WATER SUPPLY IN JAPAN

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1 Introduction

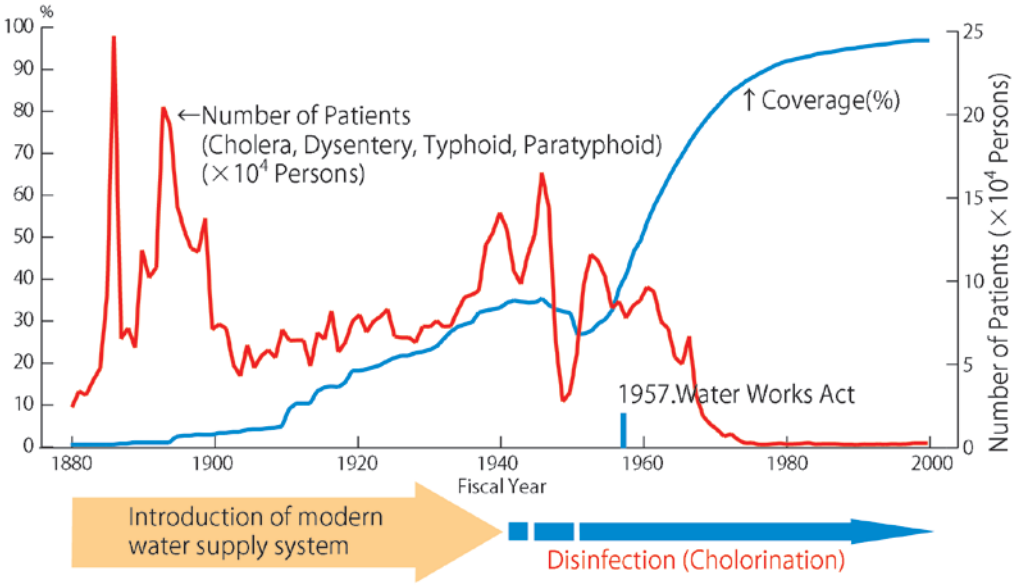
History of Japan Water Supply

Japan's first modern water supply system was introduced in Yokohama and began its operation in 1887. At the time, the modern water supply system, which provides purified water with pressure through mains, was needed to prevent the infection of water-borne diseases.

Following the operation in Yokohama, the water supply system spread in municipalities all over Japan. However, the number of patients suffering from water-borne diseases had not been decreasing until the chlorination was imposed by the Waterworks Act, which was implemented in 1957.

Through the strict water quality control required by the Act, tap water got to be safe and drinkable without boiling.

Today, very few people suffer from water-borne diseases, thanks to the achievement of nearly 100 % coverage of water supply in Japan.



