Chapter 4
The Earth, the Water Planet
－Carry Forward Beautiful Water to Future Generations－

Section 1 Status of the Water Environment of the World and Japan

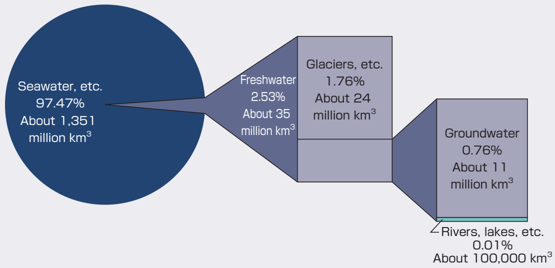
1 Water on the Earth

About 70% of the surface of the earth, often referred to as the Blue Planet, is covered with water estimated to be some 1.4 billion cubic kilometers. Of this amount, 97.5% is salt water, with the remaining only 2.5% being fresh water. Moreover, approximately 70% of freshwater is captured in glaciers and icebergs, and almost all of the remaining 30% is moisture in soil or groundwater in aquifers in deep underground. Thus, surface water in rivers and lakes easily accessible to humans is just about 0.4% of freshwater. This is equivalent to a mere 0.01% of all water on the earth, and of which only about 100,000 cubic kilometers is sustainably available as it is reproduced in the forms of rain and snowfall (Figure 4-1-1).

Thus far, in response to growing demand for water due to the population increase and economic growth, water resources, especially surface water and groundwater,

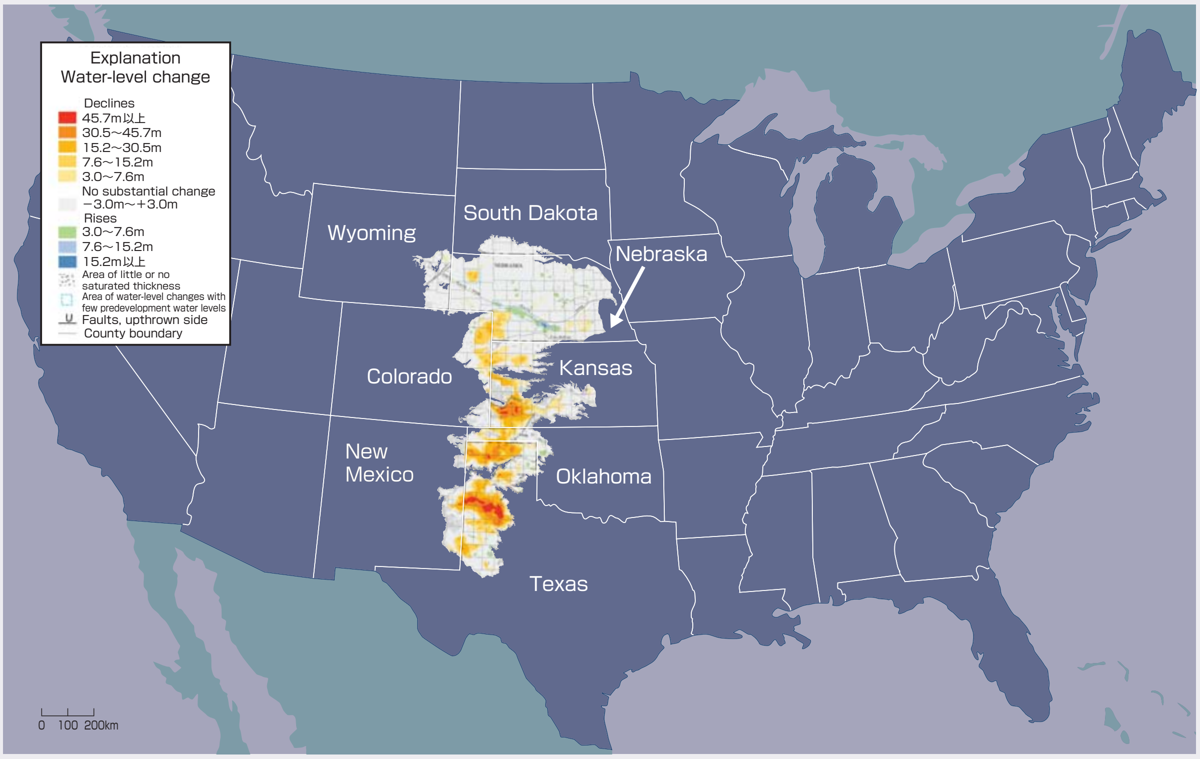
Figure4-1-1 Water Resources on the Earth

Water Resources on the earth
About 1,386 million km^3



Note: Groundwater in the Antarctic Continent is not included
Source: Prepared by Ministry of the Environment based on World Water Resources at the Beginning of the 21st Century, UNESCO, 2003

Figure4-1-2 Water-Level Changes in the Ogallala Aquifer



Source: Prepared by Ministry of the Environment based on U.S. Department of the Interior, U.S. Geological Survey, "Scientific Investigations Report 2009-5019" have been developed around the world. Consequently, for example, the Ogallala Aquifer in the United States, one of the world's largest groundwater layers, has a total area of some 450,000 square kilometers, about 1.2 times Japan's land area. Since the start of irrigation agriculture, according to a survey of over 3,600 water wells, the water level has declined by an average of about 4.3 meters, with the ratio of wells whose water level dropped 3.0 meters or more standing at about 26%, that of wells with the water-level decline of 7.6 meters or more at about 18% and that with the water-level decline of 15.2 meters or more at about 11%. Wells where the water level rose 3.0 meters or more accounted for a mere 2% (Figure 4-1-2).

The annual amount of water consumed globally has increased about 2.9 times from about 1,400 cubic kilometers in 1950 to about 4,000 cubic kilometers in 2000. This amount is equivalent to 144 times the quantity of water of some 27.5 cubic kilometers held at Lake Biwa. The annual amount of water consumed is likely to come to about 5,200 cubic kilometers by 2025, a further increase of about 1.3 times from the 2000 level (Table 4-1-1).

Water resources on the earth as a whole are sufficient to satisfy human demand for water, but the geographically uneven distribution of water resources presents a major problem (Figure-Int.-2-9). The Human Development Report 2006 of the U.N. Development Program (UNDP) points out that one out of every five people living in developing countries (about 1.1 billion) is not able to satisfy the international standard of securing "at least 20 liters of safe water from a safe water source within one kilometer from his/her home," and may lose life by consuming unsanitary water near his/her home and becoming ill.

Table4-1-1 Changes in Global Water Demand

(km^3/year, million people)

	1950	1980	1995	2000	2025
Population	2542	4410	5735	6181	7877
Agriculture	1080	2112	2504	2605 (66%)	3189 (60.1%)
Industry	86.7	219	344	384 (9.7%)	607 (11.6%)
Cities	204	713	752	776 (19.5%)	1170 (22.3%)
Total	1382	3715	3788	3973 (100%)	5235 (100%)

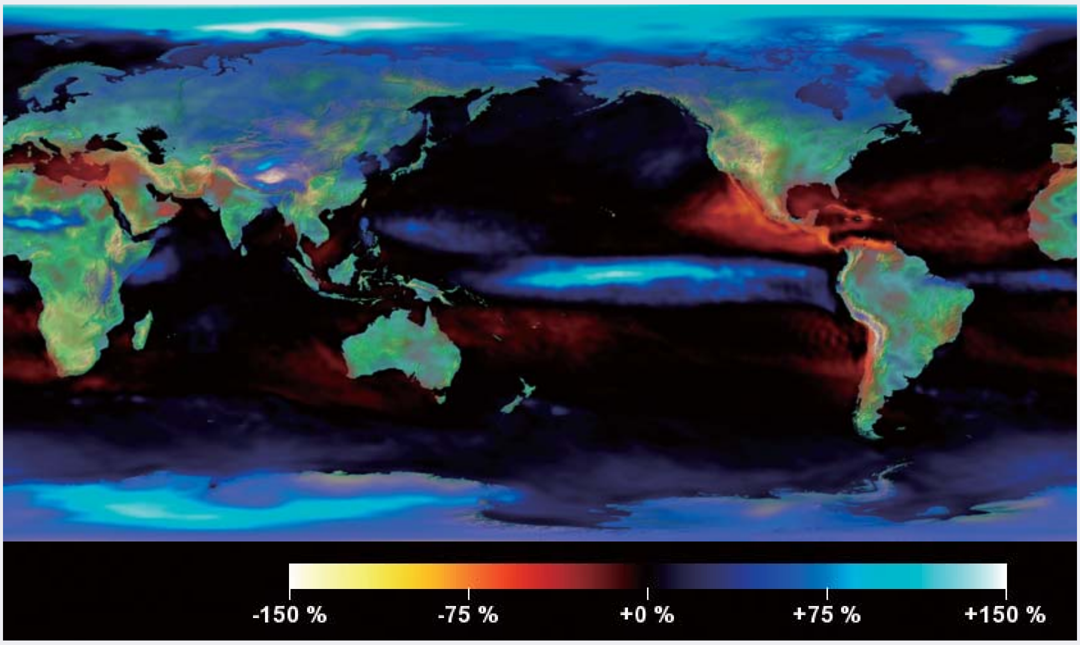
Source: State Hydrological Institute (SHI) and UNESCO (1999)

2 Impact of Global Warming

According to the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC), the progress in global warming will expose several hundred million people to increased water stress going forward, and the increased frequency of droughts and flooding is projected to adversely impact regional crop production, particularly production of subsistence crops in low-altitude regions. The rise in the global average temperature due to climate change is feared to bring about various impacts on water resources.

