Japan's Experiences on Water Supply Development: Overview

Nishiya Water Treatment Plant in Yokohama

No. I1 Ver. 1

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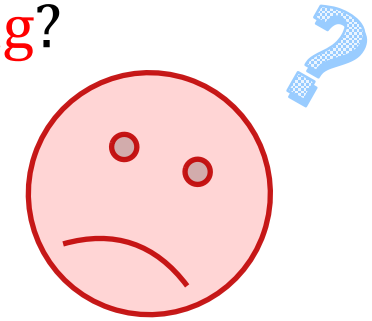
1. Introduction

Frequently asked questions from participants of the water supply training courses

Q1. How has Japan achieved almost 100% water supply coverage?

Q2. How can Japanese waterworks provide around the clock supply of safe affordable drinking?



2. Goal 6 of SDGs and Japan's Experiences

Goal 6: Ensure availability and sustainable management of water and sanitation for all.

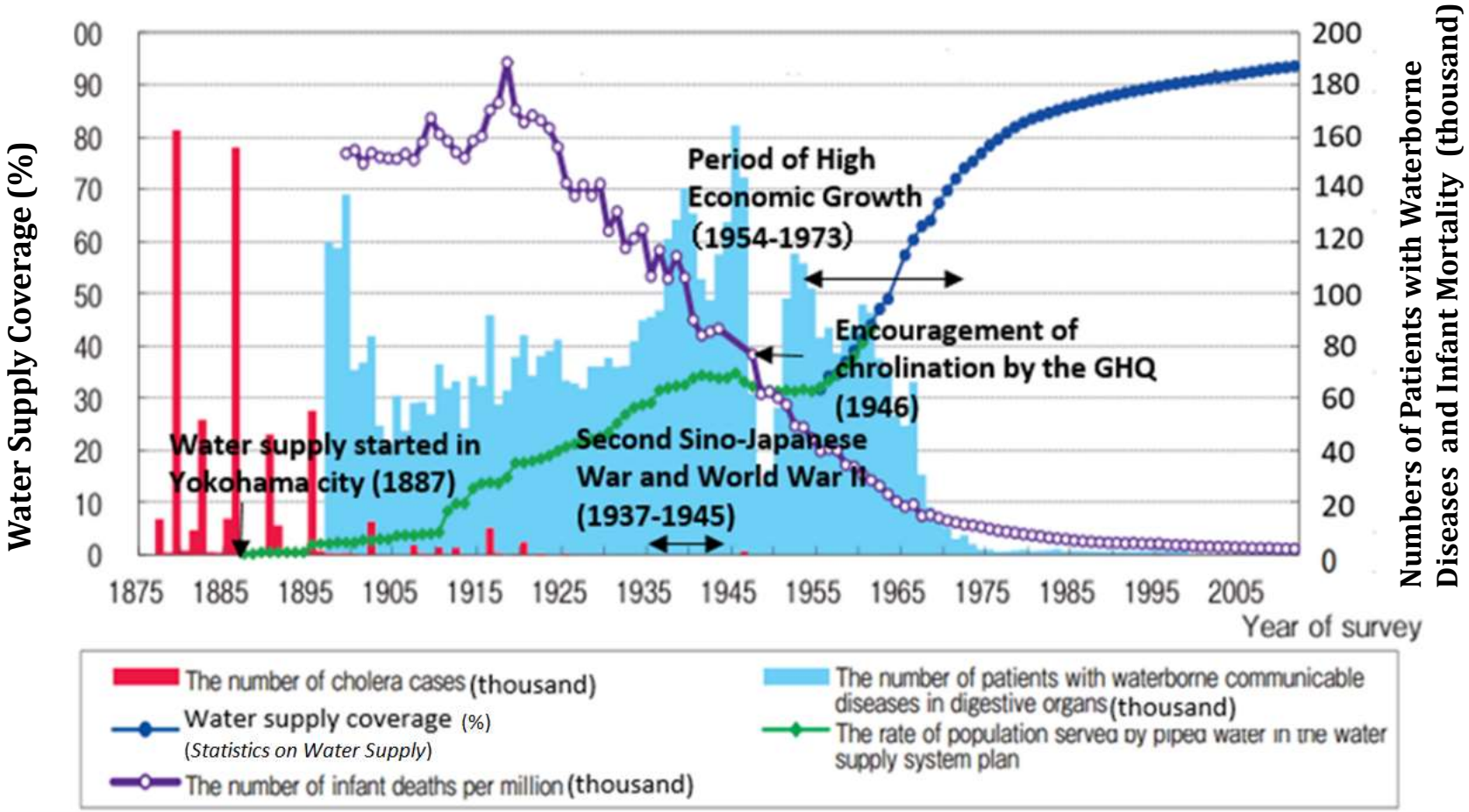
Water Supply Targets

- Universal and equitable access
- Affordable
- Safe
- Efficient water-use
- Integrated resource management
- Public engagement

Japanese Achievements

- Almost 100% water supply coverage
- Water tariff system structured with consideration for low income groups as well as ensures full cost recovery
- High-quality tap water to all customers
- Low leakage rate (4.69% in 2013)
- Securing water resources in collaboration and coordination with all stakeholders
- Always moving forward with full support of local communities

3. Universal and Equitable Access



Source: Added to the figure from Water Resources Department, Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism, "*Water in Japan*," http://www.mlit.go.jp/common/001044443.pdf

3. Universal and Equitable Access

(1) Reducing Incidence of Waterborne Diseases

- Water supply system was developed as a measure to improve public health and to prevent the spread of waterborne diseases.
- Water supply distributes filtered and disinfected water through pressured iron pipes.
- Cholera outbreaks were eliminated in Yokohama in 1887 .
- The Waterworks Ordinance was enacted in 1890 .