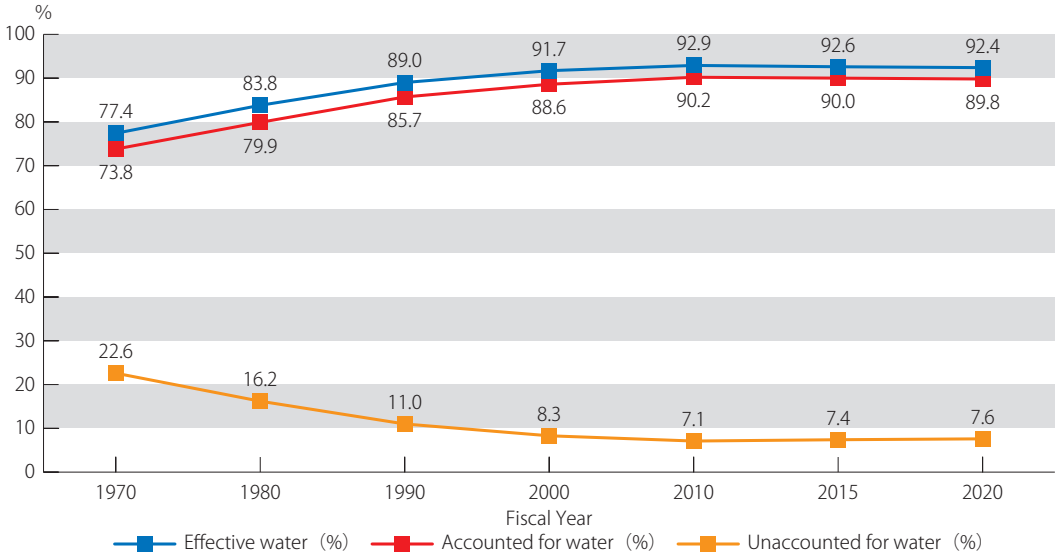
■ **Development modern water works**

Leakage Control

Leakage affects the management of water supply businesses since the process of water treatment requires huge costs. Therefore, water utilities have made great efforts to reduce leakage. In 1970s, only 78% of water distributed reached taps, but in 2020, more than 92% of water distributed reached taps (This ratio is called effective water ratio). Therefore, leakage had improved down to only 8%. The goal of effective ratio is set to be 98% for large water utilities and 95% for small water utilities by the national government.

Leakage is caused by some sort of pipe damages. Pipes could have cracks caused by load or vibration from traffic, or pipes might be corroded by acidic soil. When leakage appears on the ground, it is easily detected and pipe can be rehabilitated immediately.

However, when leakage occurs underground, its detection is not easy. Therefore, leakage control survey, rehabilitation and renewal of old pipes should be conducted according to plans made by water utilities.



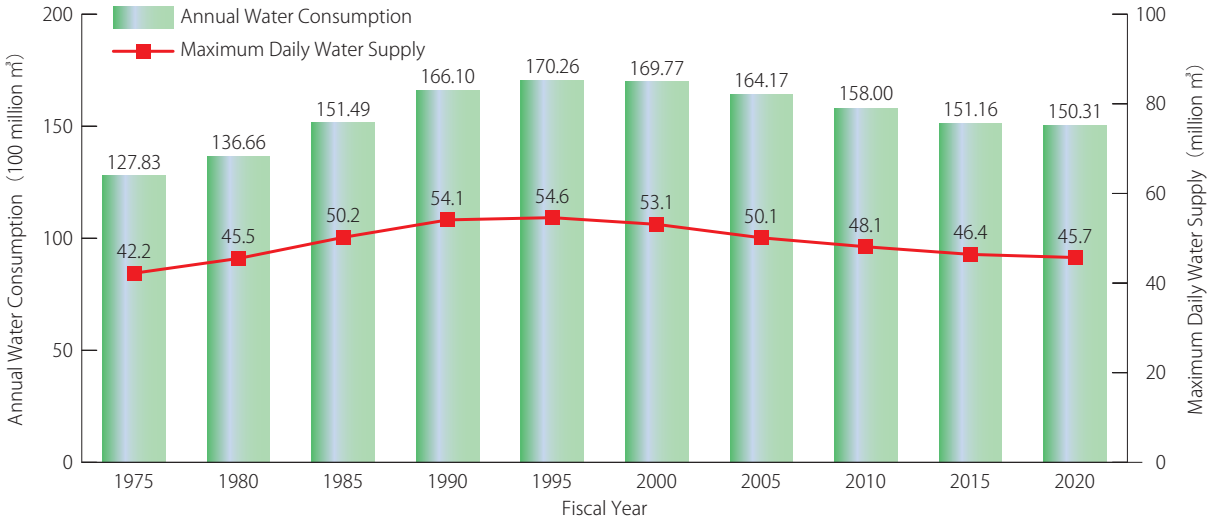
■ **Effective water ratio**

(Reference:Ministry of Health, Labour and Welfare http://www.mhlw.go.jp/english/index.html)

2 Water Consumption

There are 12,135 waterworks in Japan and most of them are small scale utilities. Supplied water volume is 15.0 billion m^3 in FY 2020 and it is 93 million m^3 more than the volume in 2019. 123.4 million people (98.1% of total population) are using supplied tap water in FY 2020.

Water supply utilities have been increasing their capacity to cope with an increasing water demand. The current trend however, is a decrease in water consumption due to the population reducing their annual water usage.



