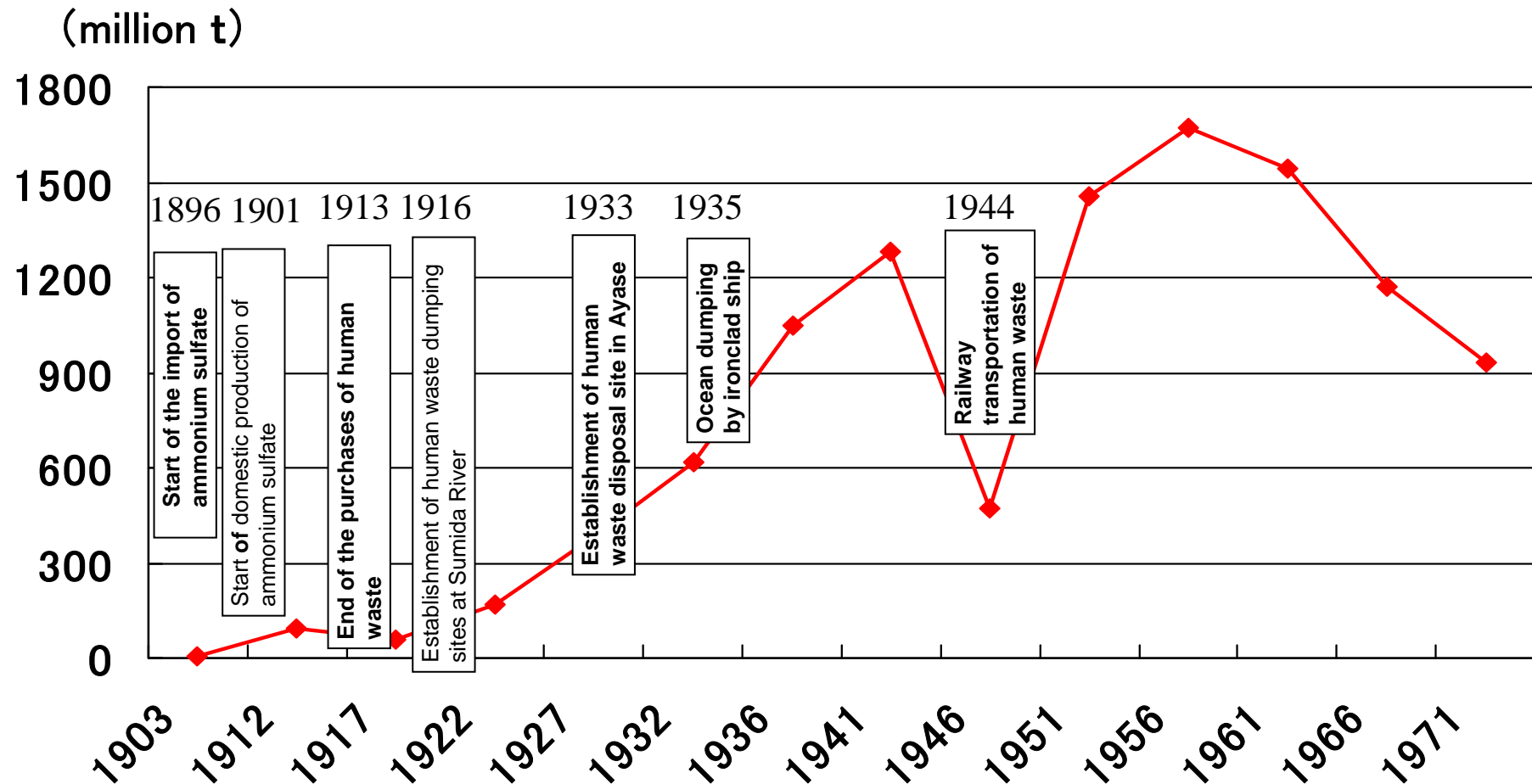
- First priority was set to prevent Cholera outbreak
- Water supply was focused since *V. Cholera* isolation by R. Koch (1884).
- Water supply was first proceeded also in Japan, followed by sewer system after World War II.

Spread of water supply and sewerage systems



Spread of sewerage systems was 40 years behind water supply service

Development of chemical fertilizer (ammonium sulfate) consumption and changes of human waste disposal methods

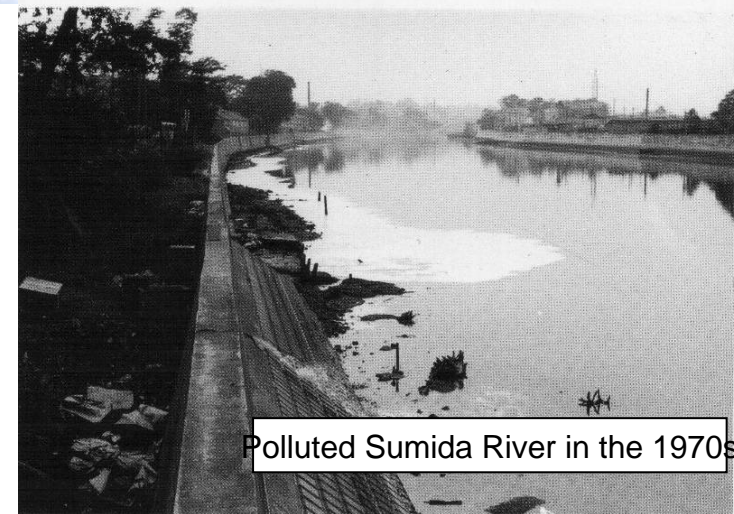
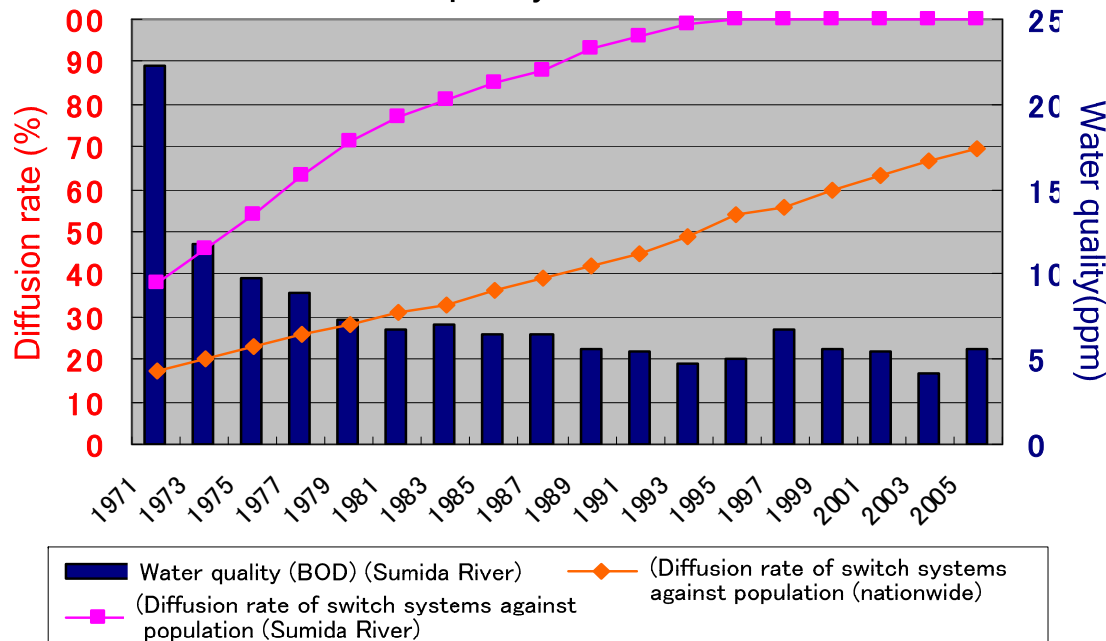