Establishment of Yokohama water in 1887

Sekiguchi weir of Kanda Josui (Waterworks) in 1919

Tokyo Waterworks Historical Museum
http://www.suidorekishi.jp/minitenji2015.html

3. Universal and Equitable Access

(2) Development of Nationwide Water Supply System

The following measures were implemented:

- **Funding for urban water supply:**
  from municipal bonds purchased by public funds (public financial institutions, pension funds, etc.)
- **Funding for rural water supply:**
  subsidies for small-scale utilities (1952)
- **Enactment of the Water Supply Act** (1957)
- **Approval (License) system requiring master plans**
- **Human resources development**
- **Enactment of "*Guidelines for Water Supply Facilities Standards*"** (1966)

4. Safe Drinking Water

(1) Water Quality Standards and Facilities Standards under the Water Supply Act

Standards are revised periodically as new knowledge emerges on toxic substances and the public concerns, and the technical level of water quality testing.

Water Supply Act

- Article 4　Drinking Water Quality Standards
- Article 5　Water Supply Facility Standards
- Quality assurance in Construction
  → Article 12,13,16, etc.
- Appropriate Operation
  → Article 19-23, etc.

Facility to secure safe water

Check and Support

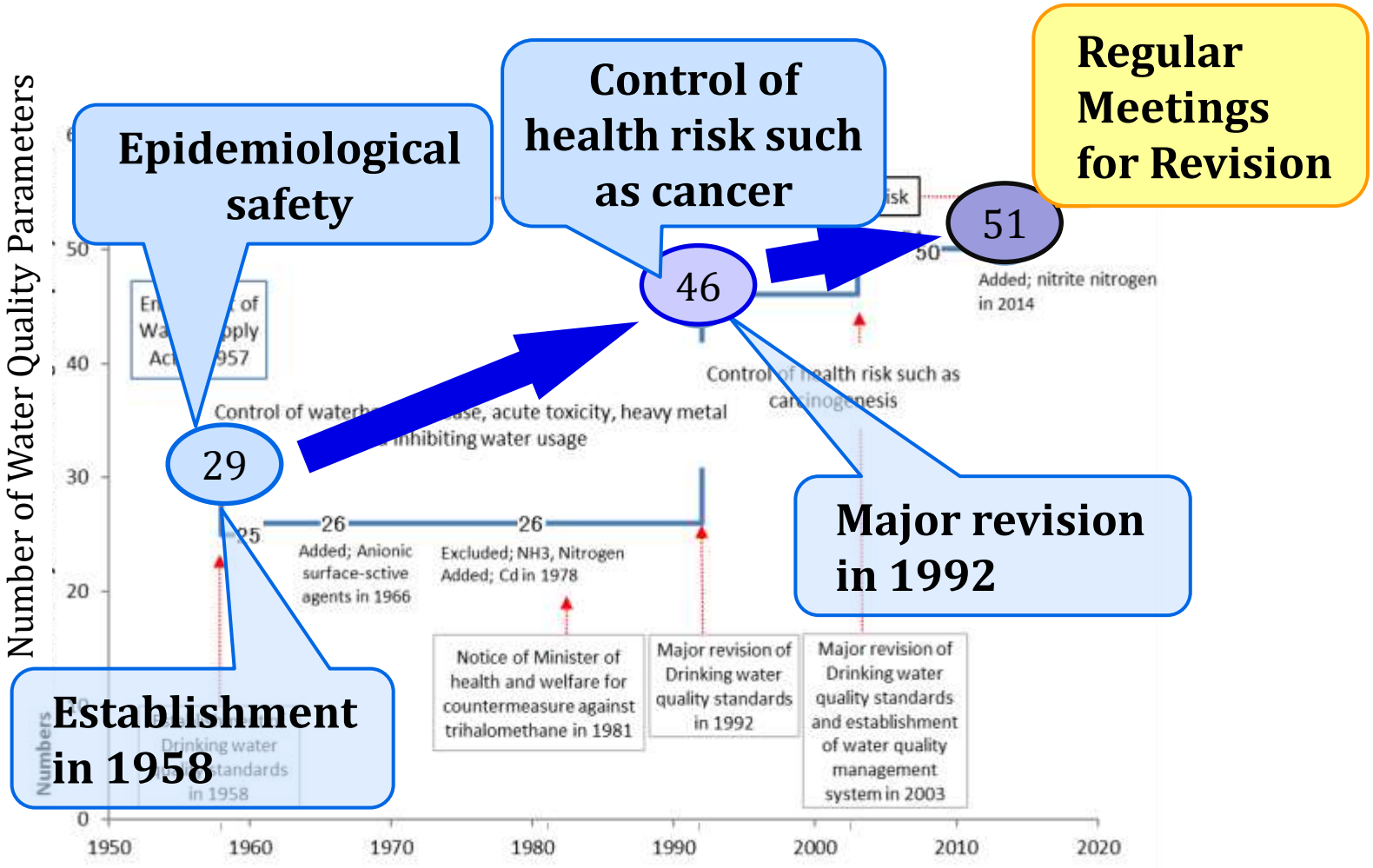
The Ministry of Health, Labour and Welfare

Health center

Water utilities

4. Safe Drinking Water

Water quality standards have been reviewed periodically.