■ **Trend of Annual Water Consumption and Maximum Daily Water Supply**

Served Population		Number of Supplies	Population Served (thousand)	Supplied Water Volume (100 million m^3/year)	Daily Demand per Capita		
					Maximum(ℓ)	Average(ℓ)	Capacity of Facility(ℓ)
Public Water Supply	More than 1,000,000	14	40,178	45.5	337	310	527
	500,000 ～ 999,999	12	8,595	10.2	365	326	527
	250,000 ～ 499,999	55	19,360	22.8	353	323	512
	100,000 ～ 249,999	148	22,263	26.8	373	330	519
	50,000 ～ 99,999	195	13,791	17.7	404	352	572
	30,000 ～ 49,999	203	7,910	10.6	445	368	614
	20,000 ～ 29,999	148	3,658	5.0	457	372	661
	10,000 ～ 19,999	255	3,745	5.6	499	407	731
	5,000 ～ 9,999	211	1,537	2.3	548	415	810
	Less than 4,999	71	246	0.5	779	515	1,335
	Total	1,312	121,284	147.1	375	332	549
Small Public Water Supply		2,507	1,742	2.9	642	461	—
Private Water Supply		8,228	370	0.3	—	—	—
Total		12,135	123,396	150.3	—	—	—

● **Number of Waterworks in FY2020**

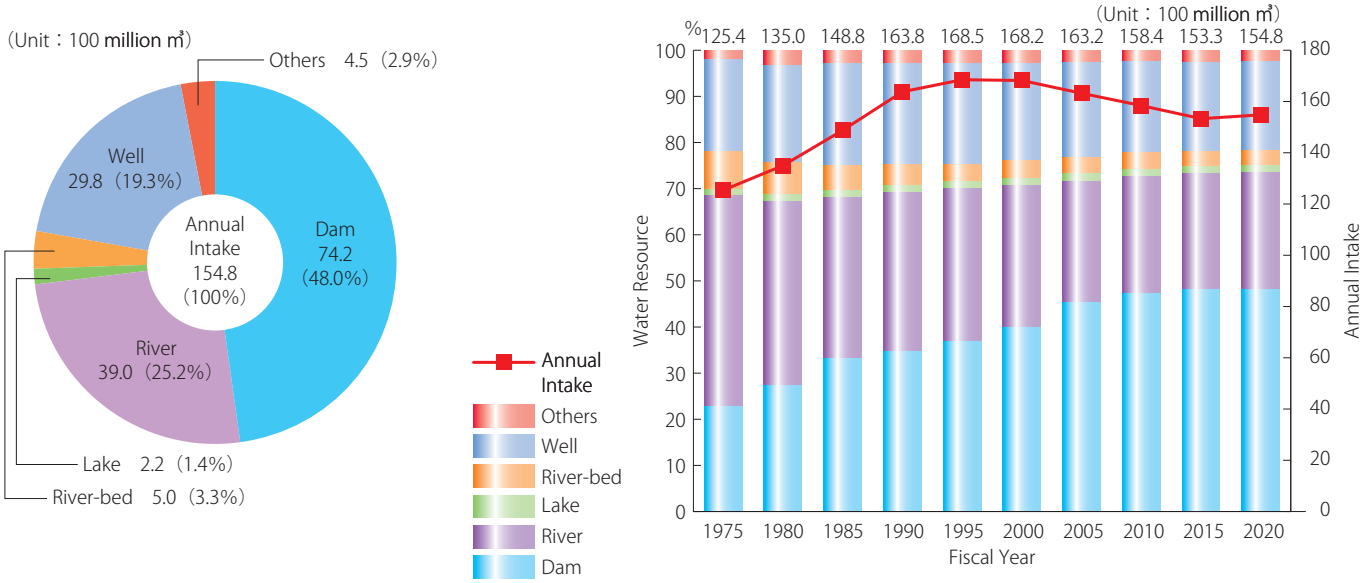
Types of Water Supply

Under the Water Works Law, water system shall mean the whole facilities to supply water for human consumption including water conduit and other structures. However, temporary facilities shall be excluded. The water supply system is classified as follows:

1) Large Public Water Supply : the facilities to supply to the population of more than 5,001.
2) Small Public Water Supply : the facilities to supply to the population of between 101 and 5,000.
3) Private Water Supply : the facilities to supply for privately owned water supply to the lodginghouses, apartment houses of private or public firms owned by enterprises having a population exceeding 100.