(Dictionary of Plant Nutrition and Soil Fertility: published by Yokendo, 1980)

Pollution and clean-up of Sumida River

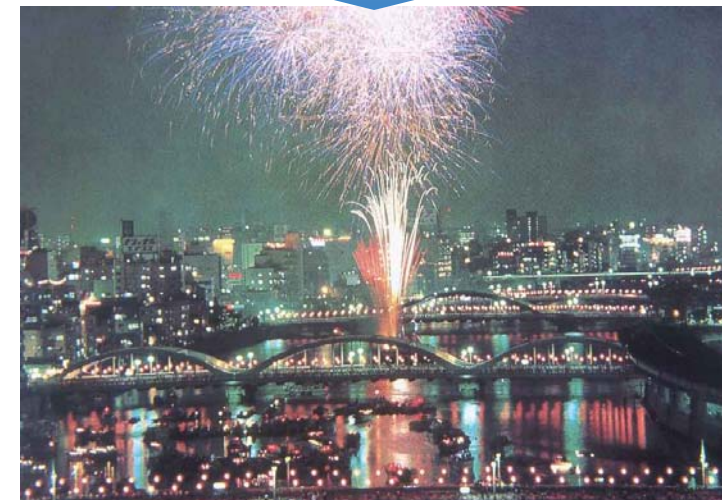
- ✓ In Japan, legal and institutional improvement, in addition to technological development in the 1970s, has enabled the rapid increase of sewerage coverage, leading to the improvement of river water quality and urban environments.