4. Safe Drinking Water

(2) Chlorination

Chlorination after WWII contributed considerably to safe water supply.

Advantages

- Prevented waterborne diseases
- Reliable process
- Easy and simple
- Low cost

Chlorination system

Source: Kyoto City
http://www.city.kyoto.lg.jp/suido/page/0000092339.html

Disadvantages

- Toxicity
- Generation of disinfection by-products
- Corrosion of equipment

4. Safe Drinking Water

(3) Quality Management of Materials and Equipment

Standards and certification system that ensure materials and equipment quality:

- Japanese Industrial Standards (JIS)
- JWWA (Japan Water Works Association) standards
- Examinations and certification by JWWA

Sticker attached to standards conforming products

Sticker attached to basic standards conforming products

This mark is allowed to be affixed to those products that are certified as conforming to the seven (7) items of performance-based standards specified by the Ministerial Ordinance of the Ministry of Health and Welfare.

In the case of seal (in recommended color)

In the case of stamping

Sticker attached to special standards-conforming products

This mark is allowed to be affixed to those products that are certified as satisfying the ease-of-use, comfort, and other performance features in addition to the seven (7) items of performance-based standards (basic standards) specified by the Ministerial Ordinance of the Ministry of Health and Welfare.

In the case of seal (in recommended color)

In the case of stamping

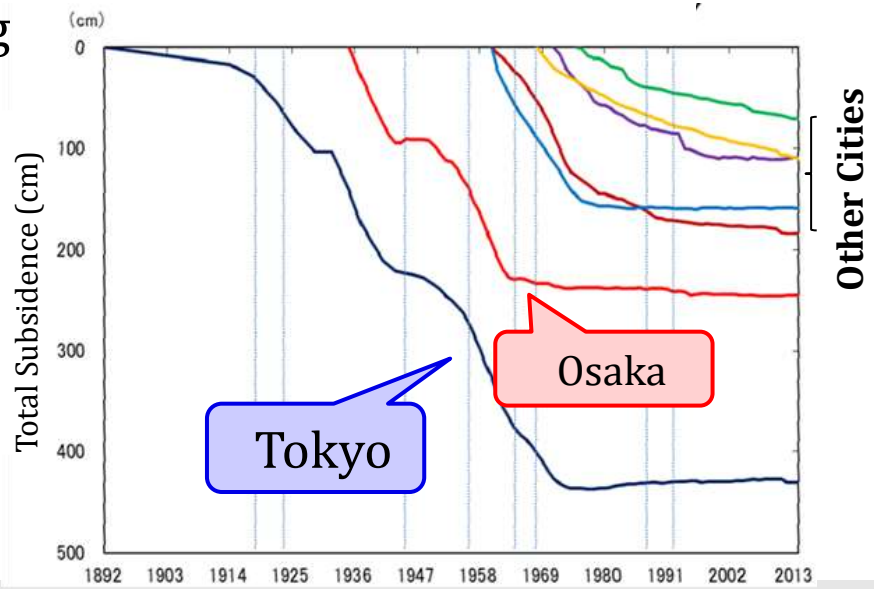
5. Sustainable Water Resources Management

(1) Securing Water Resources

To meet increasing demand - must conserve water quality and work with other users.

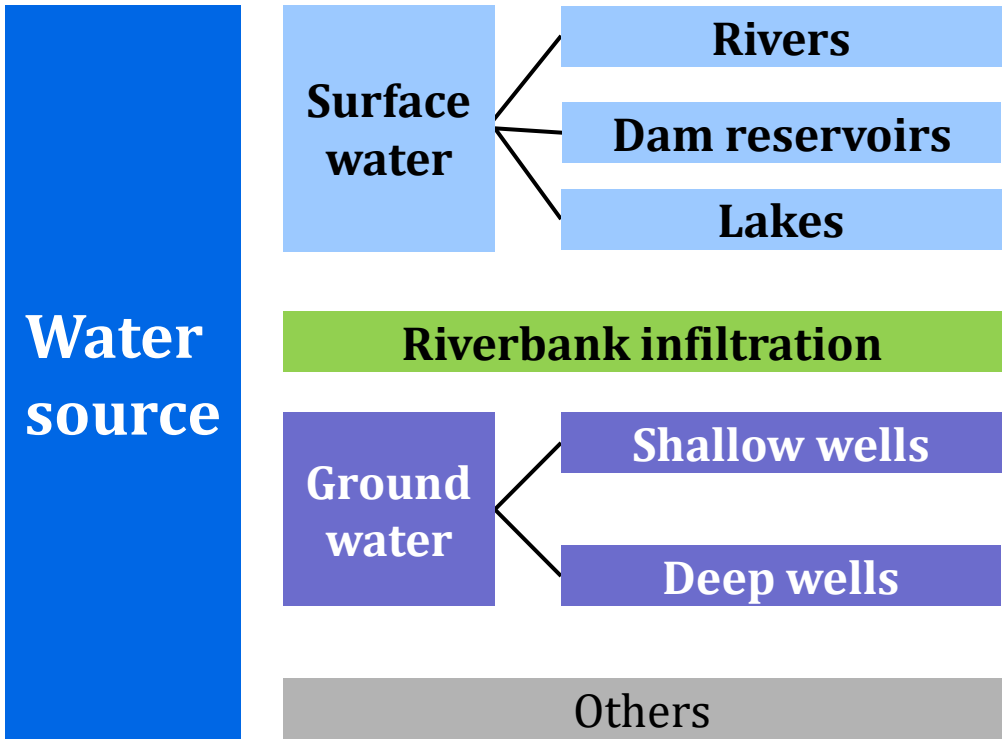
- Development of multipurpose dams for efficient investment, and for bulk water supply system
- Control pollution of water resources
- Control depletion of groundwater sources and prevention of land subsidence caused by over pumping