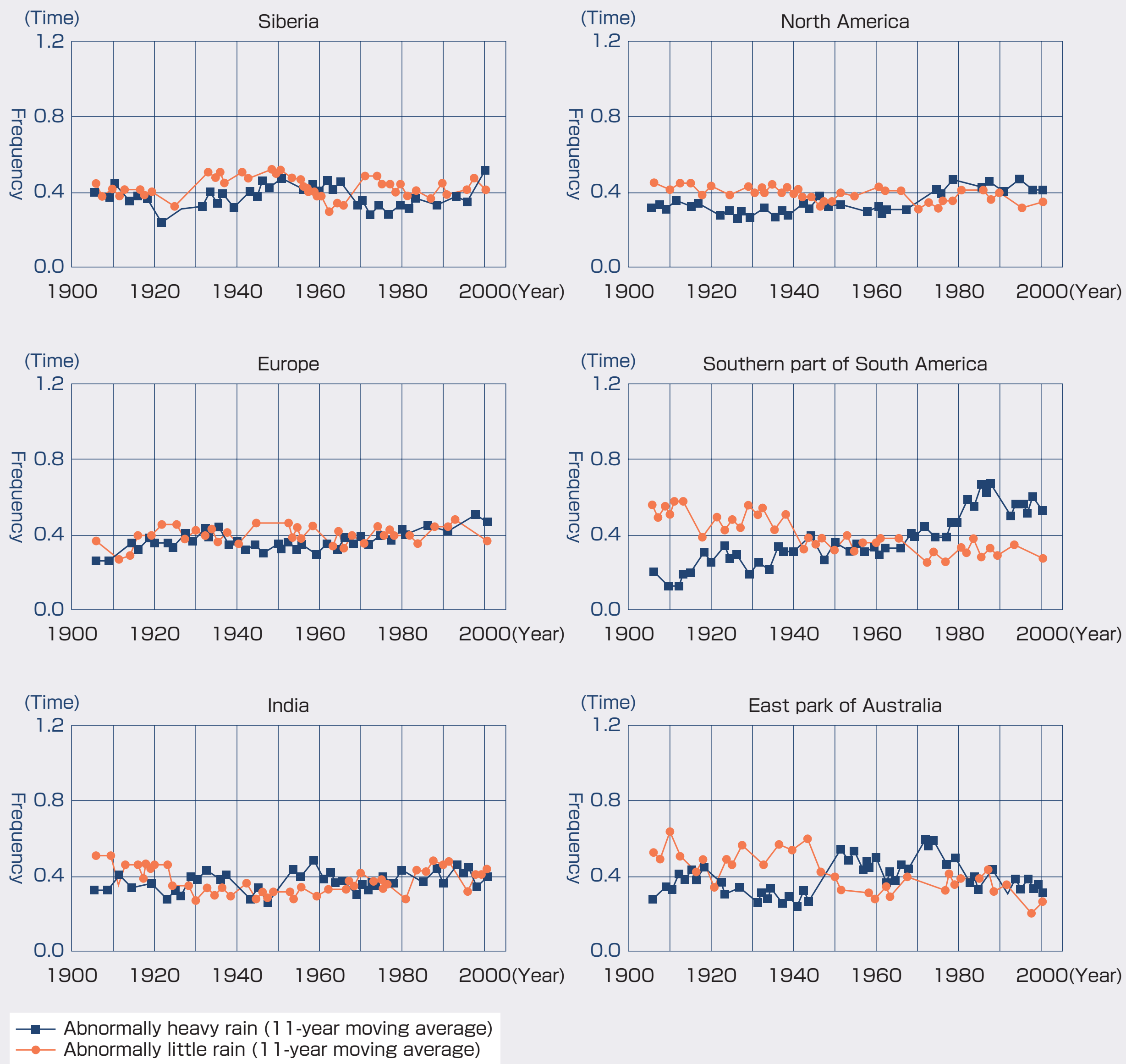
According to a global warming simulation conducted by a joint research team of the National Institute for Environmental Studies, the University of Tokyo's Center for Climate System Research (now, the Atmosphere and Ocean Research Center) and the Japan Agency for Marine-Earth Science and Technology, the global average temperature in 2071-2100 is projected to rise by 4.0 degrees C from the 1971-2000 level under a scenario that assumes the economy-focused future world will see a further progress in globalization. Precipitation, meanwhile, is projected to increase in low- and high-altitude areas and some tropical areas but decline in

Figure4-1-3 Projected Changes in Precipitation in the World in 2100



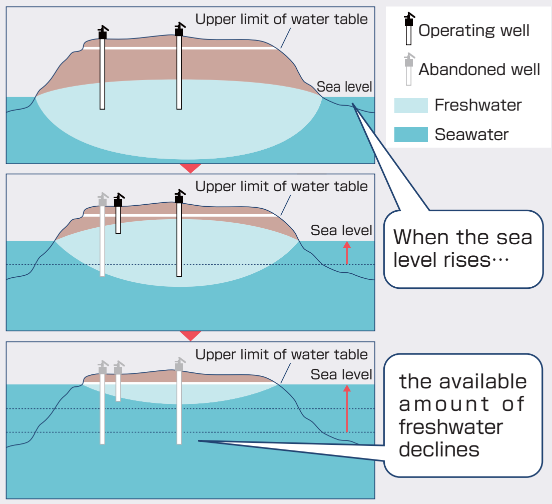
Source : National Institute for Environmental Studies, University of Tokyo, Japan Agency for Marine-Earth Science and Technology

Figure4-1-4 Interannual Changes in Frequency of Abnormally Heavy and Little Rain



Source: Abnormal Weather Report 2005 (Japan Meteorological Agency, October 2005)

Figure4-1-5 Impacts of Sea-Level Rise on Freshwater Lens



Source: National Institute for Environmental Studies, Center for Global Environmental Research (2001) Data Book of Sea-Level Rise 2000

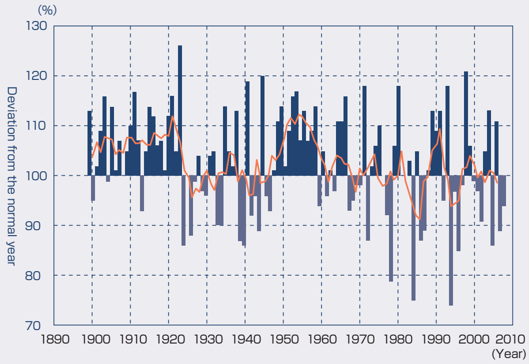
subtropical and other areas (Figure 4-1-3).

In recent years, we have seen a significant increase/decrease in the frequency of abnormally heavy rain or abnormally little rain depending on regions in the world. While the frequency of abnormally heavy rain tends to show a significant increase in Europe, North America and the southern part of South America, the frequency of abnormally little rain tends to show a significant decrease in the southern part of South America and the eastern part of Australia (Figure 4-1-4).

There also are areas where a major adverse impact on water resources is projected to emerge. For example, according to the IPCC AR4, many small islands in the Caribbean Sea and the Pacific are expected to see decreases in freshwater resources to make it hard for them to satisfy water demand during seasons of little rain. In these small island areas, not only changes in precipitation but also the rise in sea level could also trigger a decrease in freshwater resources. Below the surface of small islands made of pervious rocks, groundwater (freshwater) is floating over seawater (salt water) in the shape of lens (freshwater lens), and this freshwater lens is pushed higher by the rise in sea level, thus lowering the quantity of freshwater available (Figure 4-1-5).

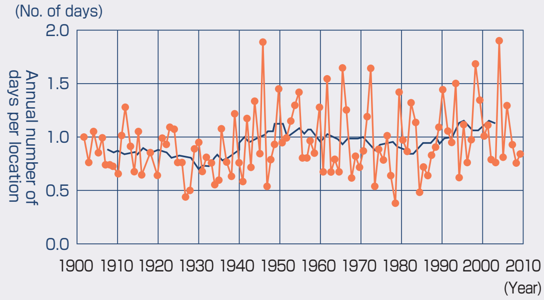
The long-term examination of annual precipitation in Japan reveals that there were periods of heavy rains until the mid-1920s and around the 1950s, and annual changes in precipitation have become larger year by year since the 1970s (Figure 4-1-6). Further, the number of days with daily precipitation of 100 millimeters or more has been on the significant rise in the long term, and comparison between the recent 30 years and the 30 years in the early 20th century shows a rise of about 1.2 times (Figure 4-1-7).

Figure4-1-6 Changes in Deviation from the Normal Year in Annual Precipitation in Japan (1898-2008)



Note: The figure shows trends in annual precipitation at 51 locations in Japan. Bar graphs show deviation from the normal year (the percentage ratio to the normal year value) in annual precipitation in each year. The red line shows the five-year moving average in deviation from the normal year. The normal year value is the 30-year average for 1971-2000.
Source: Japan Meteorological Agency, 2009

Figure4-1-7 Interannual Changes in the Annual Number of Days with Precipitation of 100mm or more

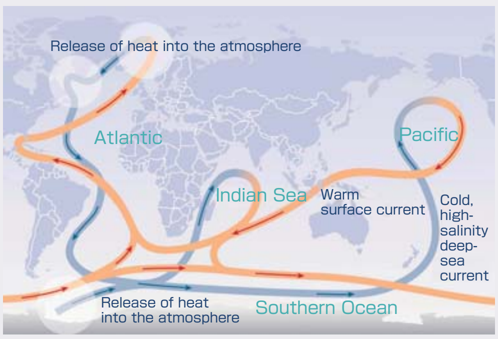


Note: The annual number of days per location obtained from the number of days of incidence at 51 locations in Japan.
indicates the value for each year, while shows the 11-year moving average value.
Source: "Climate Change Monitoring Report 2009" (Japan Meteorological Agency, 2010)

Column Deep Circulation in Oceans

Regarding deep circulation in oceans, the IPCC AR4 notes there is no sufficient evidence to determine where there are some tendencies in deep circulations, projecting that there is very little possibility of deep circulations showing large and rapid changes by the end of the 21st century. On the other hand, the current model-based projection points to the very high possibility of deep circulation in the Atlantic Ocean weakening during the 21st century.

Global Ocean Circulation



Source: IPPC Fourth Assessment Report

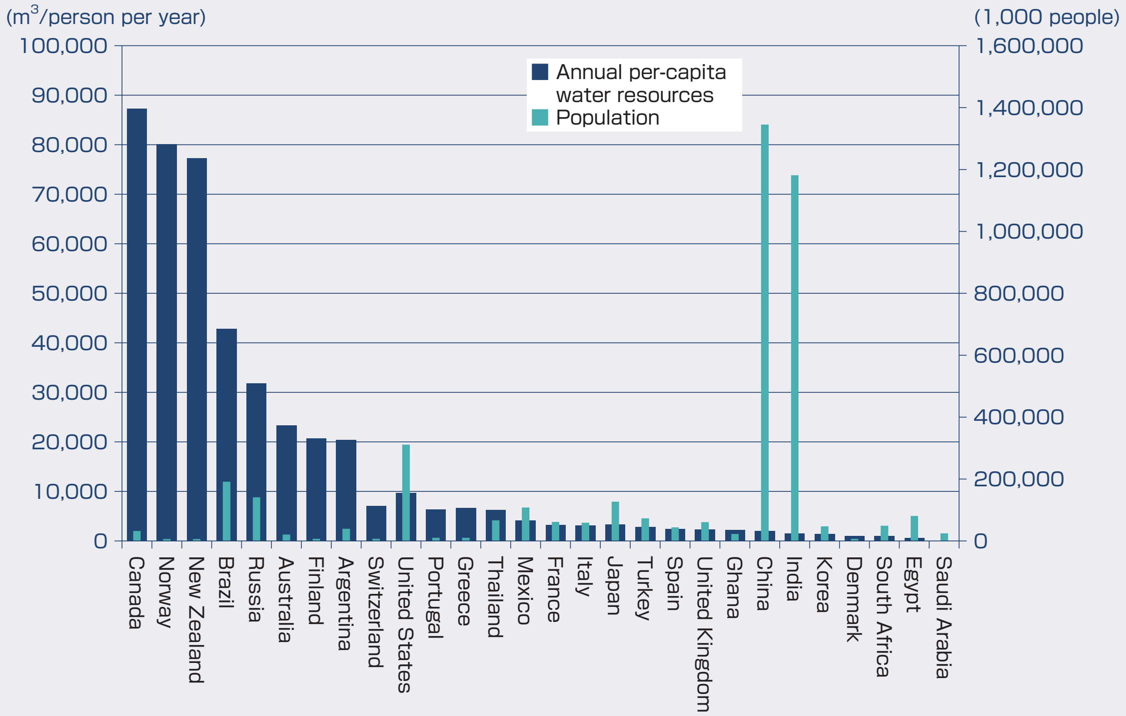
3 Various Problems Caused by Water

Due to population growth, global warming and the growth of emerging economies (which means increased demand for industrial water), it is expected that "an additional 1.8 billion people could be living in a water scarce environment by 2080," pointing to a very serious water situation in the world (Source: UNDP, "Human Development Report 2007/2008).