3 Water Resources & Treated Water

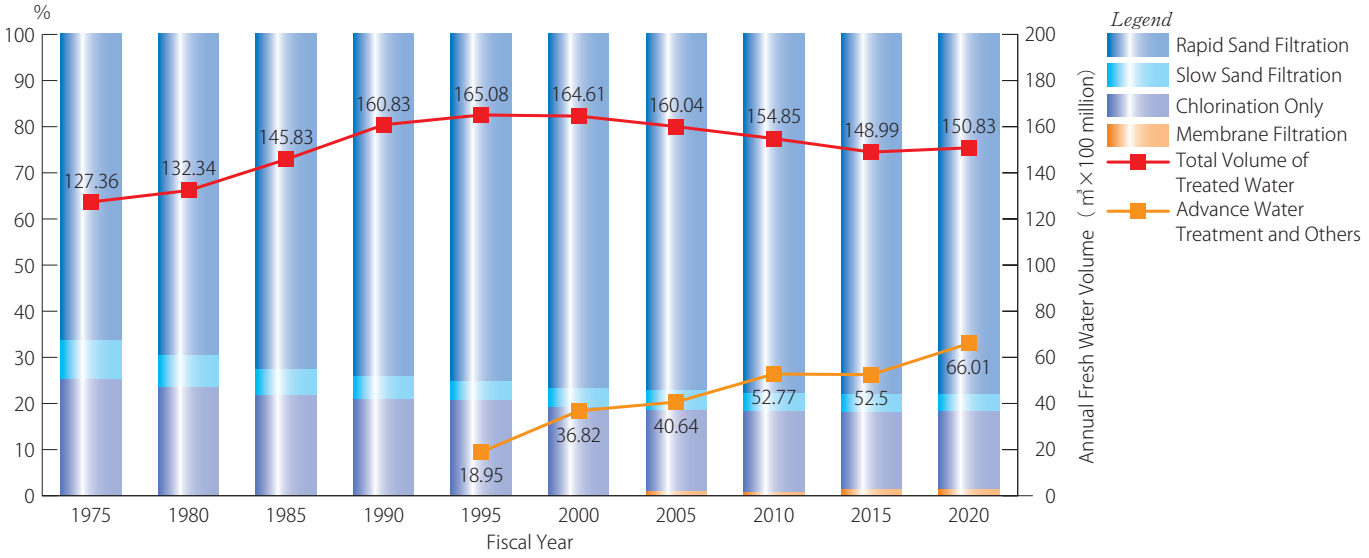
Rivers and dams makes up 73% of the raw water. The total annual volume collected is around 15.48 billion cubic meters.



■ **Water Sources of Public Water Supplies and Bulk Water Supplies（as of March, 2020）**

■ **Intake Amount and Water Resource**

At present, chlorination is an obligatory form of disinfection for all water. Recently, the advanced water treatment systems, using ozone-GAC treatment (including membrane filtration) has been introduced in Japan, offering a viable method for treating water. The advanced water treatment system completely eliminates musty odors and THM substances that cannot be removed by conventional treatment systems.