Multi purpose dam



Land subsidence controlled since 1970s.

5. Sustainable Water Resources Management



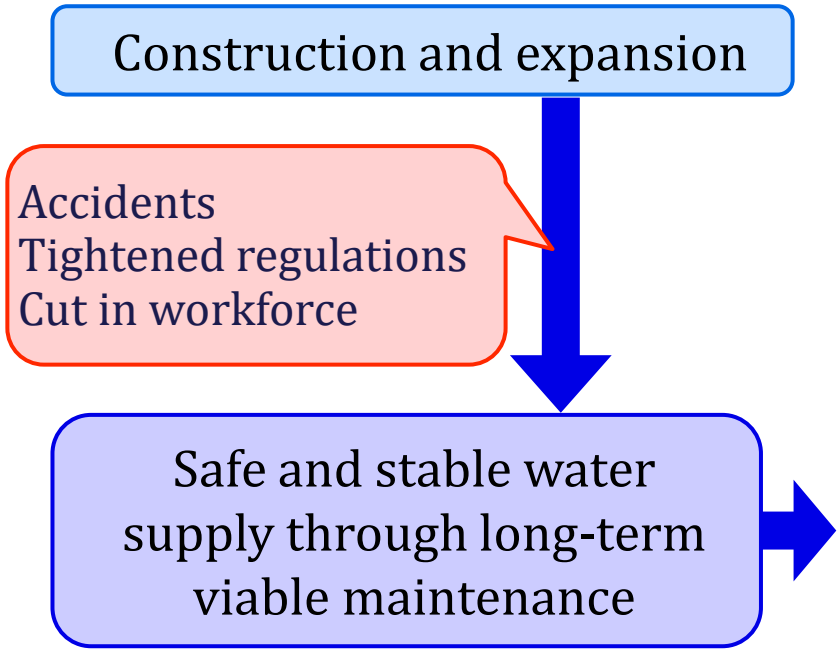
Rivers	25.5%	(3.91 billon m^3/year)
Dam reservoirs	47.3%	(7.25 billon m^3/year)
Lakes	1.4%	(0.22 billon m^3/year)
Riverbank infiltration	3.6%	(0.54 billon m^3/year)
Shallow wells	6.6%	(1.01 billon m^3/year)
Deep wells	12.7%	(1.95billon m^3/year)
Others	2.9%	(0.45 billon m^3/year)
Total	100.0%	(15.33 billon m^3/year)

Source: JWWA, *Water Sources in Japan (2014)*,
http://www.jwwa.or.jp/shiryou/water/water02.html

6. Ensuring Availability

(1) Operation and Maintenance of Facilities

The national government and water utilities worked closely to enhance management of facilities through investigation and by sharing lessons. Preventive maintenance through Time Based Maintenance (TBM) and Condition Based Maintenance (CBM) is essential, and is implemented by keeping record and sharing information.



- Increased oversight
- Sharing knowledge
- Keeping records of operations and construction
- Development of guidelines and minimum level of expertise
- Outsourcing to private sector
- Securing sustainability through asset management