1) Uneven distribution of water resources and demand outlook

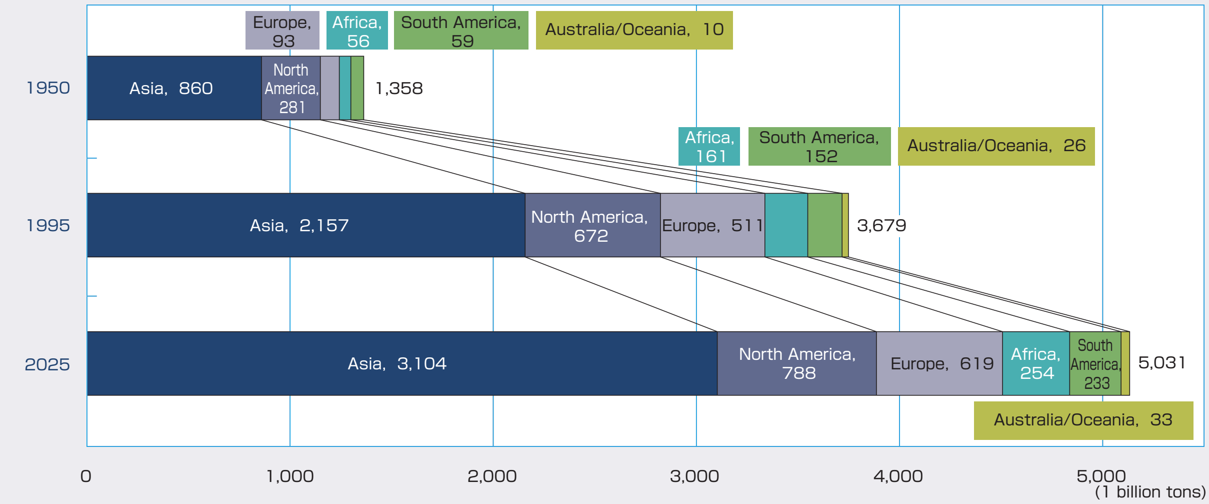
According to data provided by the Food and Agriculture Organization (FAO), there are big gaps in per-capita annual water resources among countries, and the uneven distribution of water resources is evident, with countries with relatively small water resources having relatively large populations (Figure 4-1-8). The U.N. Educational, Scientific and Cultural Organization (UNESCO) forecast a substantial increase in demand for water in Asia going forward (Figure 4-1-9). While the global population is projected to rise by about 1.4 times during a 30-year period between 1995 and 2025, domestic noncommercial use of water and water for industrial use are both expected to show sharp rises of about 1.8 times and about 1.6 times, respectively, due to population growth (Figure 4-1-10). For water for agricultural use,

Figure4-1-8 Annual Per-Capita Water Resources and Population



Source: Prepared by Ministry of the Environment based on FAO AQUASTAT

Figure4-1-9 Rapidly Increasing Water Usage



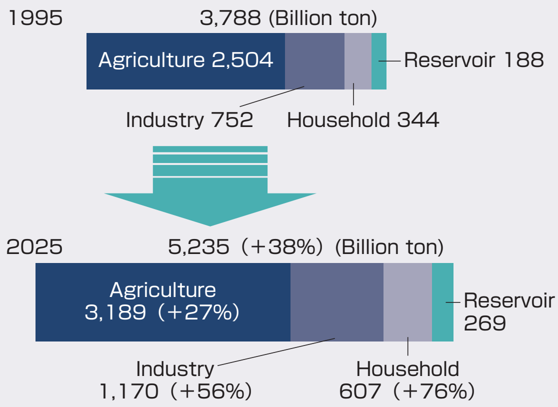
Source: Ministry of Land, Infrastructure, Transport and Tourism, "Water Resources in Japan 2007"

the amount of water pumped is likely to increase primarily due to an expansion of irrigated farmland (Figure 4-1-11). Given the geographically uneven distribution of water resources, the big issue is whether demand for water can be satisfied.

2) Use of safe and sanitary water

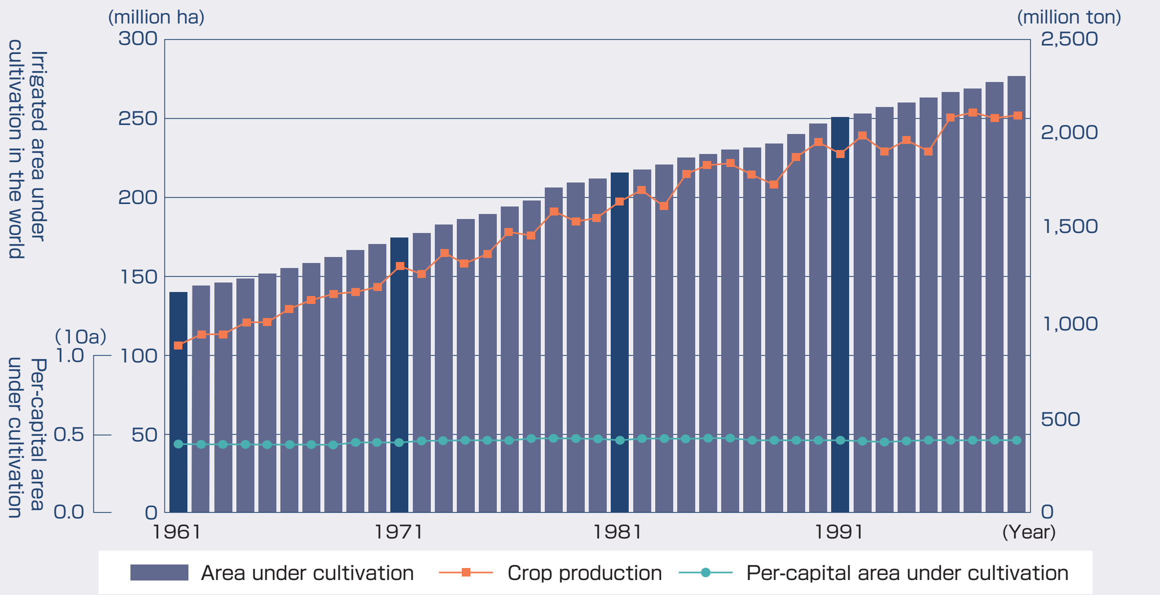
As shown in figure 4-1-8, water resources in the world are unevenly distributed and people who do not have access to safe water and sanitary facilities are concentrated in Asia and Africa. According to results of surveys conducted by the U.N. Children's Fund (UNICEF) and the World Health Organization (WHO), there are about 880 million people in the world who have no access to safe water, with Asia accounting for about 470 million people (53%) of the total (Figure 4-1-12). Also, there are about 2.5 billion people living in areas with no sanitary facilities, with Asia again accounting for a large portion of about 1.8 billion people (70%) of them (Figure 4-1-13). Because of "water" and "sanitation" problems, 1.8 million children are dying each year. These figures represent one of the biggest problems confronting mankind.

Figure4-1-10 Breakdown of Water Usage by Use in 1995 and 2025



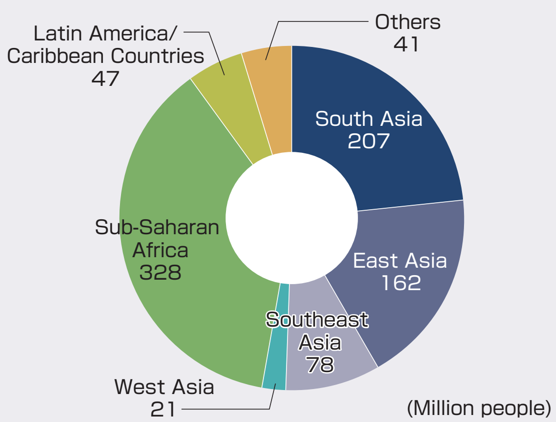
Note: Figures in parentheses show increases over 1995
Source: SHI and UNESCO (1999)

Figure4-1-11 Trends in Crop Production and Irrigated Area under Cultivation in the World



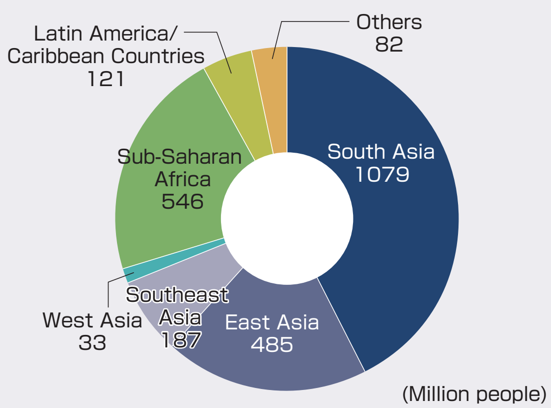
Source 1: Statistical Databases (U.N. Food and Agriculture Organization)
2: Prepared by Ministry of the Environment based on World Population Prospects: The 2000 Revision, 2001 (U.N. Department of Economic and Social Affairs, Population Division)

Figure4-1-12 Population without Continuous Access to Safe Drinking Water in Developing Countries by Region



Source: Prepared by Ministry of the Environment based on the U.N. Children's Fund (UNICEF) and the World Health Organization (WHO), "PROGRESS ON DRINKING WATER AND SANITATION : SPECIAL FOCUS ON SANITATION, 2008"

Figure4-1-13 Population without Continuous Access to Basic Sanitation in Developing Countries by Region



Source: Prepared by Ministry of the Environment based on the U.N. Children's Fund (UNICEF) and the World Health Organization (WHO), "PROGRESS ON DRINKING WATER AND SANITATION : SPECIAL FOCUS ON SANITATION, 2008"

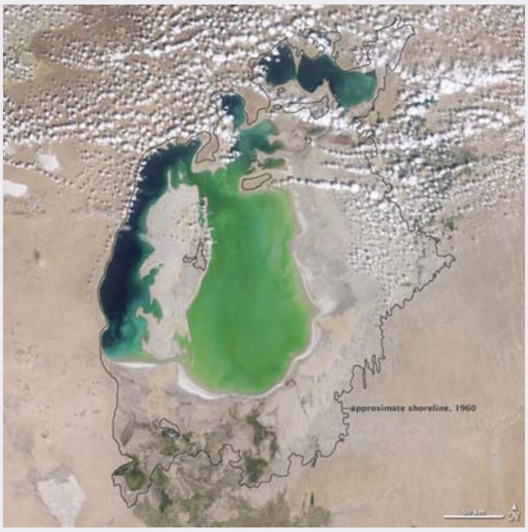
3) Various problems occurring in the world due to water

a) The shrinking Aral Sea

The Aral Sea spanning Kazakhstan and Uzbekistan in Central Asia used to be the world's fourth largest lake. Since the 1960s, vast quantities of irrigation water were withdrawn from two rivers feeding the late, the Syr Darya and Amu Darya for the cultivation of cotton and crops, causing the water level to decline and leading to the continued shrinkage of the lake surface area. In about 50 years up to 2006, the Aral Sea lost as much as about 71% of area and 91.5% of cubic volume (quantity of water) (Figure 4-1-14). Salt, sands and agricultural chemicals are being stirred up from the dried-up lake bottom, causing serious health damage to residents in surrounding areas. Remaining water has seen the rapid rise in the density of salt, which is now six times the original density. The once-rich saline lake, which used to yield 50,000 tons of fish, is now devoid of fish resources, putting fishermen out of business. With water that used to mitigate the climate in surrounding areas gone, harsher weather is said to be exacerbating growing conditions for cotton and crops.