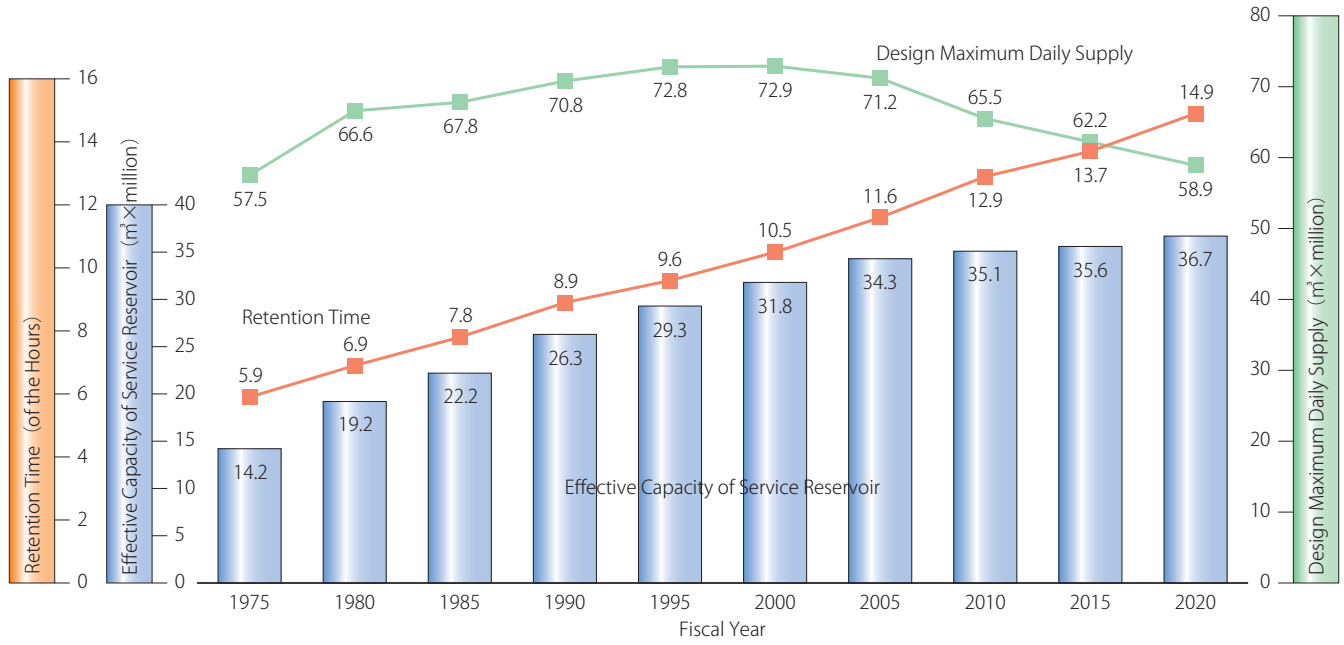


■ **Annual Fresh Water Volume by Water Treatment Systems（Large Public Water Supply + Bulk Water Supply）**

4 Water Supply Facilities

Human industry and daily life act on the premise that stable water will always be available. Our water utilities are making positive steps towards future stability by building plural distribution systems, reconstructing aging facilities and ensuring water works are resilient to earthquakes.

The total capacity of service reservoirs is increasing annually. It has grown from 14.2 million cubic meters in FY 1975 to 36.7 million cubic meters in FY 2020. Retention time of service reservoirs: [(Effective Capacity of Service Reservoir / Maximum Daily Support of Model) X 24 hours] has also increased from 5.9 hours in FY 1975 to 14.9 hours in FY 2020.



■ **Effective Capacity, Retention Time and Maximum Daily Supply**

The total length of water mains in Japan comes up to 739,403km. According to the aged pipe-renewal project, gray cast iron pipes and asbestos cement ones are decreasing. These replacements follow on the basis of long term plan which facilitates the introdution of the quake-resistant pipes.

Type \ Fiscal Year	1975	1980	1985	1990	1995	2000	2005	2010	2015	2020
Ductile Iron Pipe (Seismic Type ※)	—	141.35 —	181.36 —	179.13 —	240.45 (6.65)	289.10 (19.67)	327.38 (29.77)	356.28 (48.43)	377.19 (69.97)	399.82 (91.70)
Steel Pipe	—	13.78	16.02	16.28	18.25	19.34	19.26	18.60	18.06	18.59
Hard-type PVC Pipe	—	83.65	109.64	132.15	155.42	174.35	189.23	201.75	211.08	242.71
Polyethylene Pipe ※	—	—	—	—	6.37	9.19	14.35	23.16	35.86	56.17
Cast-iron Pipe	—	—	—	46.99	33.25	29.79	25.90	18.76	14.55	11.86
Asbestos Cement Pipe	—	86.87	82.49	67.73	47.51	26.79	14.72	7.92	5.03	3.49
Others	—	14.59	12.32	13.44	5.08	5.57	5.84	6.39	4.55	6.77
Total	262.18	340.24	401.83	455.72	506.33	554.13	596.68	632.86	666.31	739.41

● **Length of Pipelines by its Type（unit : 1,000 ㎞）　　（Length of Pipelines are included for Bulk Water Supplies.）**

※ No data for the FY pre-1995.

5 A Clean and Safe Drinking Water Supply

The Ministry of Health, Labour and Welfare established the drinking water quality standards containing 51 items, to ensure the sanitation and safety of drinking water. In response to these standards, all water utilities renovate facilities and operate them properly. They also regularly examine the water quality of tap water, to see if it meets these regulations.