Diffusion of sewage systems and change in water quality of Sumida River



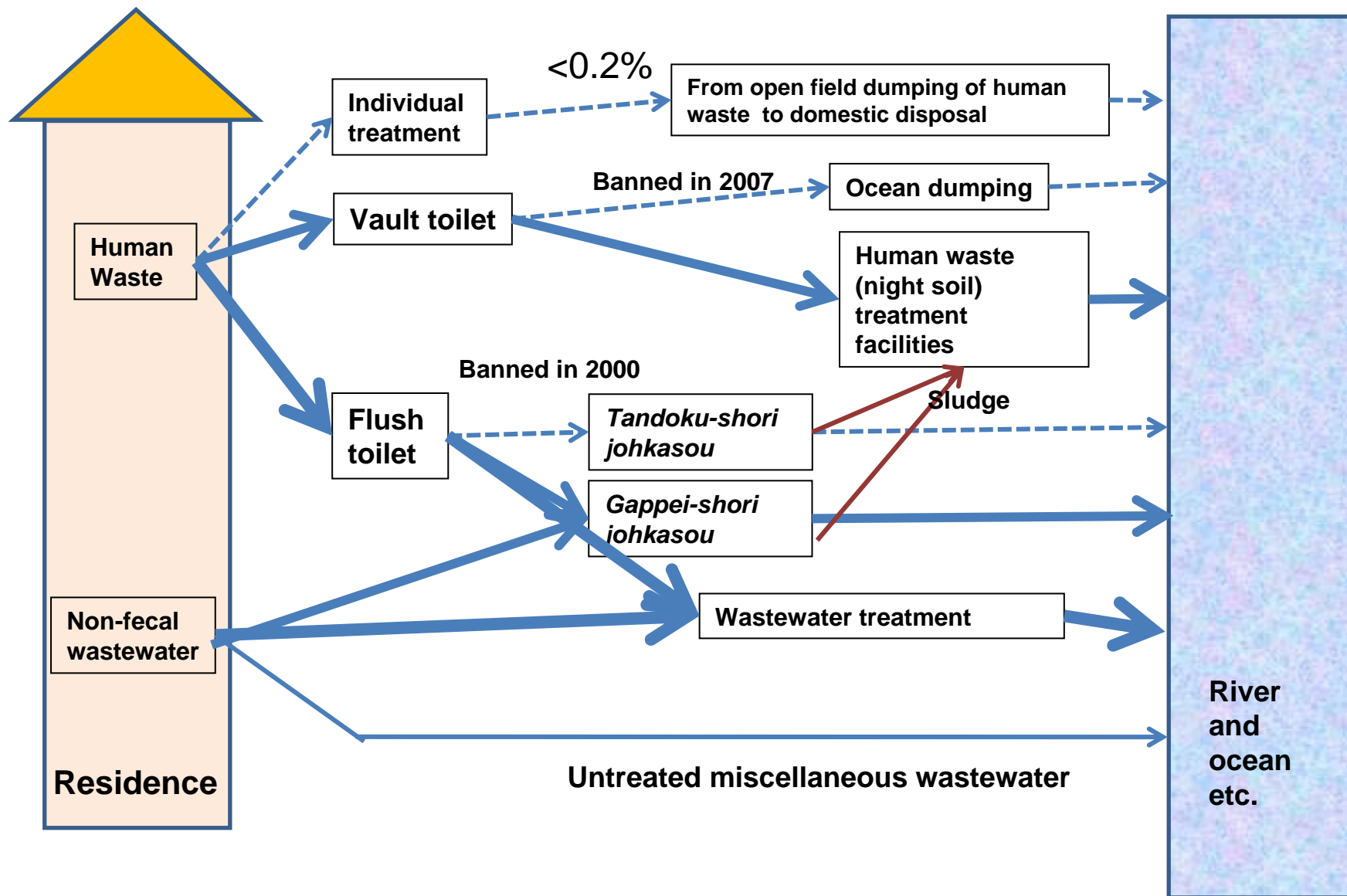
Polluted Sumida River in the 1970s

Construction of
sewage facilities

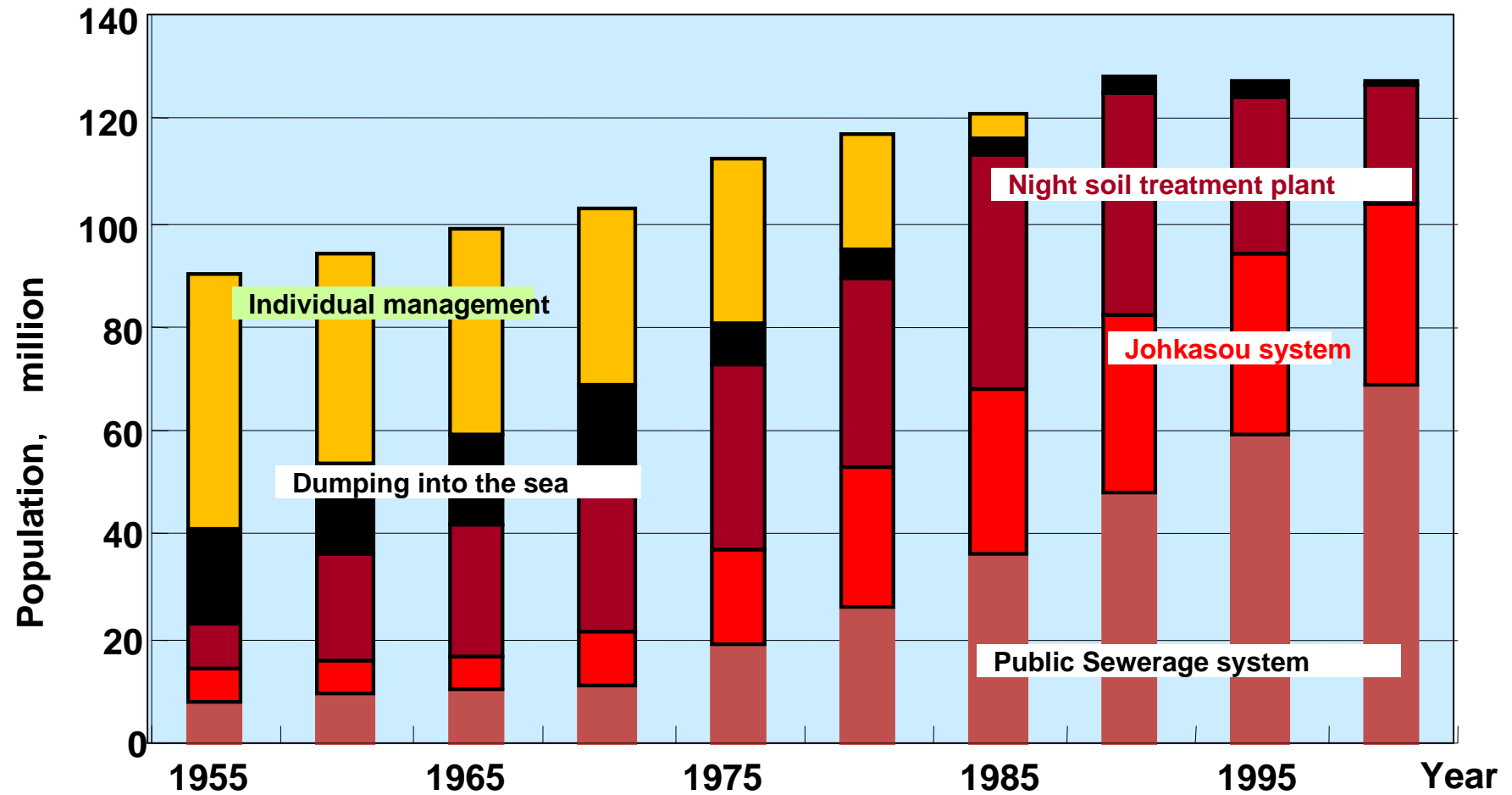


Water quality improvement resulted in the restoration of a fireworks show on Sumida River

A Variety of Types of Sanitation Facilities in Japan



History of Domestic Wastewater Management in Japan



Development of domestic Wastewater management in Japan(1955-2000)

Inception of sewerage in Japan

Modern sewerage of Japan started about 130 years ago in major cities, as a countermeasure against flood by rainwater and for prevention of spreading of epidemics through sanitary wastewater.



Mikawashima wastewater treatment plant, Tokyo
(the first plant of this kind in Japan:1922)