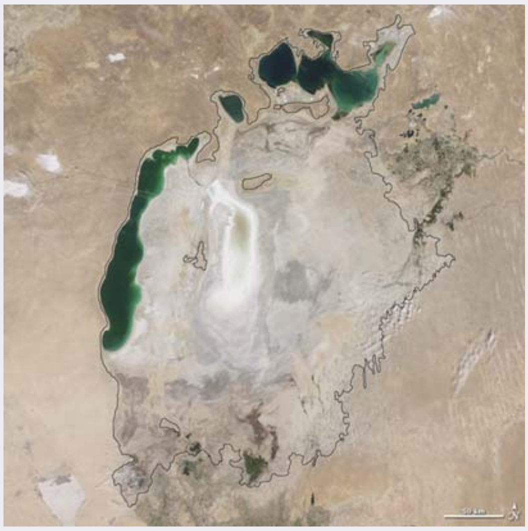
The solid line shown in Photo 4-1-1 demarcates the Aral Sea around 1960. While the Aral Sea was a single lake then, it became divided into the southern and northern parts in the latter half of the 1980s, and the South Aral Sea began to separate east and west around 2000 and continued shrinking. In August 2009, the eastern side of the South Aral Sea dried up at last (Photo 4-1-2). The North Aral Sea is beginning to recover in area after construction of the Kokaral Dam.

Photo4-1-1 Satellite Photo of the Aral Sea (August 19, 2000)



Source: NASA (http://earthobservatory.nasa.gov/Features/WorldOfChange/aral_sea.php)

Photo4-1-2 Satellite Photo of the Aral Sea (August 16, 2009)



Source: NASA (http://earthobservatory.nasa.gov/Features/WorldOfChange/aral_sea.php)

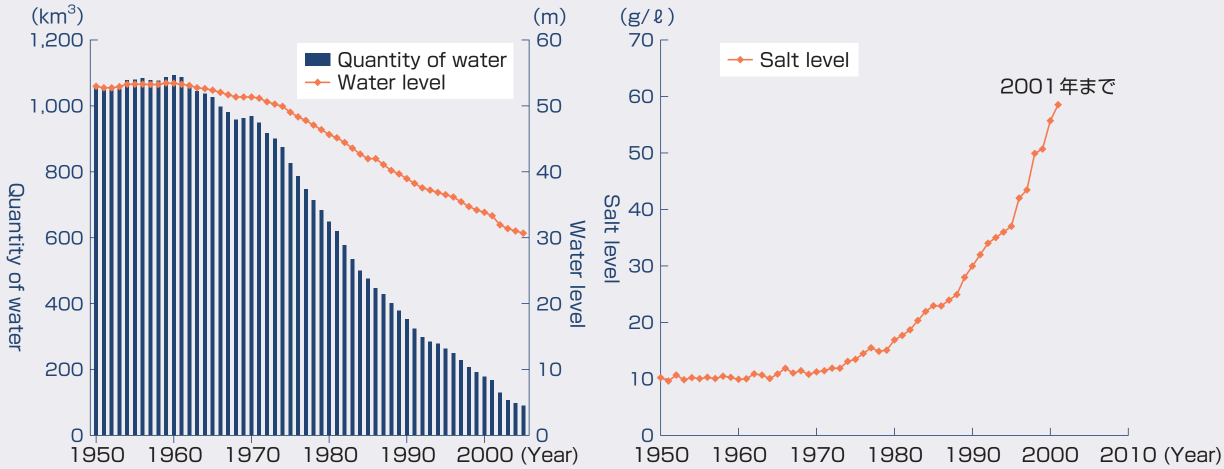
Table4-1-2 Trends in Surface Area of the Aral Sea

(km²)

	1960	1987.6～1989.9	1996.11	2003.10	2006.9～2007.10
The North Aral Sea	－	3,400	3,200	3,200	3,600
The South Aral Sea	－	42,100	31,300	17,700	13,000
Total	68,000※	45,500	34,500	20,900	16,600

※Source : Lake Biwa Environmental Research Institute, Shiga Prefecture ed., "Lakes of the World," (Jimbun Shoin, 1993)
Source: JAXA website (http://www.eorc.jaxa.jp/imgdata/topics/2007/tp071128.html)

Figure4-1-14 Trends in Quantity of Water, Water Level and Salt Level of the Aral Sea



Before shrinkage
The world' s fourth largest
(Approximately 100 times the size of Lake Biwa)

1960
Water level : 53.5m
Area : 66,459km^2
Cubic volume : 1,093km^3

2006
Water level : 30.5m
Area : 19,274km^2 (29.0%)
Cubic volume : 93.2km^3 (8.5%)

Source: Database of the Aral Sea/Bathymetric characteristics (2005)

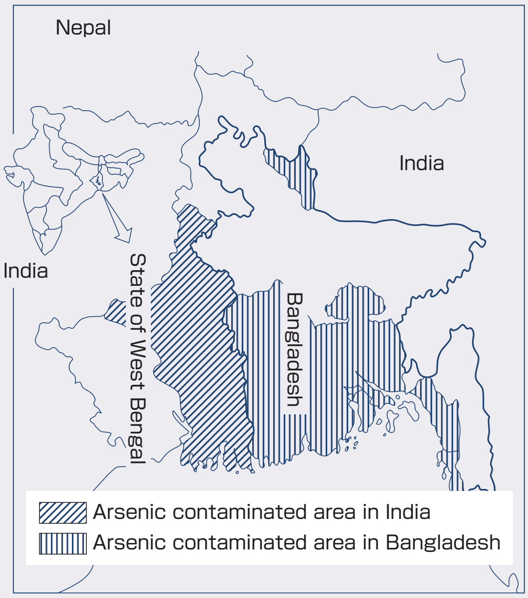
b) Arsenic contamination of groundwater in Bangladesh

In the West Bengal region straddling the border between India and Bangladesh, arsenic contamination was first officially reported in 1983, and subsequently, the contamination damage has been spreading with no halt in sight (Figure 4-1-5). Residents in the region, except for urban areas, depend on pumping wells for drinking water and domestic noncommercial water, and both countries have been promoting irrigation agriculture since the 1960s by pumping up groundwater in order to simultaneously cope with and solve the population growth and socioeconomic problems. Since it is the rice-producing region, large quantities of water for agricultural use have been pumped up with machine pumps. As a result, arsenic-contaminated groundwater has led to the high incidence of arsenic poisoning, causing skin cancer, lung cancer, keratosis, melanoderma and other diseases among poisoned patients (Photo 4-1-3). In Bangladesh, the arsenic-contaminated area extended to about 38,000 square kilometers (an area about half of Hokkaido) as of 2008, with people living in contaminated areas reaching an estimated 38 million and people who have taken arsenic-contaminated water reaching an estimated 16 million, with the number of people developing diseases unknown. In the Indian state of West Bengal on the other side of the border, the arsenic-contaminated area extended to some 37,000 square kilometers, with people living in contaminated areas reaching 34 million and people who have drunk arsenic-contaminated water reaching one million, and the number of people developing diseases totaling 200,000. In arsenic-contaminated areas, over 20% of the population suffered from arsenic poisoning, bringing about a very serious situation, with the number of patients growing at an annual rate of 8%. Under these circumstances, the government of Bangladesh carried out surveys on wells throughout the country by 2004 and launched a national arsenic mitigation policy in March 2004. Japan has provided assistance in dealing with the problem since 1998, and implemented arsenic contamination countermeasure programs since FY 2006 to reinforce the system to supply safe water to about 1.30 million residents in four zilas (prefectures) in the western part of Bangladesh.

c) Regional disputes over water

There are regions in the world where interstate conflicts are occurring over water. These disputes have been caused, among other things, by the problem of allocation of water resources, such as excessive withdrawal of water in upstream lakes and rivers as well as groundwater, and the problem of water contamination due to discharges of contaminants upstream and groundwater contamination. The disputes are over excessive use of water in the Aral Sea, water ownership in the Indus and the Jordan, and the development and allocation of water resources in the Nile and the Tigris-Euphrates basin (Figure 4-1-16).

Figure4-1-15 Arsenic Contaminated Areas around the India-Bangladesh Border

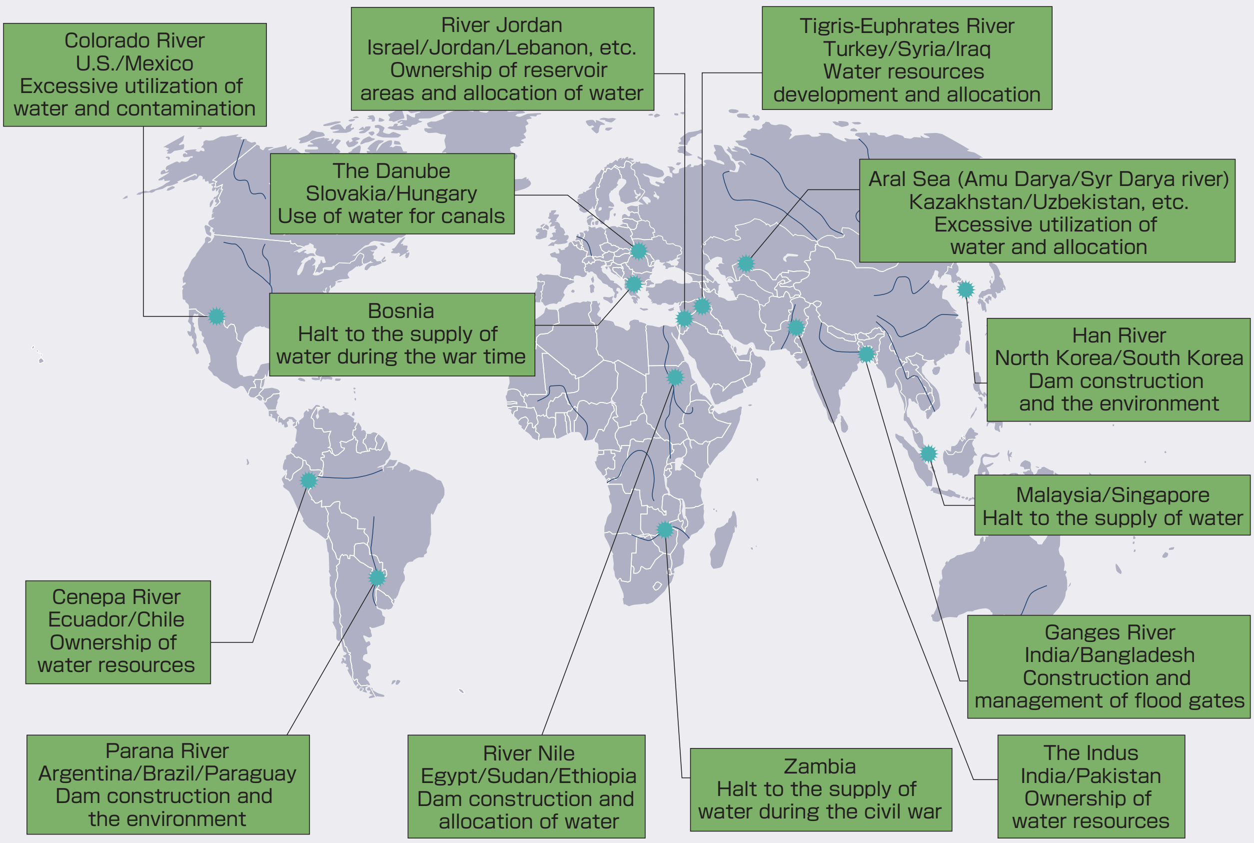


Source: Masanori Ando, Guest Professor, Musashino University

Photo4-1-3 Arsenic Poisoning (Pigmentary Anomaly)