6. Ensuring Availability

(2) Water Supply Operation by Efficient Water Distribution Systems

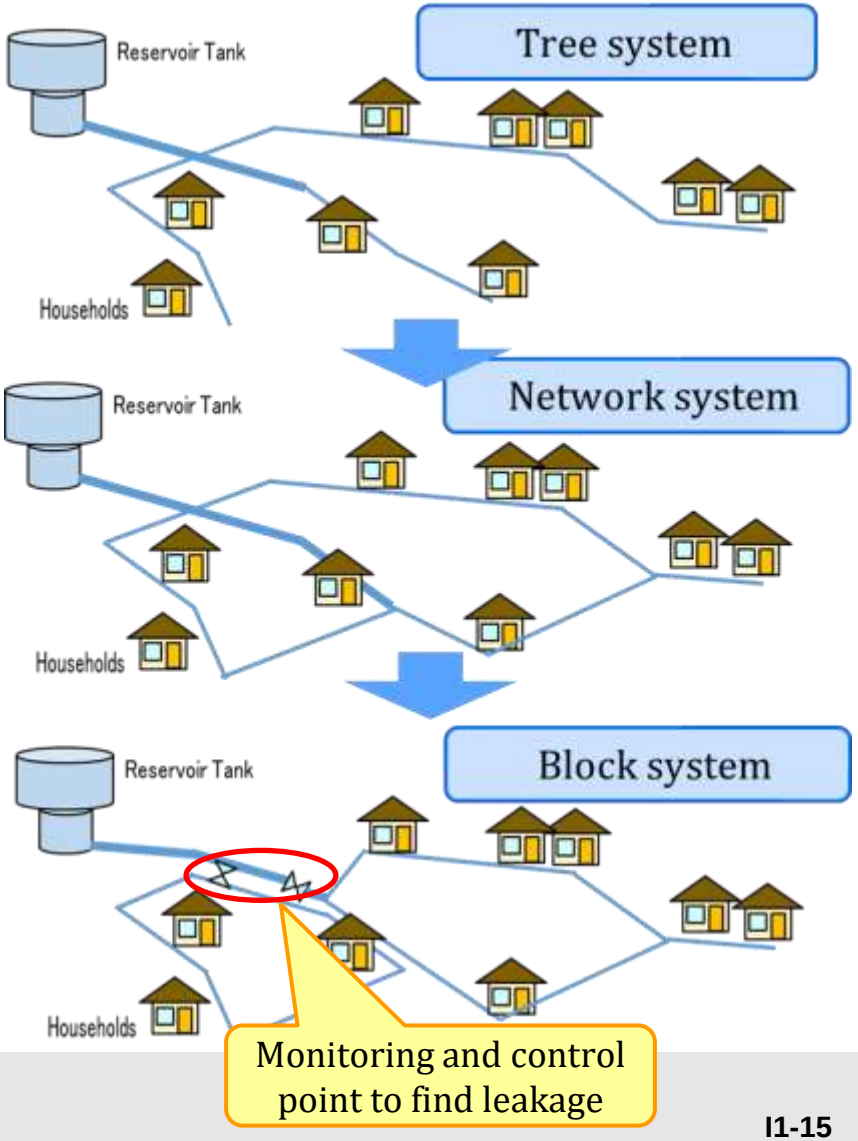
Equalizing water pressure and shortening downtime by using block distribution system.

- 1st stage: Tree (dendritic) system for simple distribution
- 2nd stage: Network system to minimize the negative impact of accidents and ensure operational flexibility
- 3rd stage: Block system for

(1) optimizing water pressure,

(2) understanding distribution condition and optimizing operation

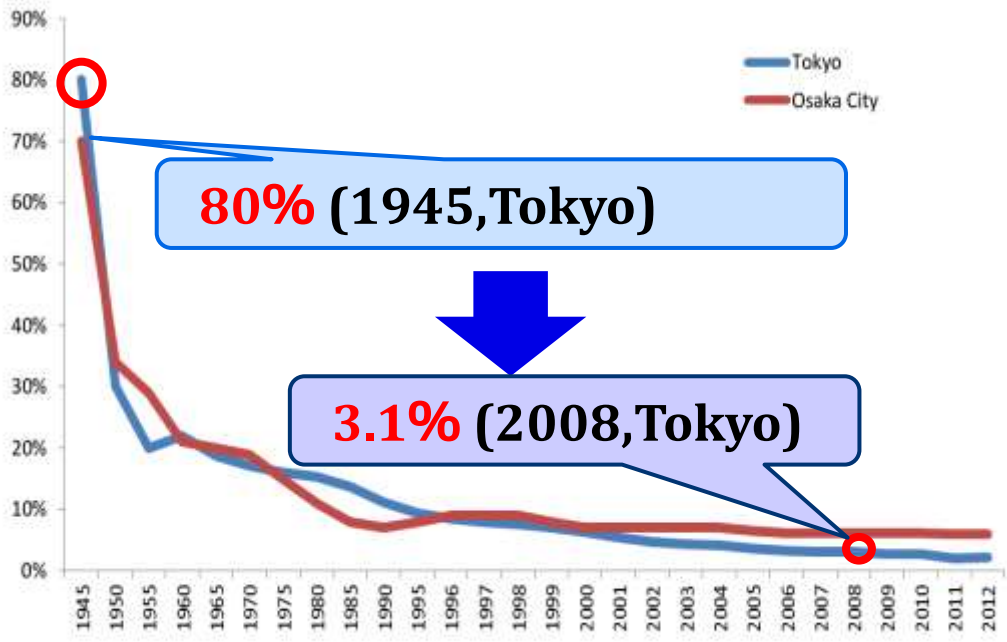
(3) identifying and minimize accidental damage and providing of backup water supply



7. Efficient Water-Use

(1) Water Leakage Prevention

Average leakage rate dropped to 4.7% (2013) from 70-80% in 1945. Efforts prompted by serious droughts and accidents involving the suspension of service.