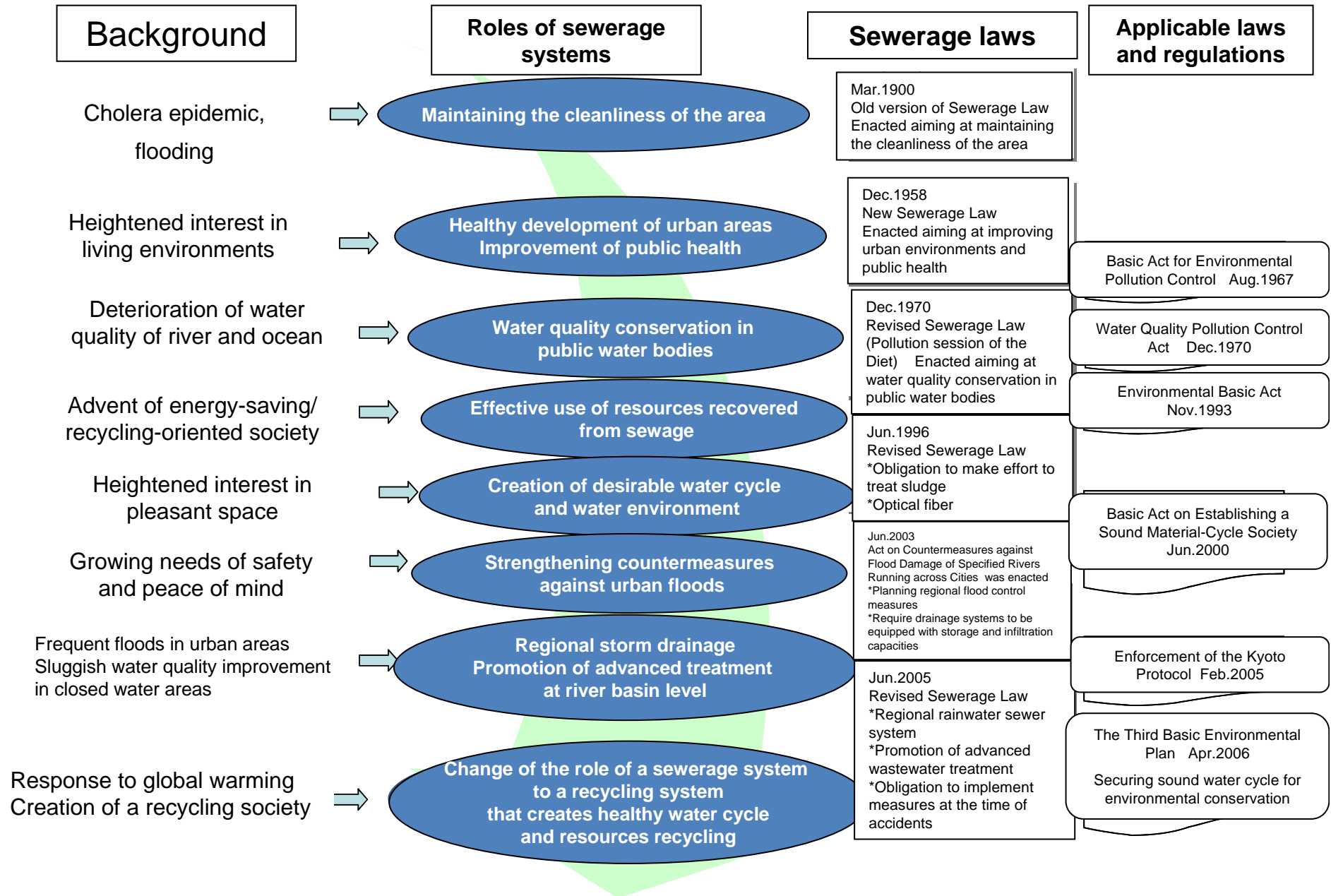


Brick-made sewer, Yokohama
City (1881)

Wastewater law

- Local government is primary responsible for public health and sound city environment as well as protection of public water body.
- To ensure the water quality, local governments plan, build and operate wastewater treatment systems.
- Rainwater management is also included.

Changing roles of sewerage systems

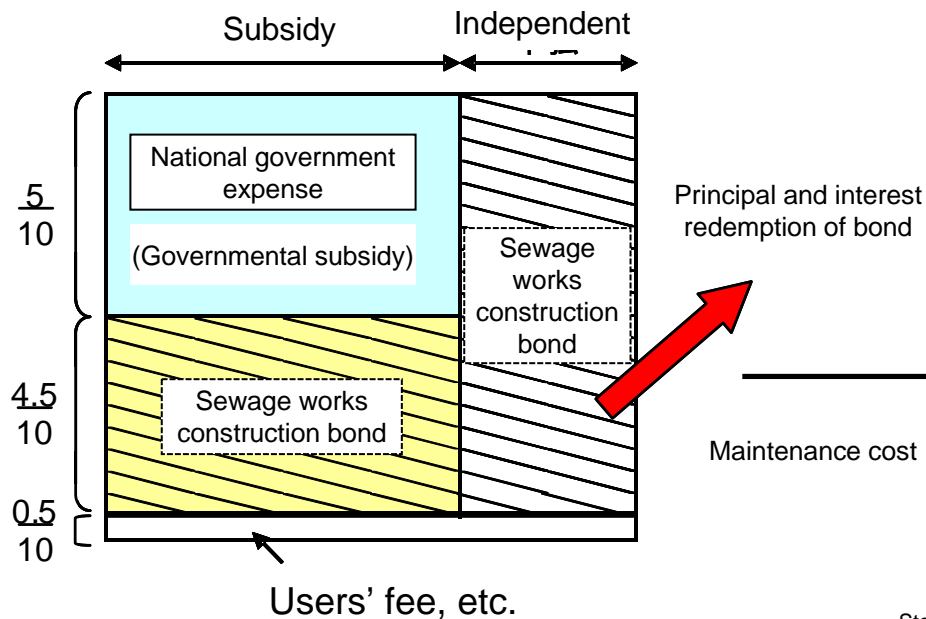


Financial system supporting evolution of the sewerage service

In view of personal benefits, such as flushing of toilets, and public policy objectives including water quality conservation of public water area and control of flood, the national government expenses, local expenditure, and charges have been properly combined to promote the sewerage service.