Source : Asia Arsenic Network (Specified Nonprofit Corporation)

Figure4-1-16 Water Disputes around the World



Source: Prepared by the Secretariat of the Third World Water Forum based on Peter H. Gleick, "The World' s Water," and Marq de Villiers, "Water"

4 State of Water Demand in Japan

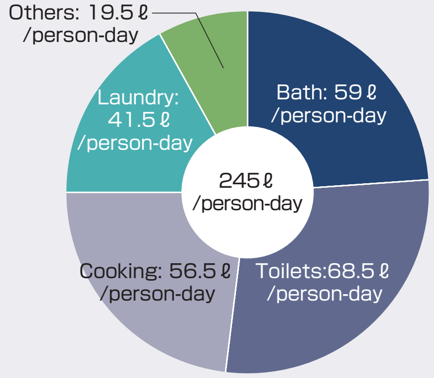
1) Amount of water consumption at households

We consume about 245 liters of water per day as "domestic water." Of the amount, water consumed as drinking water is just two to three liters, with most of the remaining portion being used for washing and cleansing, including cooking, laundering, bath, cleaning, flash toilets, water sprinkling and other purposes (Figure 4-1-17). Meanwhile, water for commercial use at such places as restaurants, department stores and hotels, water for use at business offices and water for public use, such as fountains and public restrooms in parks are collectively called "water for urban activity." Including this category of water, per-capita use of water came to an average of about 305 liters per day in FY 2006 in terms of effective volume of water.

2) Water supply-demand balance in Japan

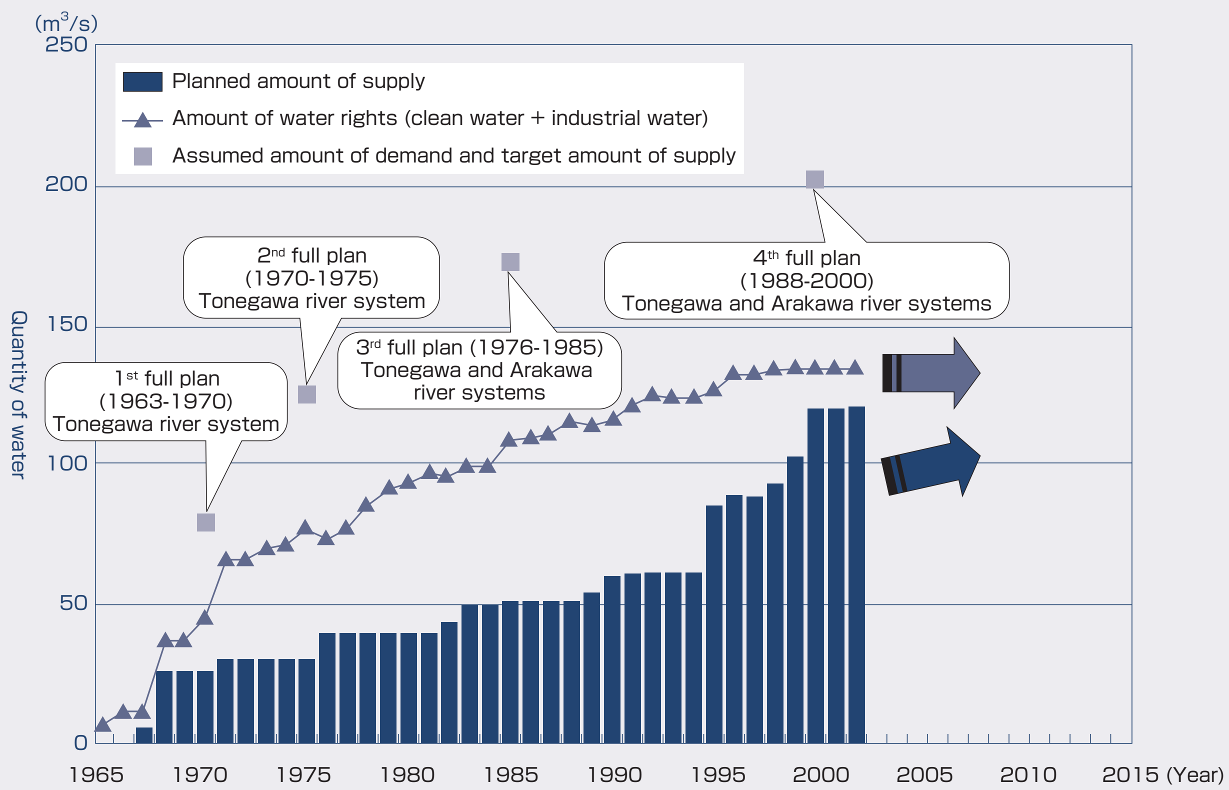
Thanks to the implementation of stable measures for ensuring water supply, Japan appears to be out of the situation where the supply of water cannot catch up with the rapid increase in demand for water (Figure 4-1-18). On the other hand, snow now melts earlier than previously due to, among other things, the decreasing amount of snowfall in part because of global warming, causing the narrowing of the supply-demand gap based on the planned supply in management of rivers, etc. and water rights, which requires the examination of an impact on facilities management.

Figure4-1-17 Ratio of Household Water by Usage



Source: Bureau of Sewerage, Tokyo Metropolitan Government, "Fact-Finding Survey on Usage of Household Water"

Figure4-1-18 Narrowing of Water Supply-Demand Gap in the Tonegawa/Arakawa River Systems



Note 1: Planned amount of supply = Amount of water under development, such as dams (facilities under construction and water diverted from agricultural rationalization projects during winter are not included)

2: Amount of water rights = The sum of water rights secured and temporary water rights

Source: Water Resources Department, Land and Water Bureau, Ministry of Land, Infrastructure, Transport and Tourism

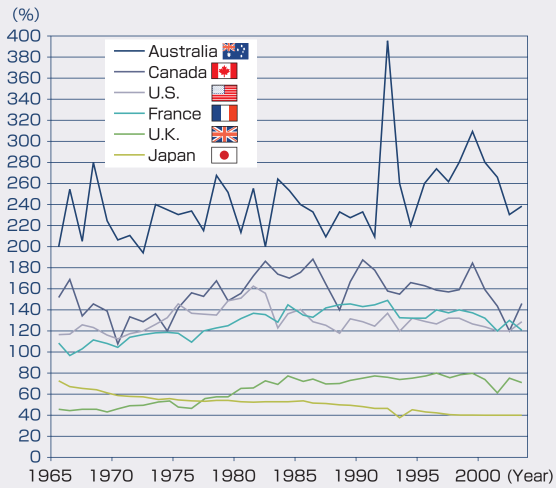
3) Japan deepening dependence on water resources abroad

Japan has safe and stable water supply systems in place for the supply of water with one of the best water quality and most sufficient amount in the world. Does this mean Japan is totally free from water stress? We must not forget that Japan consumes a lot of water around the world through imports of food. In a country that imports goods that require water in producing them (a consuming country), the amount of water estimated to be required if those goods are to be produced in the consuming country is called "virtual water."

Japan's self-sufficiency rate, on a calorie basis, stands now at around 40%, and unlike developments in other major developed countries, Japan's rate has been on the consistent decline since 1965 (Figure 4-1-19). This means Japan depends on other countries for more than half of water needed for food production and that the dependence is continuing to rise. In 2005, Japan imported 80 billion cubic meters virtual water from other countries, with the bulk of that amount stemming from food. The amount is roughly the same as the annual combined intake of water for domestic use, industrial use and agricultural use (Figure 4-1-20).

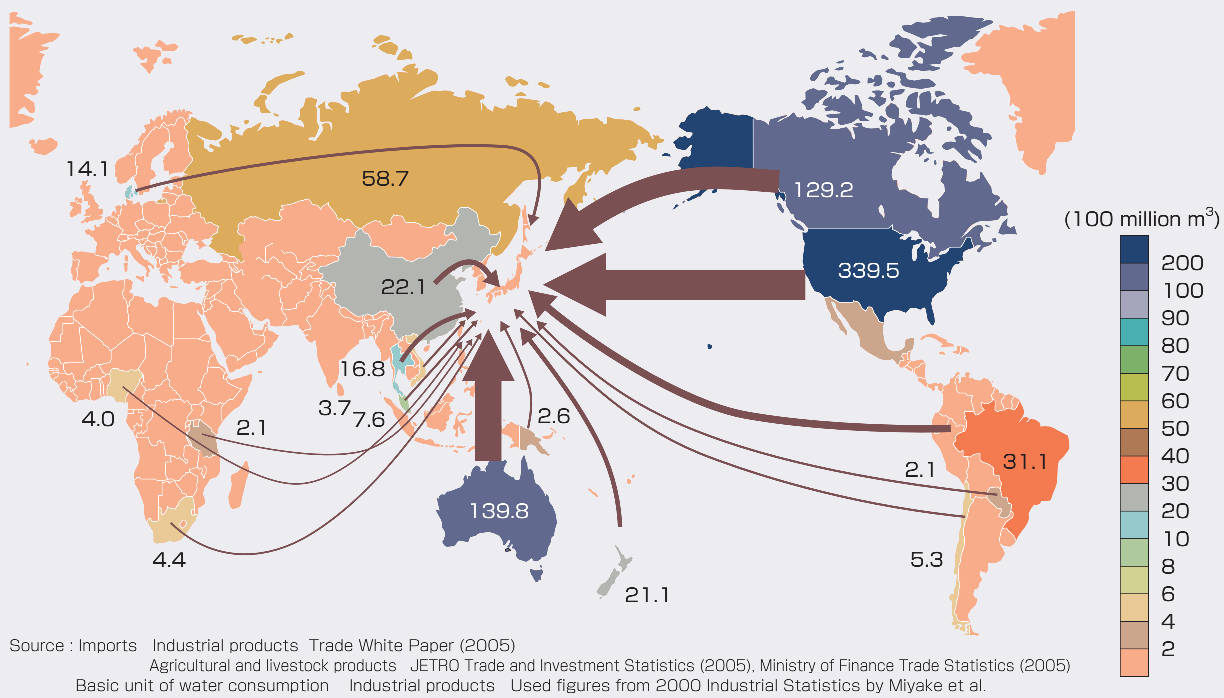
The state of water use in Japan indicates the flattening trend of demand for water for all of domestic use, industrial use and agricultural use, with no cause for alarm over possible water shortages. However, in considering the stable supply of food, we have to always bear in mind the status of water resources that support food production.