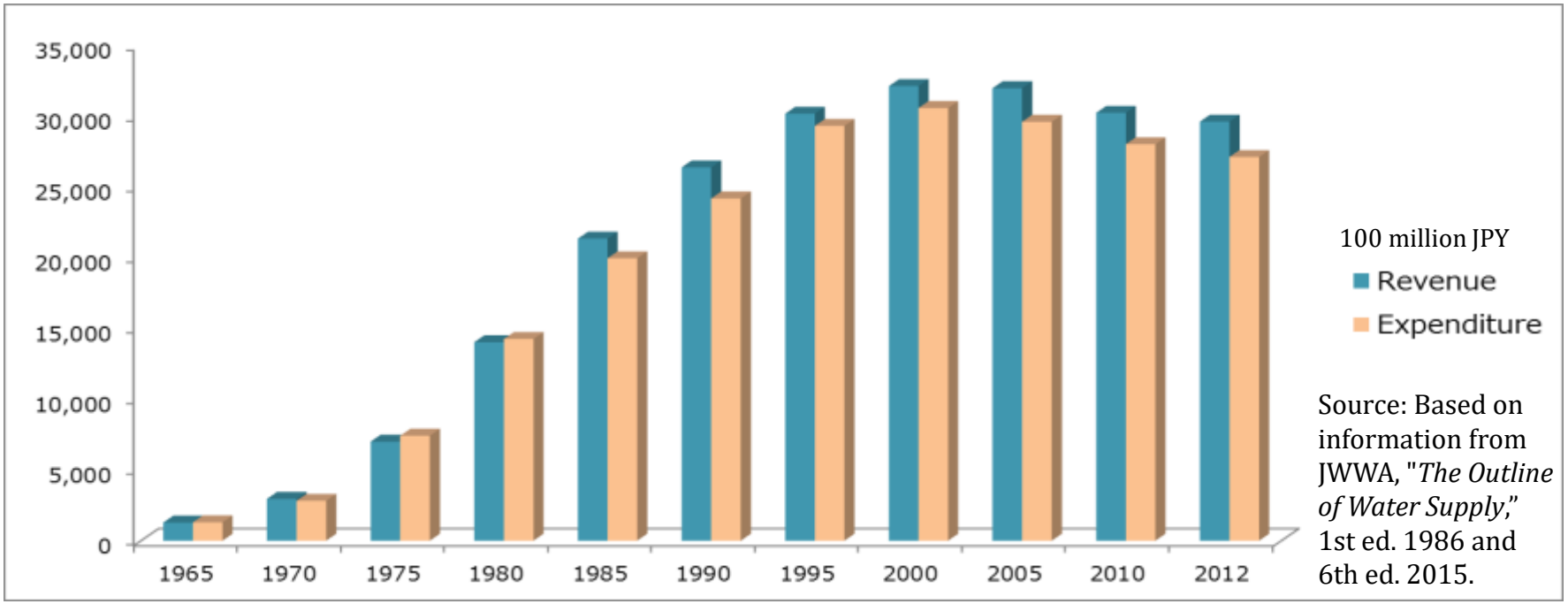
Drop in leakage rate in large cities

- Improved quality of pipe materials and active leakage control.
- Ensuring meter accuracy and scheduled replacement as required by the Measurement Act.
- Reduction of measurment errors, rare unauthorized/ illegal connections.

8. Sustainable Management

(1) Self-Supporting Accounting System and Cost Recovery

Total Revenue (water tariff, etc.) **≥** **Total Expenditure** (repayment of the long-term loans, interest payments, operation and maintenance costs, administrative expenses, etc.)



Source: Based on information from JWWA, "*The Outline of Water Supply*," 1st ed. 1986 and 6th ed. 2015.

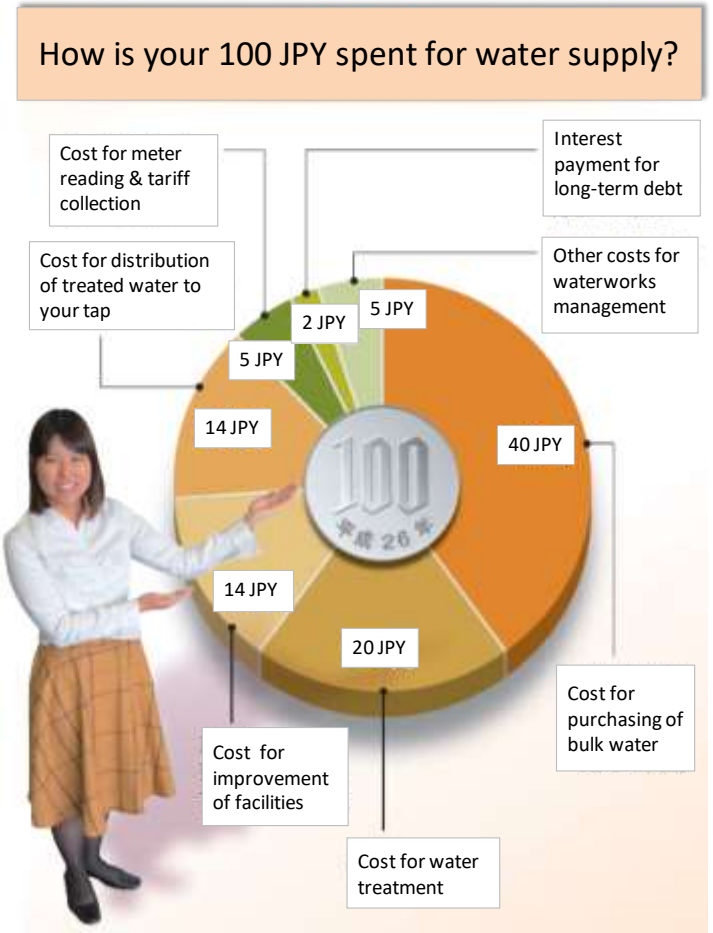
Change in Total Revenue and Expenditure of Water Utilities in Japan

8. Sustainable Management

(1) Self-Supporting Accounting System and Cost Recovery

Setting tariff systems based on:

- Fairness (beneficiary pays principal)
- Affordability
- Clarity in the pricing of water tariff
- Transparency & accountability
- Understanding of customers
- Efficient management



Source: Kawanishi Water and Sewerage Authority
http://www.kawanishi-water.jp/ikkrwebBrowse/material/files/group/2/h27-12-1.pdf

8. Sustainable Management

(2) Customer Relations

Starts with understanding the fundamental importance of water tariffs.