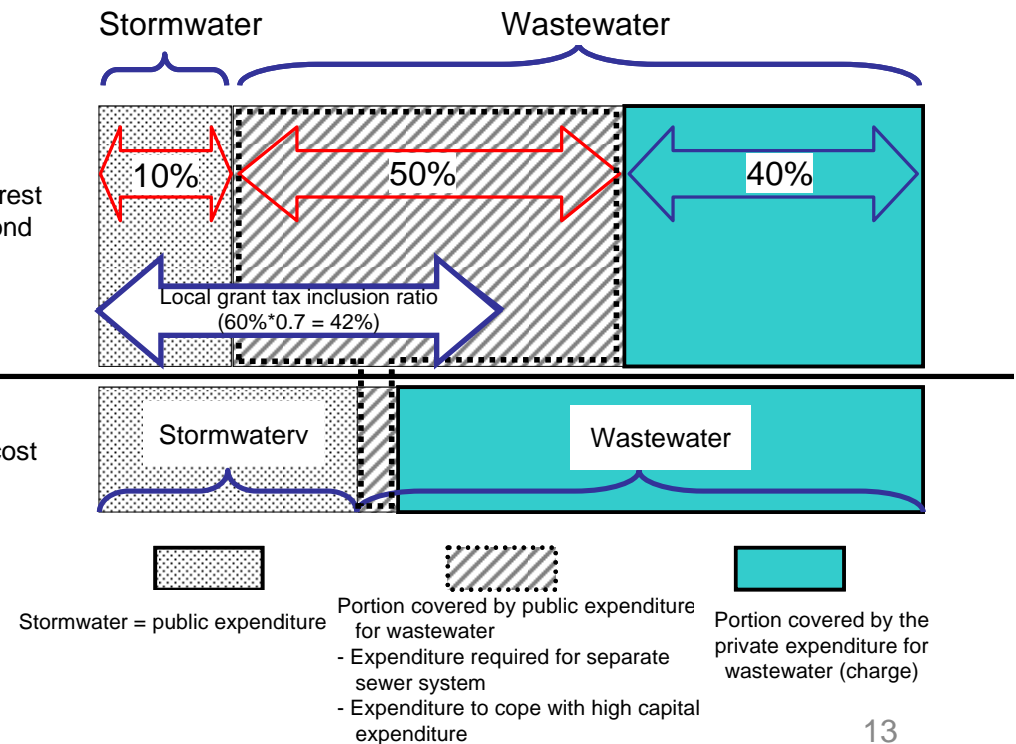
Fund composition for construction costs

Example: Separate sewer system



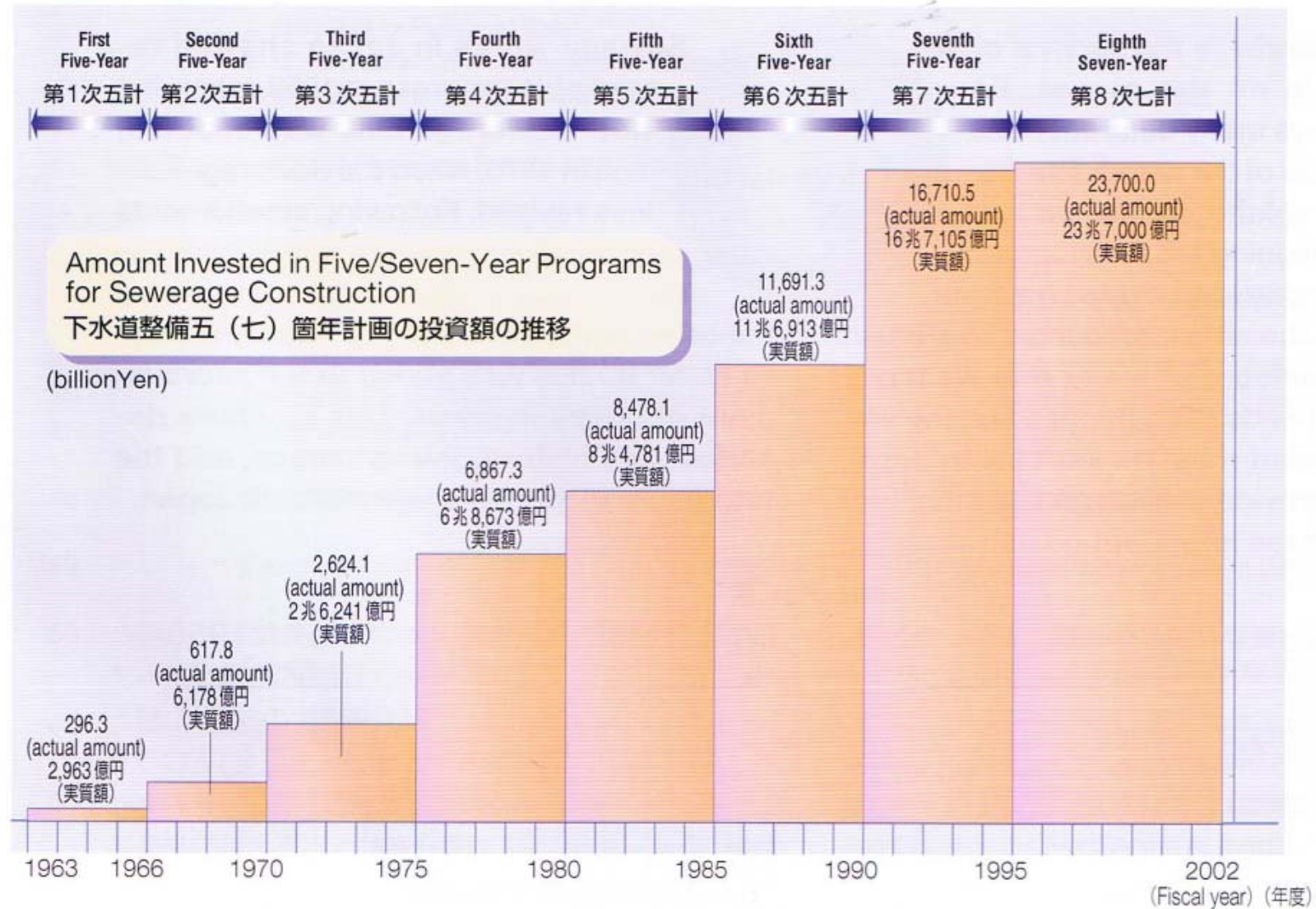
Fund composition for sewerage maintenance costs

Example: Treatment area with the internal population density of 25 – 50 people/ha