No	Item	Standard Value
1	Common Bacteria	100 per 1 ml less or equal
2	E. coli	Not to be detected
3	Cadmium	0.003 mg/L less or equal
4	Mercury	0.0005 mg/L 〃
5	Selenium	0.01 mg/L 〃
6	Lead	0.01 mg/L 〃
7	Arsenic	0.01 mg/L 〃
8	Chromium (VI)	0.02 mg/L 〃
9	Nitrite Nitrogen	0.04 mg/L 〃
10	Cyanide ion and Cyanogens chloride	0.01mg/L as Cyanide 〃
11	Nitrate and Nitrite	10mg/L as Nitrogen 〃
12	Fluoide	0.8 mg/L 〃
13	Boron	1.0 mg/L 〃
14	Carbon Tetrachloride	0.002 mg/L 〃
15	1,4-dioxane	0.05 mg/L 〃
16	cis-1,2-Dichloroethylene & Trans-1,2-Dichloroethylene	0.04 mg/L 〃
17	Dichloromethane	0.02 mg/L 〃
18	Tetrachloroethylene	0.01 mg/L 〃
19	Trichloroethylene	0.01 mg/L 〃
20	Benzene	0.01 mg/L 〃
21	Chlorate	0.6mg/L 〃
22	Chloroacetic acid	0.02mg/L 〃
23	Chloroform	0.06mg/L 〃
24	Dichloroacetic acid	0.03mg/L 〃
25	Dibromochloromethane	0.1mg/L 〃
26	Bromate	0.01mg/L 〃

No	Item	Standard Value
27	Total Trihalomethanes (Total of Chloroform, Dibromochloromethane, Bromodichloromethane and Bromoform)	0.1 mg/L less or equal
28	Trichloroacetic acid	0.03 mg/L 〃
29	Bromodichloromethane	0.03 mg/L 〃
30	Bromoform	0.09 mg/L1 〃
31	Formaldehyde	0.08 mg/L 〃
32	Zinc	1.0 mg/L 〃
33	Aluminium	0.2 mg/L 〃
34	Iron	0.3 mg/L 〃
35	Copper	1.0 mg/L 〃
36	Sodium	200 mg/L 〃
37	Manganese	0.05 mg/L 〃
38	Chloride	200 mg/L 〃
39	Calcium, Magnesium (Hardness)	300 mg/L 〃
40	Total residue	500 mg/L 〃
41	Anionic surface active agent	0.2 mg/L 〃
42	(4S, 4aS, 8aR)-Octahydro-4,8a-Dimethylenaphtalene-4a(2H)-ol	0.00001 mg/L 〃
43	1,2,7,7 - Tetramethylbicyclo[2,2,1]Heptane-2-ol	0.00001 mg/L 〃
44	Nonionic surface active agent	0.02 mg/L 〃
45	Phenols	0.005mg/L in terms of Phenol 〃
46	Organic substances (Total Organic Carbon)	3 mg/L 〃
47	pH Value	5.8-8.6
48	Taste	Not abnormal
49	Odor	Not abnormal
50	Color	5 degree less or equal
51	Turbidity	2 degree 〃

■ **Water Quality Standards of Drinking Water**

When concentrations possibly exceed those set out by the standards, it is necessary to ascertain the causes and hence take preventative action; modifying operation management of the treatment plant is usually a good solution as is renovating the water purification facilities. All these measures are necessary to supply a constant, stable and safe service.

● Water Quality Management

It is vital to make prudent managerial decisions regarding water quality in order to ensure the future safety of tap water. A guideline has therefore been established, identifying 27 items to look for when examining water. Pesticides that are used in agriculture and other such are activities are also included in a 115-item list. Local pesticide usage is monitored accordingly.

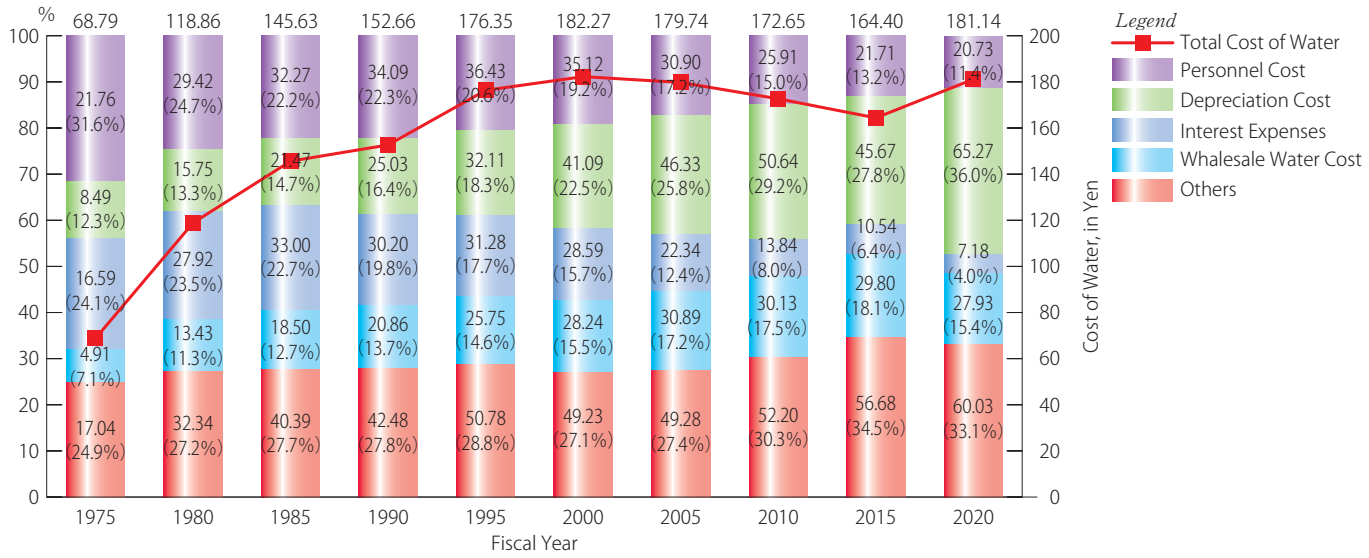
● Revision of Drinking Water Quality Standards and Improvement to Water Supply