Figure4-1-19 Trends of Food Self-Sufficiency Rates of Major Countries on a Calorie Basis (1965-2003)



Source: Policy Issues of Japan in International Comparison, "Comprehensive Research Report" (National Diet Library, 2010)

Figure4-1-20 Virtual Water Imports in 2005

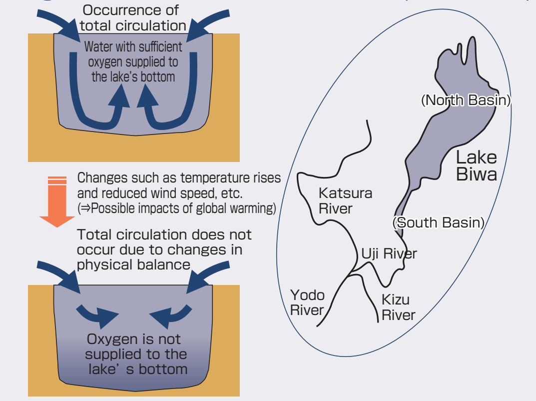


Source : Imports Industrial products Trade White Paper (2005)
Agricultural and livestock products JETRO Trade and Investment Statistics (2005), Ministry of Finance Trade Statistics (2005)
Basic unit of water consumption Industrial products Used figures from 2000 Industrial Statistics by Miyake et al.
Agricultural products Used figures from unit yields in Japan for 2000 by Sato
Round wood Used figures calculated on the basis of wood supply and demand, etc.
Source: Calculated and prepared by Ministry of the Environment based on data from Professor Oki of the Institute of Industrial Science, University of Tokyo

Column Total Circulation of Lake Biwa

In Lake Biwa, layers of water temperatures are formed in summer because of big differences between the surface water temperatures of 26-28 degrees C and deepest-part water temperatures of 6-8 degrees C. When the lake surface cools down from autumn to winter, the surface water temperatures come down and layers of water temperatures disappear, with shallow water and deep water becoming admixed. This phenomenon is called “total circulation.” However, if the lake surface does not cool down and the surface water does not sink as deeply as before because of rising atmospheric temperatures, the total circulation would decrease and oxygen is not supplied to the lake’s bottom, possibly causing a deterioration of water quality and thus giving an impact on lake ecosystems.

Image of Total Circulation of Lake Biwa (North Basin)



Source: Ministry of Land, Infrastructure, Transport and Tourism, "Water Resources in Japan 2007"

Section 2 Efforts to Solve Water Problems

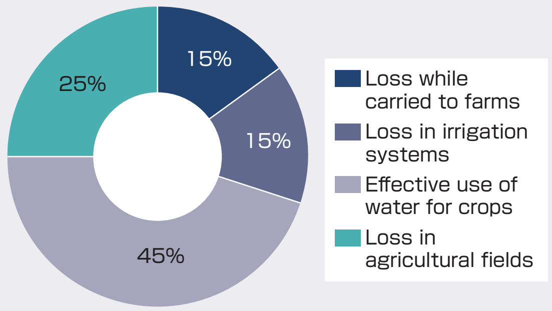
1 Problems in the Use of Water Resources

As discussed in Section 1, water resources available to humans are limited and unevenly distributed geographically. On top of this, we expect to see an increase in water stress due to global warming as well as further rises in demand for water owing to population growth and economic growth. Then, are we using limited water resources effectively without wasting them? For example, in the case of water for agricultural use, which accounts for about 70% of the total water consumption, water is lost in each stage in the course of irrigation of farmland. For example, there a report that in Asia, 20% of irrigation water is lost in the stage where water is carried from reservoirs to irrigated areas, another 15% is lost when water is delivered to agricultural fields, and in addition, 25% of water is wasted in agricultural fields (Figure 4-2-1). In this case, as much as about 60% of water is lost and only the remaining 40% is actually used to grow crops. These loss problems can be improved through the averaging of agricultural fields, improvements to irrigation channels, and the “drip infusion” of irrigation water to crop roots.

In developing countries, the nonrevenue water rate (the ratio of the difference obtained by deducting water sold from water produced to water produced) is said to average at 40%. Nonrevenue water rates in major cities of Asian countries show a lot of water is wasted through water leaks, while very little water is wasted in Japan (Figure 4-2-2). Fact-finding surveys on water projects in China and Vietnam, conducted in FY 2008, found that leaks of clean water are big problems in those countries. In Zhejiang Province, China, 20 to 30% of water projects in the province are estimated to suffer water leaks. In water projects in Changxing County of the same province, the quantity of water supply is as much as 36% lower than the quantity of clean water, presenting the authorities there with a major challenge to taking measures to deal with water leaks.

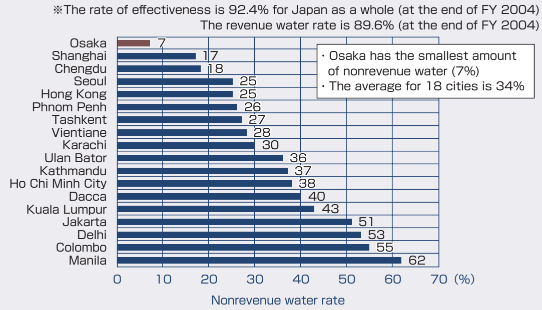
Installation of sanitary facilities remains inadequate in Asian countries as a whole, though the degree of sanitation varies from country to country, standing at 44% in China, 55% in Indonesia, 72% in the Philippines, 61% in Vietnam, 17% in Cambodia, 33% in India, 59% in Pakistan and 39% in Bangladesh. Substantially more effective utilization of water resources is possible if sewage water is adequately treated for reuse as water resources. We need to further promote effective use of water resources through prevention of water leakages and adequate sewage treatment when sewage is discharged into public water areas.

Figure4-2-1 Average Loss of Irrigation Water in the World



Source: Prepared by Ministry of the Environment based on the International Commission on Irrigation and Drainage (ICID), "Irrigation and Drainage in the World – For the Earth Blessed with Water and Green," p.140

Figure4-2-2 Nonrevenue Water Rate in Major Asian Cities



Source: Water in Asian Cities, Utilities' Performance and Civil Society Views, Asian Development Bank 2003 (data is for 2001)

2 International Goals and Efforts toward Solving Water Problems

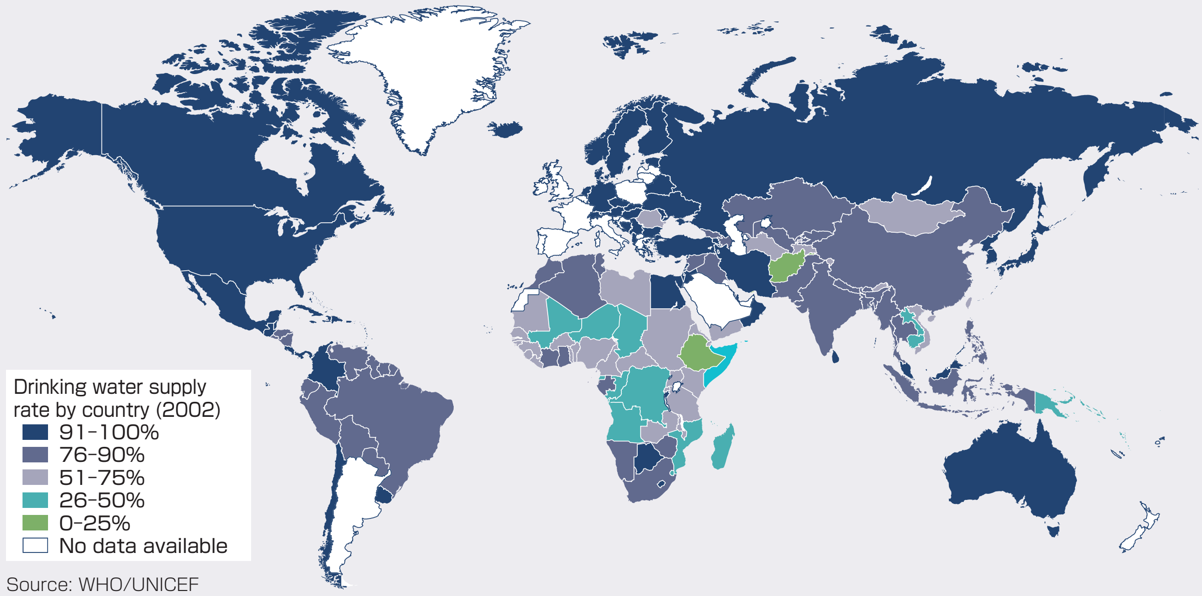
(1) Millennium development goals

By integrating the United Nations Millennium Declaration adopted at the U.N. Millennium Summit held in New York in September 2000 and international development goals adopted at major international conferences and summits held during the 1990s into a single framework, the "Millennium Development Goals (MDGs)" were worked out. In addition, after discussions at the World Summit on Sustainable Development in Johannesburg in 2002, on both aspects of securing safe drinking water and sanitation for adequate wastewater treatment, the numerical target was adopted to "halve, by the year 2015, the proportion of people who are unable to reach or to afford safe drinking water and the proportion of people who do not have access to basic sanitation." (Figure 4-2-3, 4-2-4)

Subsequent international developments on water problems have been revolving around ways to achieve this target, at such forums as G8 Summits, the U.N. Advisory Board on Water and Sanitation (UNSGAB) and the World Water Forum (Figure 4-2-5).