Expanding coverage through well-planned investment in sewage works

Progress of Investment in Sewage Works in Japan at a Glance 下水道投資額の推移

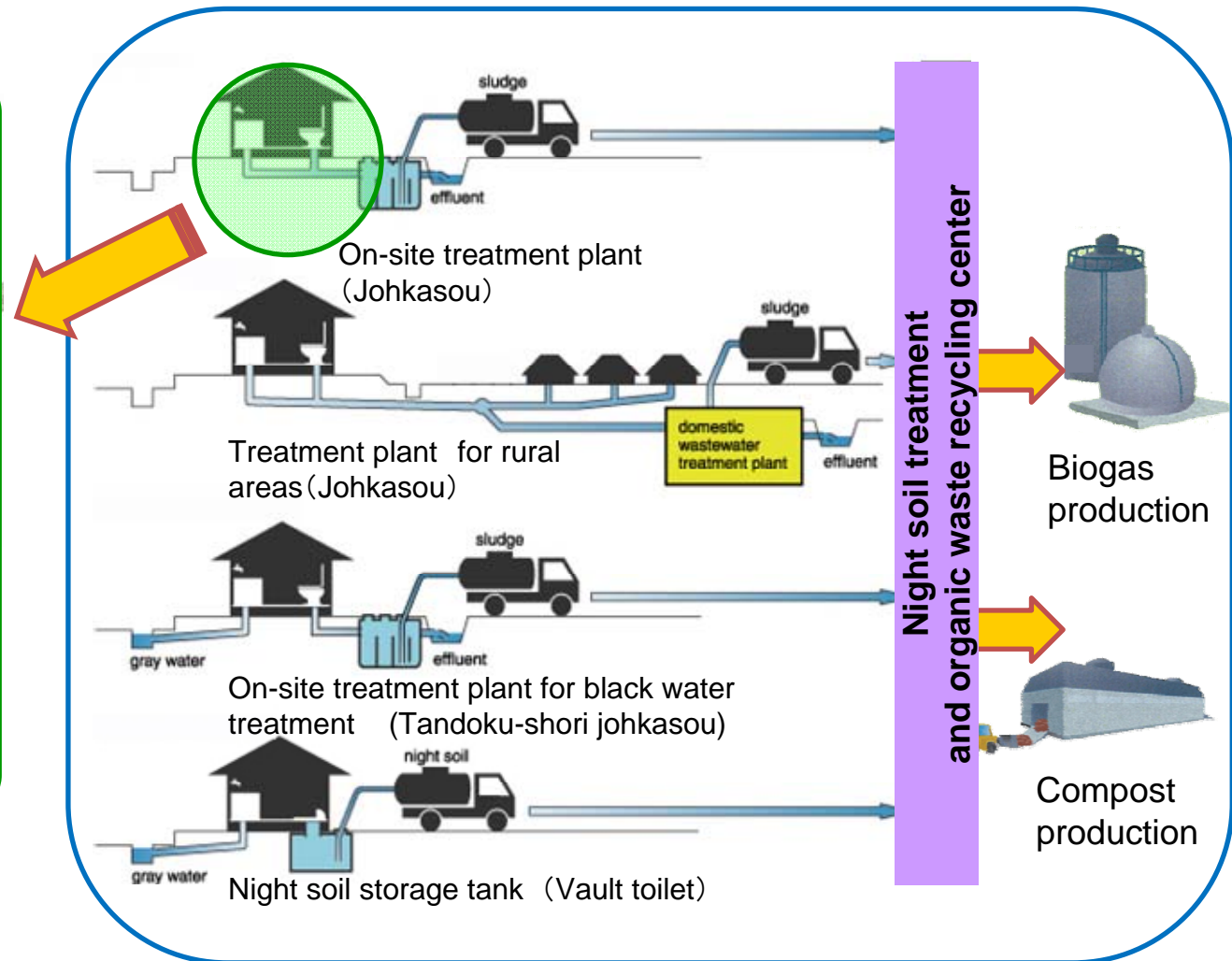


On-site Sanitation Systems (Johkasou) and night soil treatment

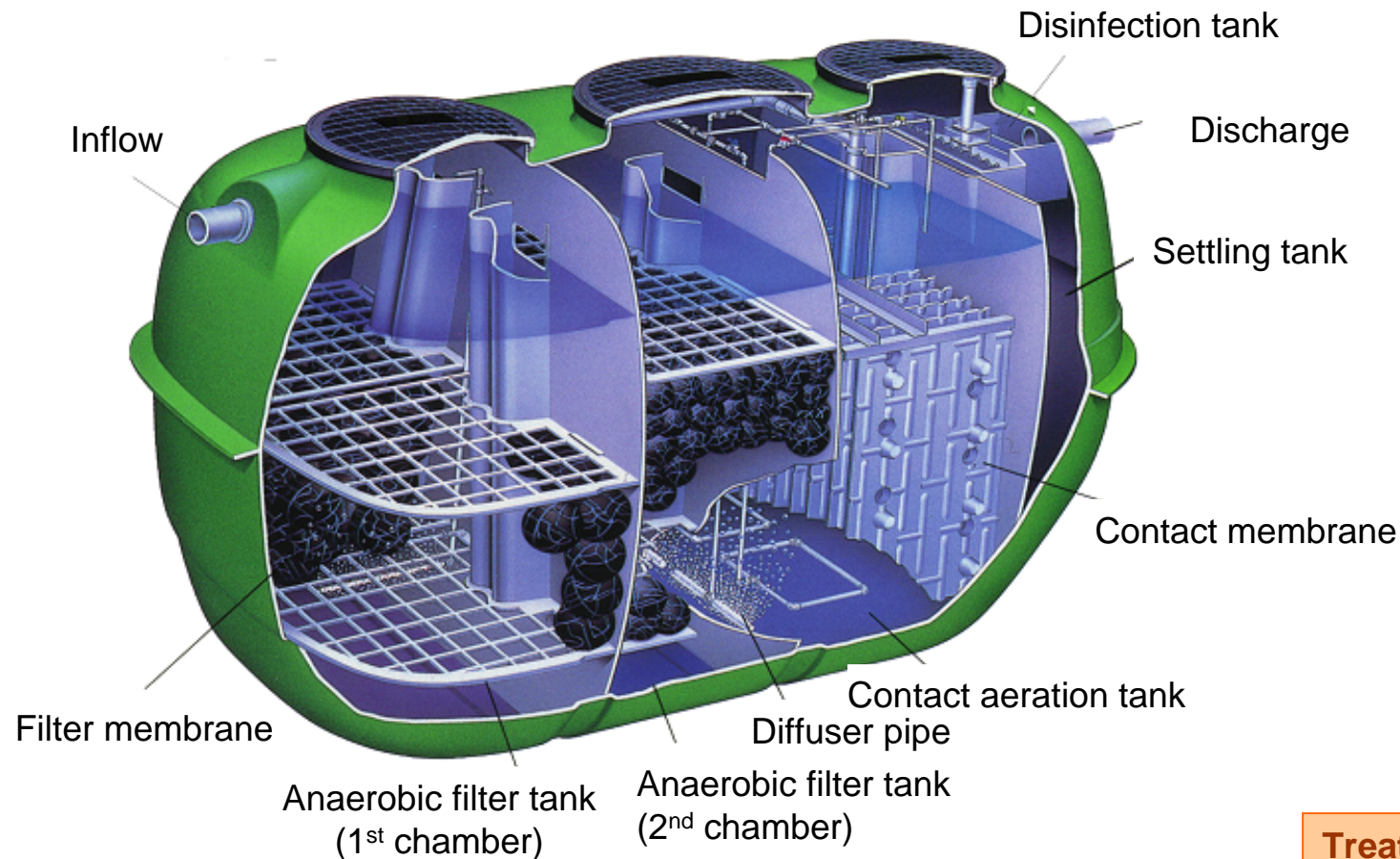


This type of Johkasou can be applied to organic pollutants removal as well as nitrogen and phosphorous removal