Drinking water quality standards are constantly updated by integrating the latest scientific approaches (eg. health effects information). Water utilities are improving their facilities and testing water quality severely to match new drinking water quality standards so as to supply good quality, safe tap water for the future.

6 Cost of Water : Capital Cost and Operation Cost

Depreciation costs and interest expenses account for about 40% of the total cost of water. This is especially true in cases of bulk water supply, where, the cost rises by about 49%.

Production costs of water per cubic meter increase annually relative to the individual charges, despite decreasing staff costs and interest paid. The reason for this is the renovation of the old water supply facilities as well as increasing of water reservoirs' capacity; these are measure implemented to improve our service, securing a safe and stable water supply.



■ **Trend and Composition of Cost of water per cubic meter**

Pipeline renewal projects, one of the key developments to operate water supply, require 1.27 trillion yen annually. These projects account for about 52.5 % of the capital expenditure in the fiscal year of 2020, which increased from 13 % in the fiscal year of 1975.

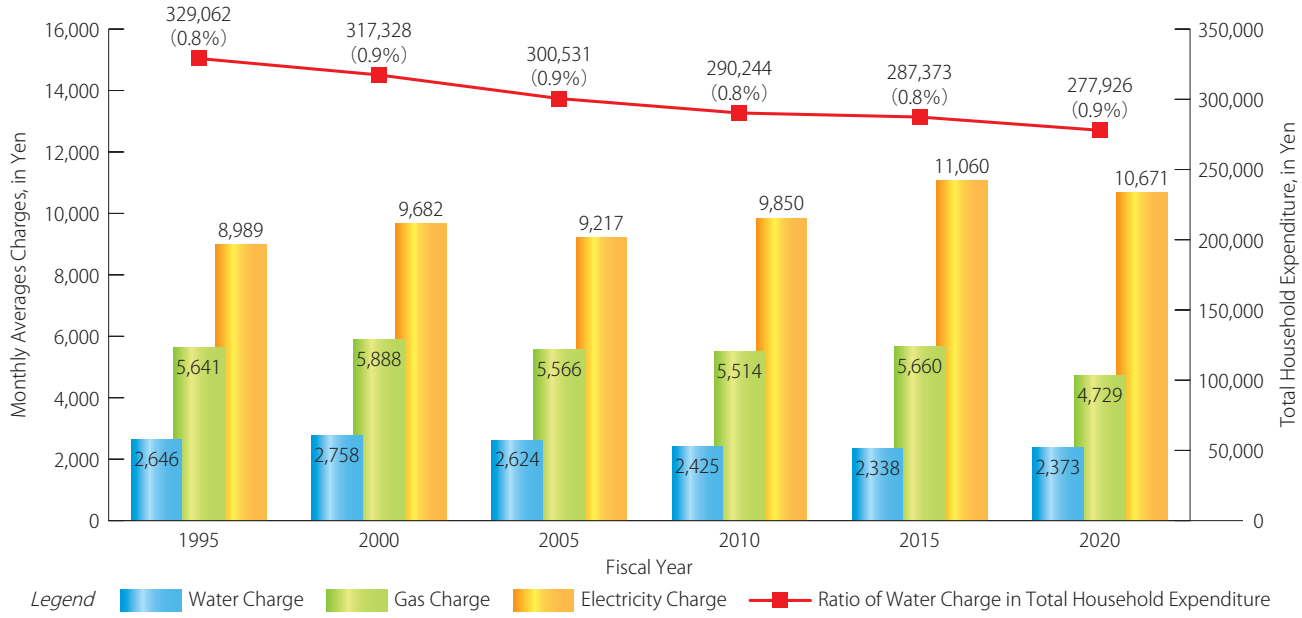
Item \ Fiscal Year	1975	1980	1985	1990	1995	2000	2005	2010	2015	2020
New & Expansion Works	6,388	6,318	6,096	5,886	7,863	6,576	4,257	3,357	3,061	2,778
Improvement Works	1,154	2,373	3,209	5,810	8,644	7,635	6,263	5,889	7,947	9,911
Redemption Cost on Revenue Bond	876	1,390	2,812	2,827	4,195	5,021	7,710	6,941	5,602	5,630
Redemption Cost on Long-term Loan	52	85	83	90	97	106	63	62	105	65
Others	166	333	232	514	590	517	696	784	536	485
Total	8,636	10,499	12,432	15,127	21,389	19,855	18,989	17,033	17,251	18,869