Figure4-2-3 Rate of Access to Safe Drinking Water

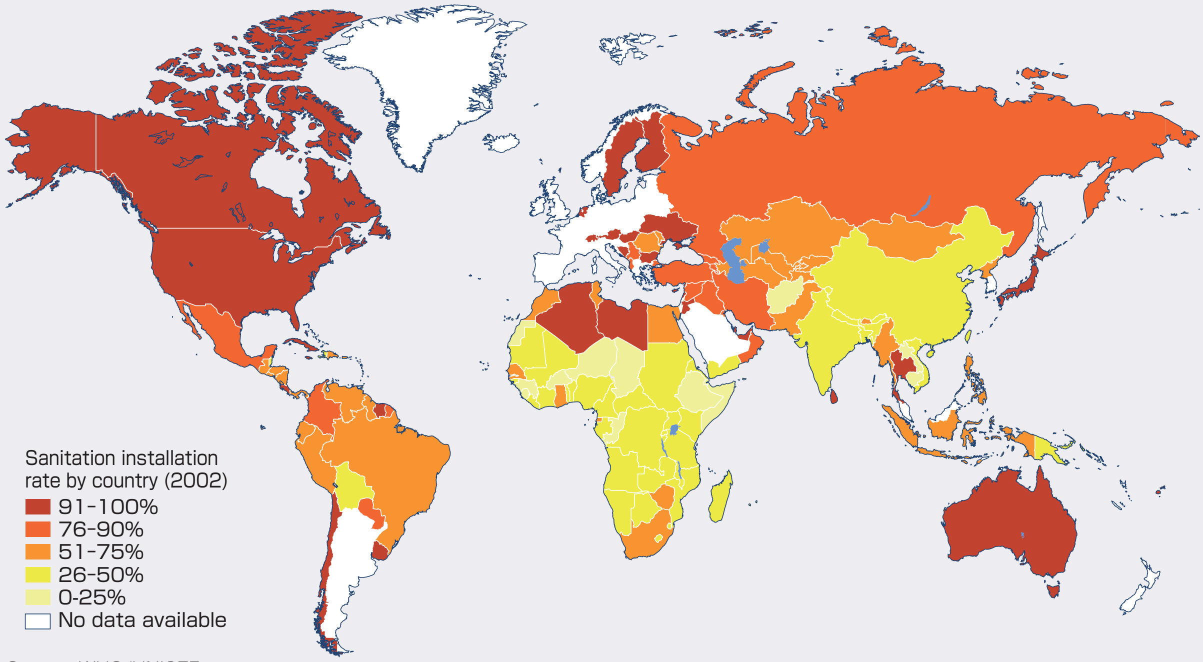
○1.07 billion people (17%) do not have access to safe drinking water around the world (of them, 97% are in developing countries)
○Areas with the low access rate are in Oceania (52%), sub-Saharan Africa (55%), etc.



Source: WHO/UNICEF

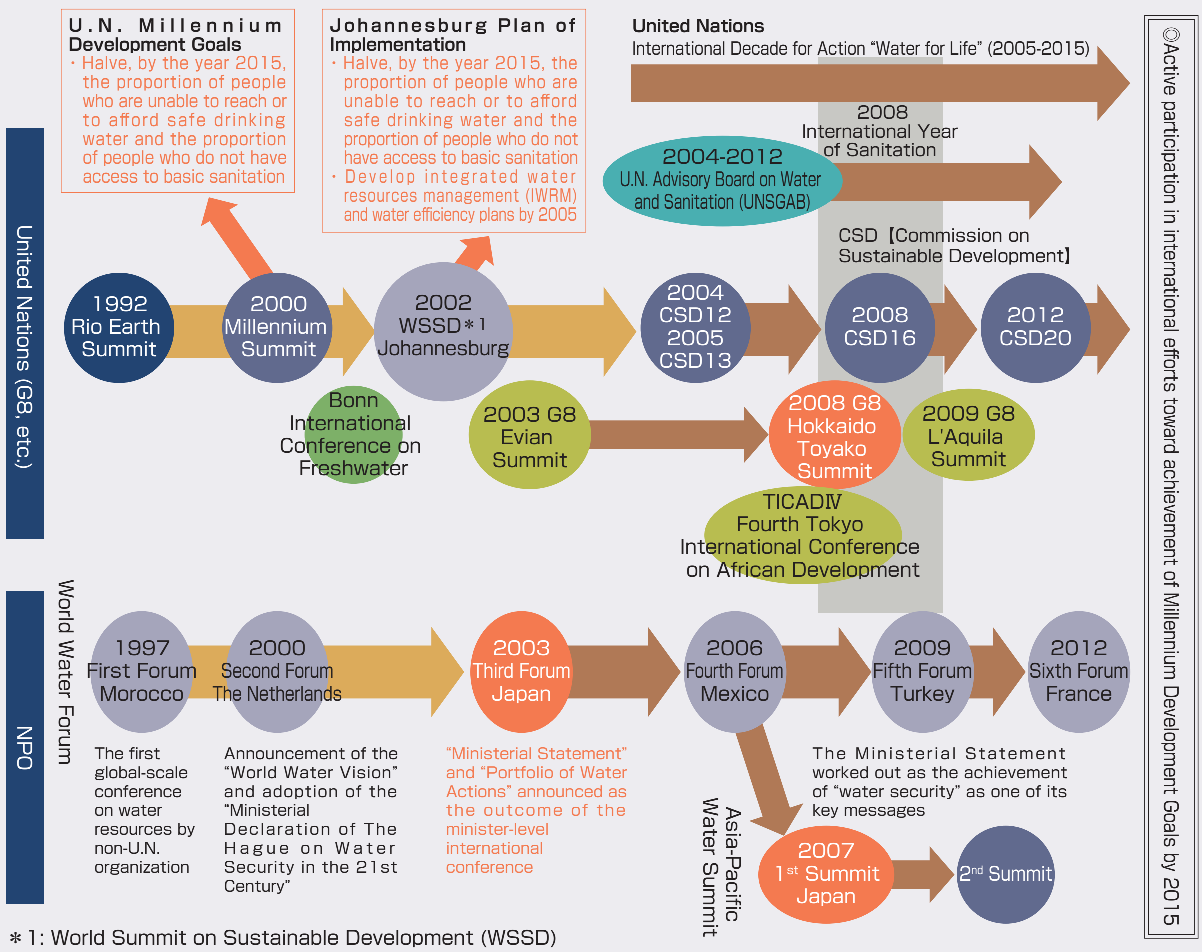
Figure4-2-4 Rate of Access to Basic Sanitation

○2.62 billion people (42%) do not have access to basic sanitation around the world (of them, 97% are in developing countries)
○Areas with the low access rate are in sub-Saharan Africa (37%), South Asia (37%), East Asia (51%), etc.
○Improvements in sanitation lagging particularly in rural areas, with the achievement of MDGs by 2015 seen difficult



Source: WHO/UNICEF

Figure4-2-5 Flow of Global Discussions on Water Resources



＊1: World Summit on Sustainable Development (WSSD)
Source: Water Resources Department, Land and Water Bureau, Ministry of Land, Infrastructure, Transport and Tourism

(2) Comprehensive and integrated water management

There have been movements toward comprehensive and integrated water management for effective utilization of limited water resources, through cooperation among countries in each region and coordination among countries in each hydrographic basin. The Johannesburg Summit in 2002 called upon each government to "develop integrated water resources management (IWRM) and water efficiency plans," and such plans are internationally recognized as effective methods to solve water and sanitation problems. In March 2009, in order to encourage countries to develop such plans, UNESCO coordinated efforts to work out "The Integrated Water Resources Management (IWRM) Guidelines at River Basin Level."

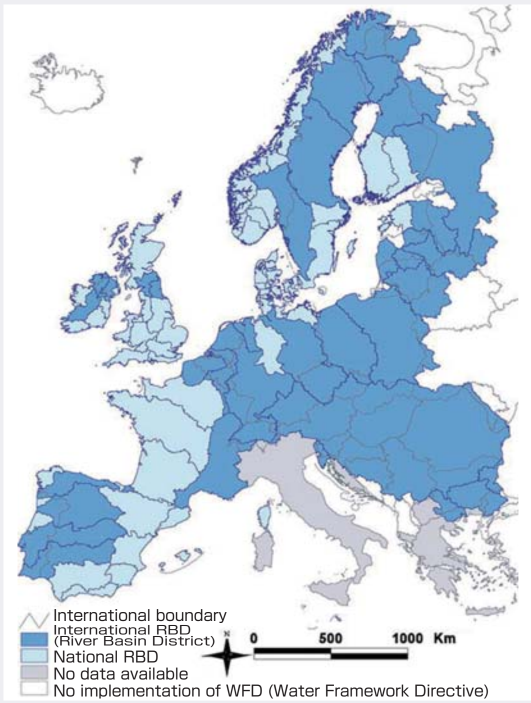
a) Example of Europe

In Europe, as a method of integrated water resources management, the EU Water Framework Directive (WFD) has been introduced. The WFD is designed to achieve, through unified water management, protection of human health by the supply of drinking water and bath water with adequate quality, building of sustainable water management system, protection of aquatic ecosystems and related regional ecosystems, and mitigation of the effects of floods and droughts. To that effect, measures called for under the WFD are characterized by integrated efforts by various water-related sectors, participatory approaches involving various interested parties and river basin management plans developed on the basis of respective river basins instead of administrative areas. What should be implemented to achieve the goals are primarily the following four points:

- Establish a framework for protection to manage water resources such as inland surface waters, estuary waters, wetlands, brackish waters, coastal waters and groundwater, etc. along circulations in nature;
- Prevent environmental deterioration in river basin water systems as a whole and improve them;
- Progressively reduce or cease discharges and consumption of priority substances, and preserve and improve the aquatic environment; and
- Progressively improve the quality and quantity of groundwater.

The WFD also requires EU members to develop river basin management plans for all river basins throughout the EU territory by 2009 to push forward with management efforts (Figure 4-2-6). The WFD implementation process is as follows:

Figure4-2-6 Basin Map for River Basin Management Plans in Europe



Source: BioOne website

<WFD implementation process>

By December 2003 EU Water Framework Directive (WFD) comes into effect; transposition of WDF into national legislation

↓

By December 2006 Development of operational monitoring programs as the basis for water management

↓

By December 2008 Development of river basin management plans (draft)

↓

By December 2009 Development of river basin management plans (approval by the European Commission (EC))

↓

By December 2015 Implementation, evaluation and adjustment of river basin management plans

b) Example of Australia

In Australia, irrigation and other measures have been taken in the Murray-Darling river system as broad-based water management (Figure 4-2-7). The governments of relevant states have been managing water resources in the river basin over more than 100 years. In recent years, however, droughts have taken serious proportions due to decreased precipitation since 2000, causing sharp drops in yields of wheat and other crops due to water shortages and poor growth of pasture grass that is having an adverse impact on cattle rearing. As precipitation continued to decline, river flows are likely to decrease further going forward. Despite these poor conditions, the relevant state and territory governments responsible for water resources management continued to grant water rights excessively and water users also continued to overexploit water resources, rendering water resources management for solving problems difficult, a situation that called for a system under control of the federal government. Under these circumstances, federal Prime Minister John Howard in January 2007 announced the National Water Security Plan for Cities and Towns. The plan was designed for drastic improvement of water resources management across the country, with the federal government spending 10.05 billion Australian dollars (about ¥950 billion at the prevailing exchange rate then), including an overhaul program for irrigation pipes in the Murray-Darling river system. As the plan included the transfer of some powers related to water resources management from states to the federal government, the discord between the federal and state governments also drew attention. In September 2007, the Water Act 2007 was enacted with provisions for the partial transfer of powers related to water resources management in the Murray-Darling river system to a federal government agency. Based on this act, the Murray–Darling Basin Authority was established as an independent agency made up of experts and responsible for preparing an integrated management plan for water resources of the vast Murray-Darling Basin. As the basin management plan includes the establishment of limits on integrated and sustainable use of surface water and groundwater, identification of climate change and other risks to water resources in the river system and a strategy for managing such risks, an indication that the independent agency has been given the functions and powers necessary for management of water resources in the basin in an integrated and sustainable manner. Thus, the Australian government has established, albeit partially, a framework for a federal agency to manage water resources, previously the preserve of state governments and other related parties.