The Water Supply Act stipulates that :

- A water utility shall specify " Water Supply Rule" including water tariff calculation, cost of service connection, and condition of water supply.
- A water utility has the obligation to supply safe drinking water.
- A water utility shall notify customers of the results of water quality testing, and other information about water supply services.

Staff repairing a tap

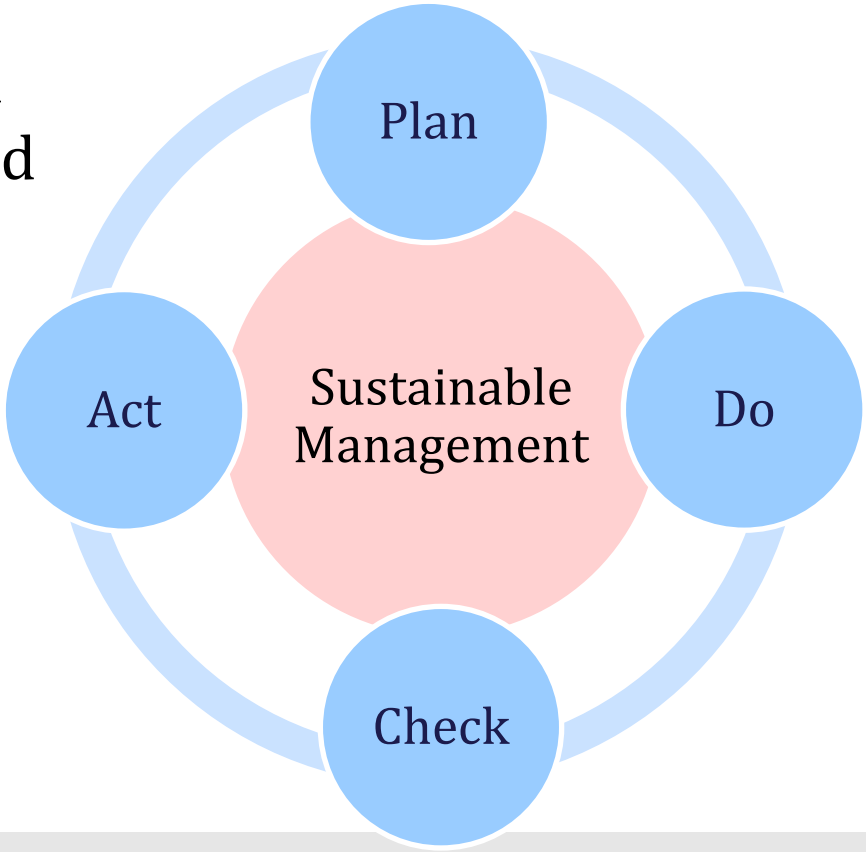
Source: Osaka Municipal Waterworks Bureau, “One Hundred Year History of Water Supply in Osaka City,” Osaka Municipal Waterworks Bureau, 1996.

8. Sustainable Management

(3) Master Plan, Business Plan and PDCA Cycle

Master plans and business plans are essential. They are guideposts for sound day to day management, while visualizing the path toward future directions.

- In the preparation of plans, all staff members are engaged and share objectives. It is a good opportunity for team building
- PDCA ensures the continuous improvement of sustainable business operations.



8. Sustainable Management

(4) Public-Private Partnerships (PPP)

Involvement of private companies in the water supply business is increasing.

- Private companies must be qualified and are inspected to ensure that their performance meet national standards.
- PPPs are promoted under legal frameworks with clearly defined allocation of the risks among the parties.

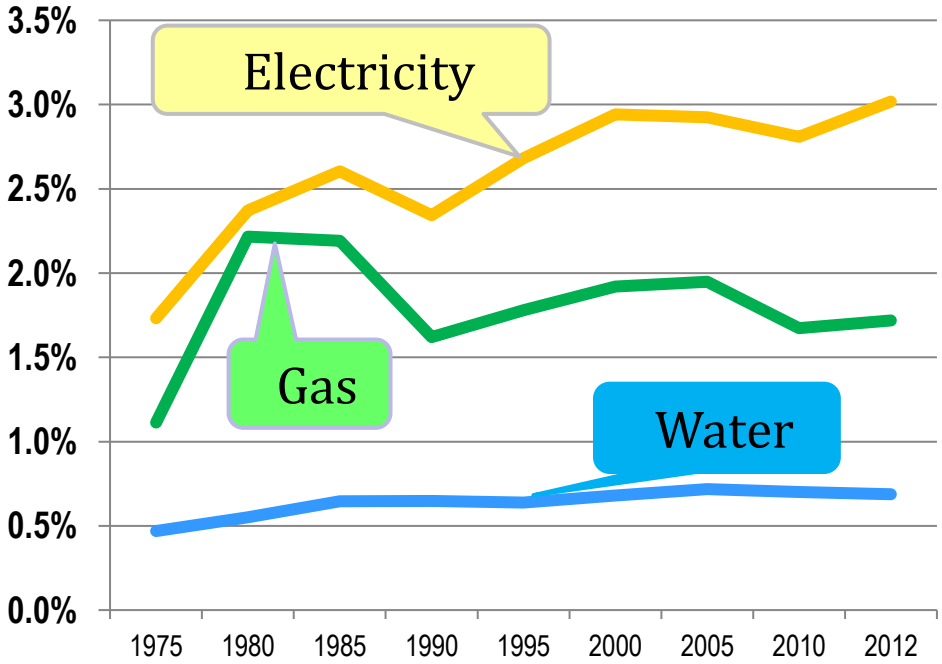
Inside of water purification plant "CERAROKKA"; built by PFI scheme in Yokohama