● **Trend of Capital Expenditure (unit : 100million yen)**

7 Water Charges

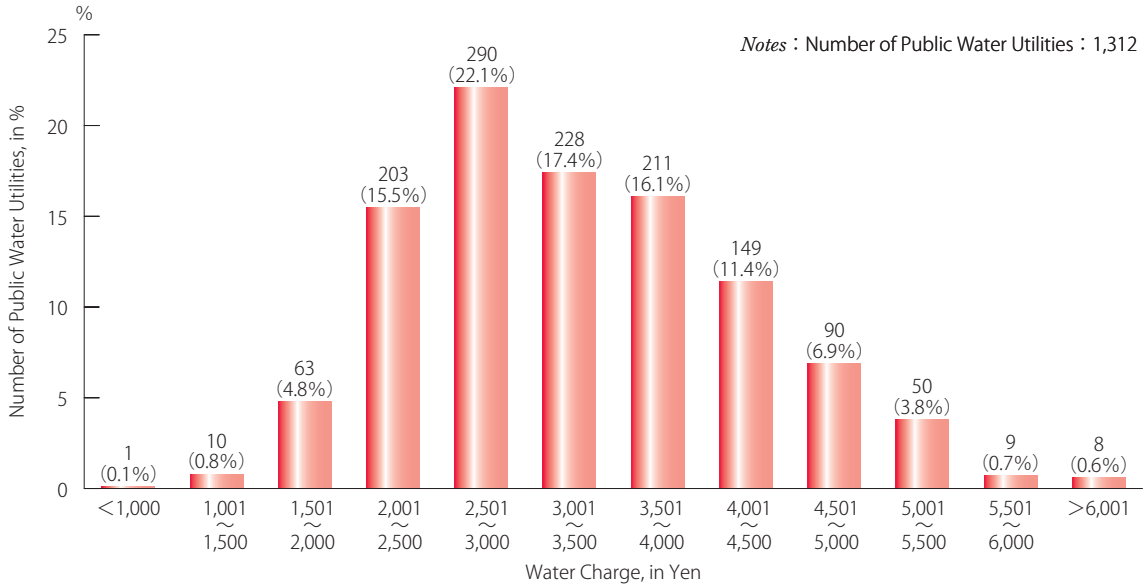
Most water supply utilities in Japan are established by prefecture or municipality and are operated on a self-sufficient basis. The water charge is set separately by each water supply utility; for an average household, it takes up about 0.9% (2,373 yen per month) of the household expenditure.

The average monthly water sales decline in the past few years. Water consumption expenses account for about 0.9 % in the total domestic expenses.



■ Trend if Total Household Expenditure and Water Charge in Monthly Average (National average for Households of two or more people)

Water suppliers are deemed to be self-sufficient, such that they are expected to meet their own costs of construction and facility operation through customer charges. Charges differ depending on region because there are differences in condition, distance from source, construction year, scale, staff costs, maintenance costs, etc.



■ Number of Water Supplies and Water Charge for Domestic Usage of 20 m³ ／ month for a Family Living in a House Consuming（as of March , 2020）

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