On-site treatment plant for individual houses (Johkasou)

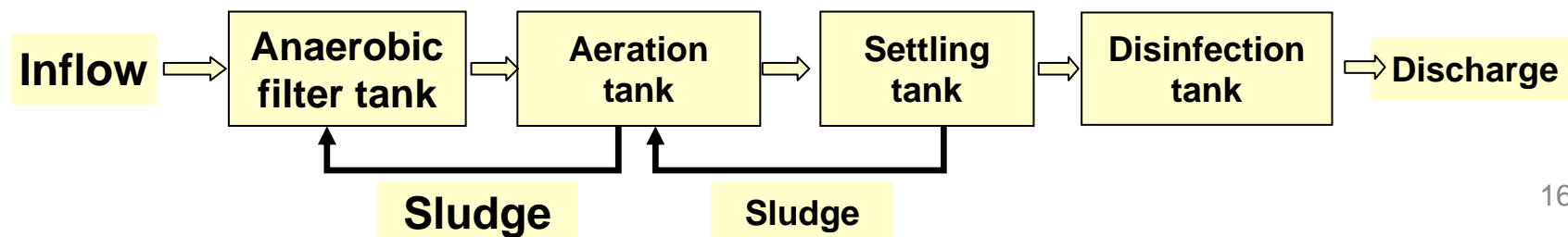


On-site treatment facilities (johkasou) in Japan



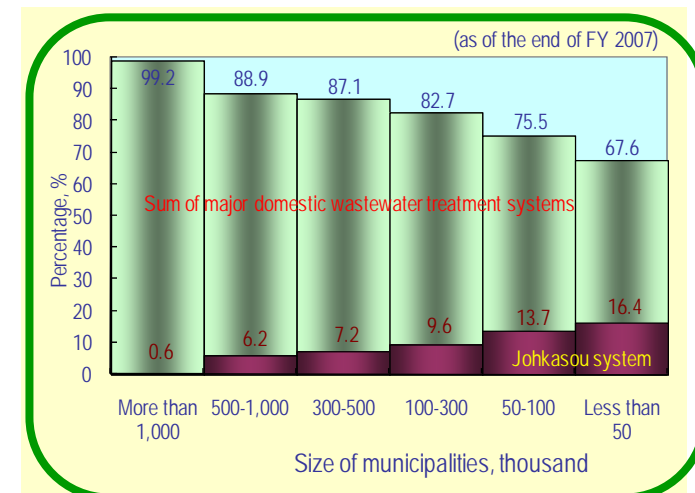
An example of small-scale johkasous

Treated water quality
BOD ≤ 20 mg/L



Advantages of On-site Sanitation Systems (Johkasou)

- Low initial investment cost, high treatment performance
- Little topographic limitation, short installation time and early realization of the effects
- Invaluable contribution to maintaining sufficient water in small rivers and aquatic environments near inhabited areas
- Johkasou-treated water and sludge are easy to reuse
- Be flexible enough to respond to depopulation society
- Less vulnerable to earthquakes and other disasters