9. Affordable Drinking Water

(1) Consideration for the Low-Income Group

Affordability

- "Minimum volume" with minimum rate, a cross-subsidy.
- Reduction and exemption as a welfare policy of the local government.
- Installment plan and funds for subsidizing connection charge in the past.



Percentages of water, gas and electricity tariffs in average monthly living expenses

10. Engaging Local Communities

(1) Participation of Residents

Local residents contributed funds and labor, in developing rural water supply systems.

Public consultations, customer satisfaction surveys, supporters system (monitoring system by customers), etc.

Villagers working in rural water supply development.

Source: Susumu Hani, the film "*Water in Our Life*," 1952

10. Involving Local Communities

	1940s	1950s	1960s	1970s	1980s	1990s	2000s	2010s
water supply coverage rate		26.2%	53.4%	80.7%	91.5%	94.7%	96.6%	97.5%

Old days, simple issue

Social background and demand for water supply

Outbreak of Infectious Diseases

Water Supply Development for Tap Water

Introduction of advanced water treatment

Popularization of bottled water

Popularization of water purifier

Strengthening of water quality standard for lead & replacement of lead pipe

Rehabilitation

Severe drought

Promotion of drought management

The Great Hanshin-Awaji Earthquake

Earthquake resistance measures

Nowadays, diversified

Needs of people

Improvement of Public Health

Ensuring water supply

Need to collaborate with citizens

Stable (continous) water supply in emergency

Safe and good tasting water supply

Collaboration with citizens is essential for recognizing needs of people

Further service improvement

Source: Ministry of Health, Labour and Welfare, http://www.mhlw.go.jp/stf/shingi/2r98520000027cq9.html

11. Lessons Learned (1)

- **(Legal Framework for Universal Access)** The national government established the legal frameworks to support utilities in securing funds and in standardizing technical requirements in developing water supply system. Utilities could issue public enterprise bonds for long-term financing. Small utilities in rural areas could not recover the cost with their operation and utilized national subsidies for facility construction.

- **(Water Resources Development)** The national government established an organization responsible for multi-purpose dam constructions and coordination of dam users. By sharing both the costs and benefits of dam construction, the financial burden for each water utility was reduced. Measures and new laws to improve and protect raw water quality, have helped to restore water quality.

11. Lessons Learned (1)

- **(Safe water supply)** To operate a stable supply of good quality water for 24 hours a day, the national government established water quality standards. Water utilities are responsible for implementing water quality analysis, and made efforts to secure quality pipe materials and equipment. The JIS and other standards, and JWWA inspection played key roles to guarantee the quality of pipe materials and equipment.

- **(Maintenance for Stable Water Supply)** Preventive maintenance is very important for a stable water supply. Accidents can be prevented by analyzing data and information of daily inspections, operation, and repairs. Information and knowledge sharing by manual and OJT, regulations and guidance by the national government played an important role for the prevention of accidents and problems.

11. Lessons Learned (2)

- **(Leakage Control)** The average leakage rate in Japan is 4.7%. The dramatic drop from 70-80% after the war was the result of corrective and preventive measures implemented after experiencing severe droughts and water scarcity. These include detection and repair of leaking pipes, replacement of aging pipes and installation of new pipes with better materials and improvement of pipe connections and construction methods. Pipe networks organized in distribution blocks facilitates the leakage reduction activities.
- **(Sustainable Management)** Self-supporting accounting system and cost recovery have been essential for sustainable management. Utilities are required to prepare a financial plan, clearly describe future conditions demonstrate efforts for cost reduction. Master plans, business plans and PDCA cycle are important tools for sustainable management.
- **(Affordable Tariff)** Minimum rates including minimum water are set relatively low making it affordable for low-income group. The progressive rates allocate more financial liabilities to high-volume users (a cross subsidy). Low-income group can apply for tariff reductions or exemptions.

11. Lessons Learned (3)

- **(Training of Utilities' Staffs)** The National Institute of Public Health developed the human resources required to establish the nationwide water supply system. Utility workers were trained through OJT and attended training programs conducted internally. JWWA organizes seminars and committees for knowledge sharing and professional development.
- **(Public Relations)** Public relations activities and mechanisms for public participation are important to building mutually supportive relationship between the utility and its customers. Staff of each utility understand that customers' willingness to pay is directly related to their level of satisfaction with the quality of service. Maintaining trusting relationships with customers is a very important component of the water supply service.