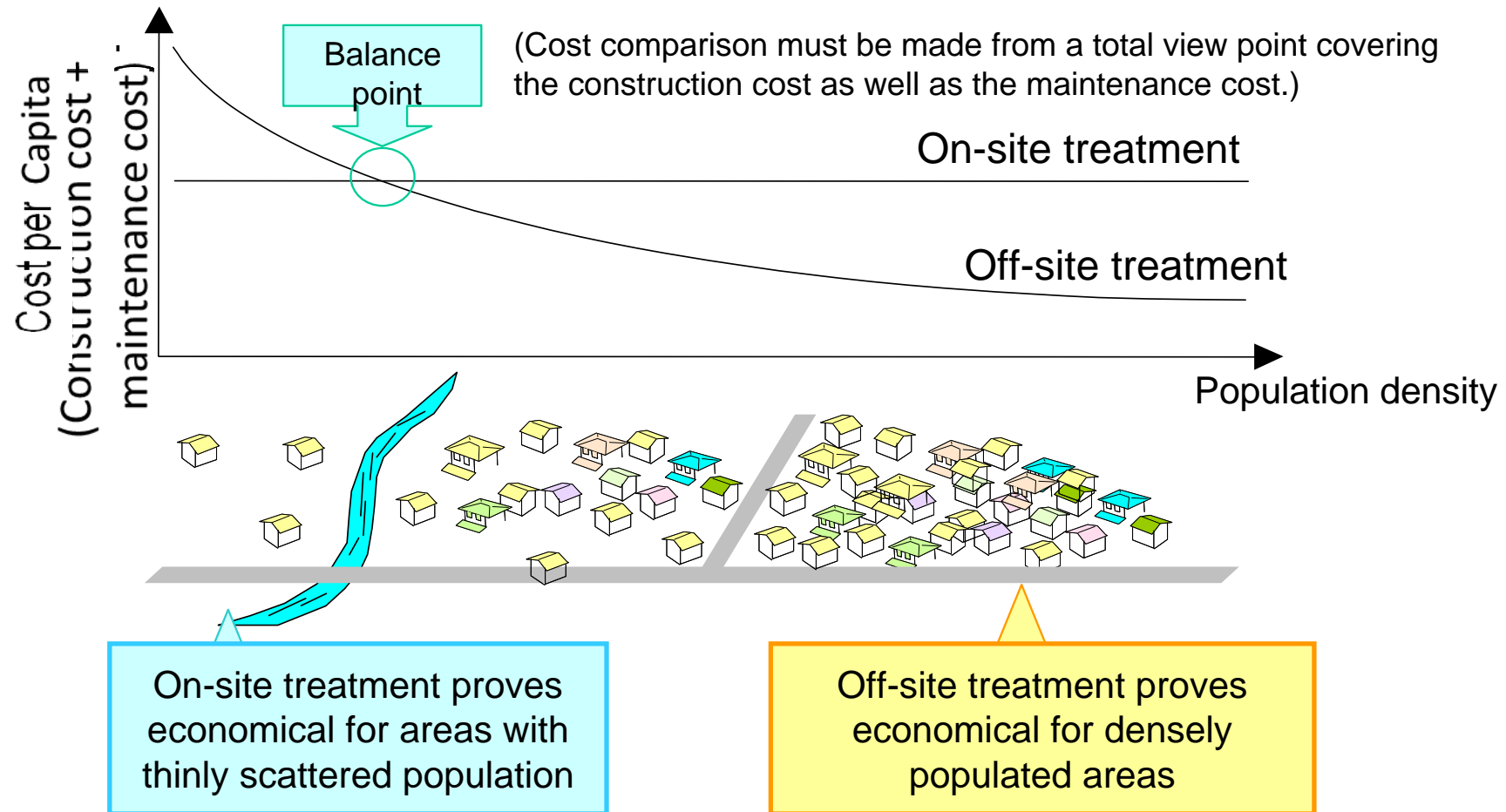


Johkasou Law and Service Population

- 1983: Johkasou Law, 1985 set into effect.
 - Regulating manufacturing, installing, operating and sludge-disposal of johkasou.
- 1987: National subsidy program for individuals, 100 million yen.
- 1994: Subsidy to municipalities for promotion of gappei-johkasou
- 2000: Revision of Johkasou Law, banning tandoku-shori johkasou.
- 2004: National subsidy amounted 25.7 billion.
- 2008: Johkasou serves 11.3 million people, i.e. 8.9% of the total population.

Sanitation systems based on careful study of population density and the cost

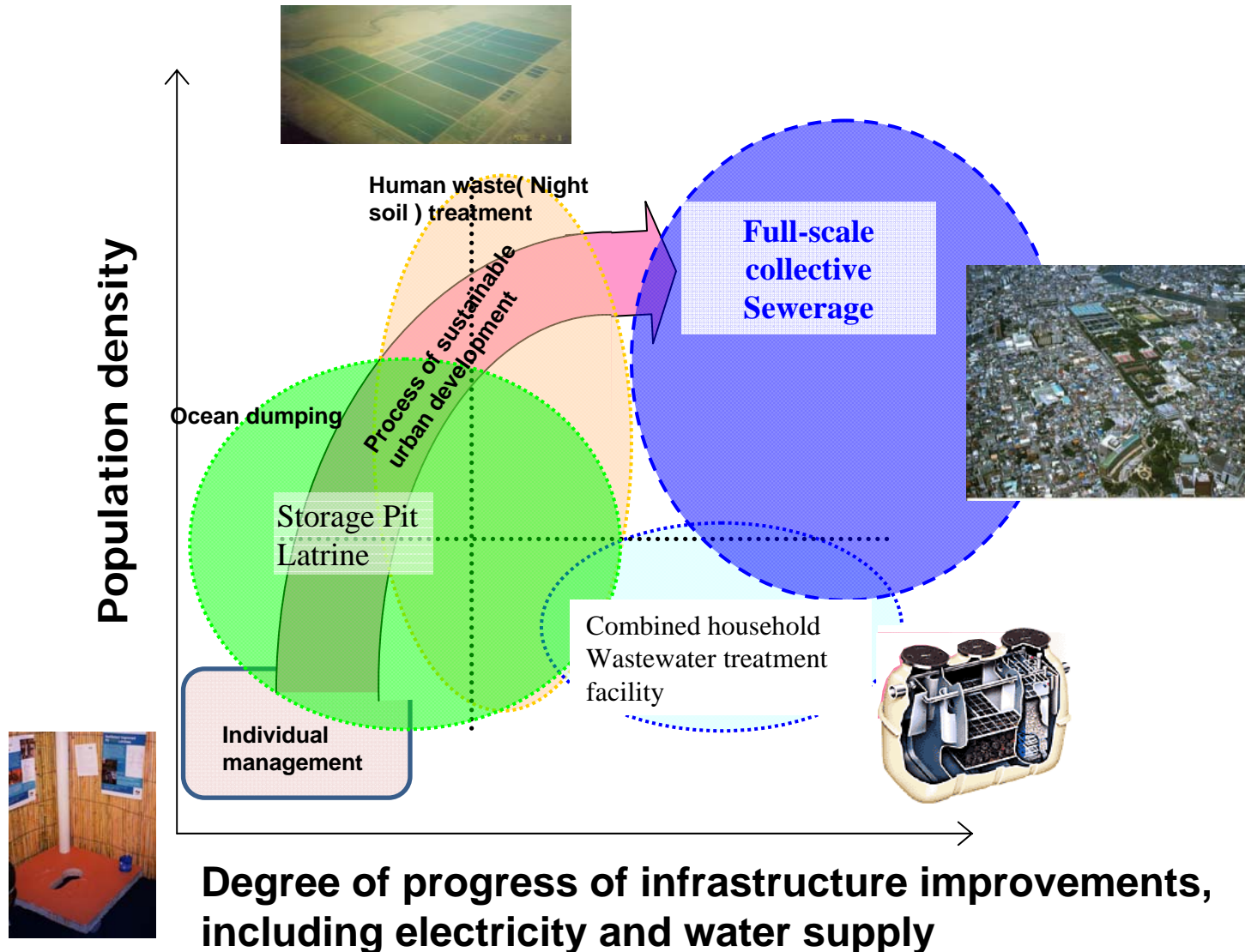
Conceptual diagram of cost comparison



※In comparing the cost per person between centralized treatment (sewerage systems, rural sewerage systems etc.) and individual treatment (*gappei-shori johkasou*), there is an equilibrium point, which is determined by the characteristics of the region.

Choice of appropriate sanitation systems considering degree of urbanization (population density) and social overhead capital investment into account

Human waste(Night soil) treatment



Conclusion

- History of sanitation in Japan: custom of storing
 - Cause less environmental pollution
 - From ocean dumping to night soil treatment
- Spread of flush toilets: further improvement of living environments
 - Sewerage systems cover densely-populated areas and work as storm-water drainage facilities in urban areas
 - (*Tandoku-shori/gappei-shori*) *Johkasous* cover thinly-populated areas
- Japan's experience: key to the improvement of sanitation
 - High coverage rate of Japan's sanitation services was realized by an ideal combination of on-site and off-site systems
 - Financial support
 - Regulations and standards / standardization
 - Hygiene education