Figure4-2-7　Murray-Darling Basin Map

Source: Murray River Tourism

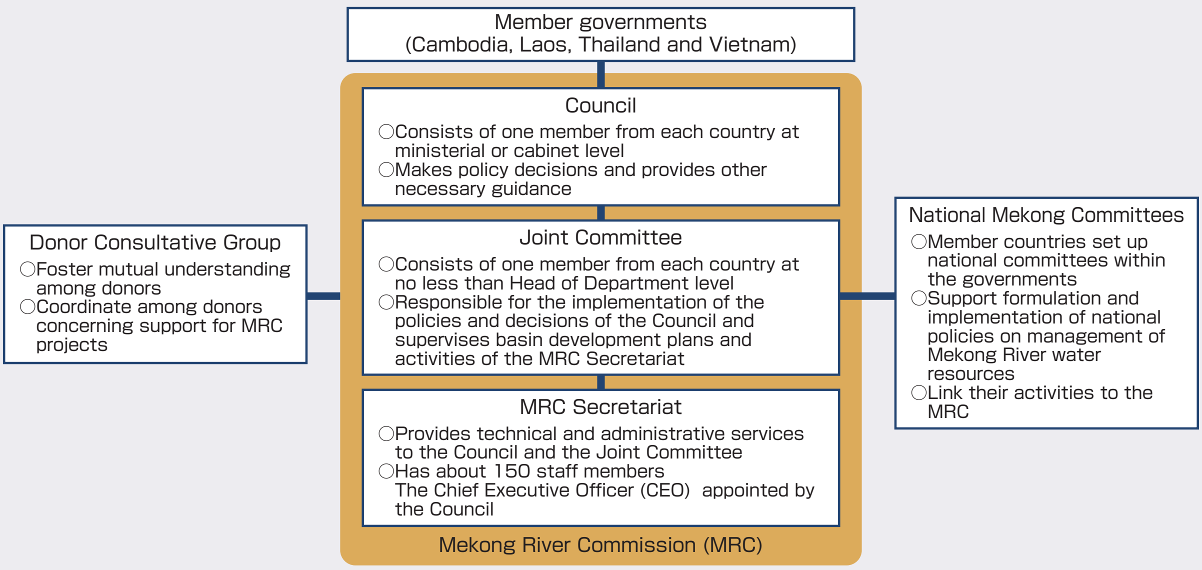
c) Example of Asia

In February 2004, the Network of Asian River Basin Organizations (NARBO) was established by such entities as the Japan Water Agency, an incorporated administrative agency, the Asian Development Bank (ADB) and the Asian Development Bank Institute (Figure 4-2-8). NARBO, which now comprises 71 organizations

Figure4-2-8 Organizations Comprising the Network of Asian River Basin Organizations (NARBO)

Source: Network of Asian River Basin Organizations (NARBO)

Figure4-2-9 Outline of the Mekong River Commission (MRC)

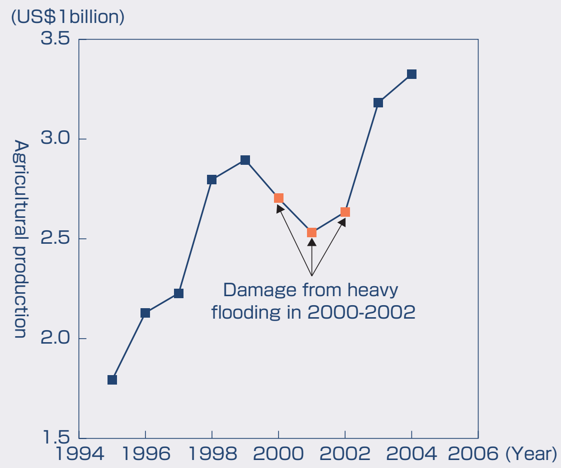


Source: Water Resources Department, Land and Water Bureau, Ministry of Land, Infrastructure, Transport and Tourism

from 16 countries, is designed to serve as a knowledge partner to provide information to river basin organizations and government institutions for the promotion of integrated water resources management (IWRM) in river basins in Asian countries and also function as an institution to offer training and other services for the promotion of IWRM.

Separately, at the initiative of Japan (Ministry of the Environment), the Water Environment Partnership in Asia (WEPA) was established by 11 countries in East Asia (Cambodia, China, Indonesia, Korea, Laos, Myanmar, Thailand, Malaysia, the Philippines, Vietnam and Japan) for the purpose of strengthening environmental governance in the region, providing support for relevant countries in their policy implementation by carrying out construction of information database, information sharing among stakeholders, and human resources development and capacity building in an integrated manner. Currently, efforts are under way for information base development, human resources development and policy implementation as well as strengthening and enhancement of aquatic environmental governance in the Asian monsoon region.

Figure4-2-10 Vietnam's Agricultural Production in the Mekong Delta (1995-2004)



Source: Mekong River Commission (MRC)

One example of IWRM initiatives in Asia is the Mekong River, which has multiple countries in its basin. The governments of Cambodia, Laos, Thailand and Vietnam established the Mekong River Commission (MRC) in 1995 (Figure 4-2-9) to regulate water use for the purpose of sustainable development in the entire basin. Achievements of MRC activities in recent years include the establishment of the flood management and mitigation program (FMMP) to mitigate damage from flooding in the Mekong basin. The MRC is building the flood database and providing training and other programs for enhancing management capabilities in order to achieve effective cooperation. These efforts, coupled with river development in the 1990s, helped Vietnam increase agricultural production in the Mekong delta from US$1.75 billion (about ¥154.8 billion) in 1995 to US$3.3 billion (about ¥291.9 billion) in 2004 (Figure 4-2-10). Similarly, farm production in Phnom Penh, Cambodia, in the Mekong basin has also increased.

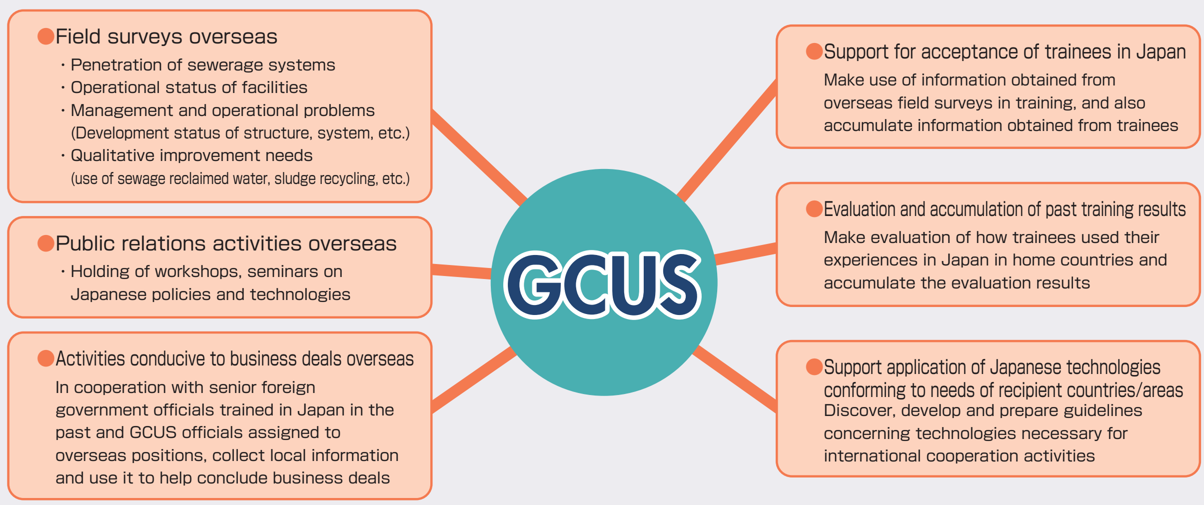
d) Japan's international contribution

Global water problems cannot be solved with efforts by a limited number of countries in limited areas alone. Going forward, Japan needs to actively contribute by offering technical cooperation for the achievement of MDGs as its coordinated efforts on water problems.

For example, the Japan Global Center for Urban Sanitation (GCUS) was established in April 2009 for the purpose of undertaking activities to spread sustainable sewage systems overseas by mobilizing knowhow and expertise held by Japan's industry, academic and public sectors on the sewage system.

GCUS has the three specific objectives: 1) international contribution to solving global water and sanitation problems; 2) support business activities of sewage-related companies; and 3) transposition of overseas experiences into sewage-related policy measures at home. GCUS supports international cooperation activities by the Japan International Cooperation Agency (JICA) and other institutions, while it also consolidate results of overseas field surveys, information on

Figure4-2-11 Activities of Global Center for Urban Sanitation (GCUS)



Source: Global Center for Urban Sanitation (GCUS) international cooperation activities and information on human resources and technologies in Japan and build the network of sewage-related organizations in Japan and abroad (Figure 4-2-11).

It is also necessary for the Japanese government, businesses and citizens alike to take on the role of sending messages on leading-edge initiatives to the world on efforts to tackle global warming as well as activities to conserve the aquatic environment and diffusion and educational efforts related to such activities.

Column Restoration of the Cheong Gye Chon River in Seoul

The Cheong Gye Chon River, which runs from east to west through the central part of South Korea's capital city, had been gradually slipping away from the memory of Seoul citizens. Because of the progressive contamination, the river had become a hotbed of contagious diseases. Construction work to cover the river continued over some 20 years between 1958 and 1978, and the 16-meter-wide Cheong Gye elevated highway was then built over the river cover for a total length of 5.8 kilometers. Together with the Cheong Gye road that runs under it, the highway served as the artery of Seoul, carrying some 170,000 automobiles a day.

About 20 years since then, calls grew among citizens for the restoration of the Cheong Gye Chon River. In 2003, the Seoul mayor, Mr. Lee Myung-bak, who is now president of the country, decided to bring down the degraded highway and developed the hydrophilic space by planting trees along the river.

Currently, the riverside provides a comfortable recreation area for Seoul citizens, and the restored Cheong Gye Chon River has become one of the best-known tourist spots in the sightseeing city of Seoul.

Photo4-1-4 Restoration of the Cheong Gye Chon River

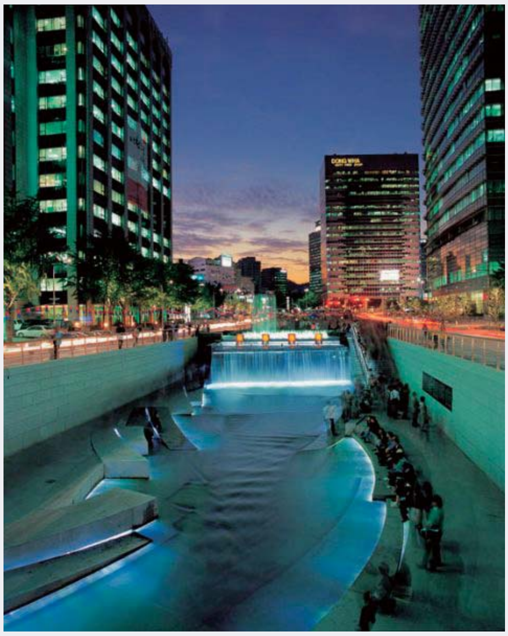


Photo: Seoul City

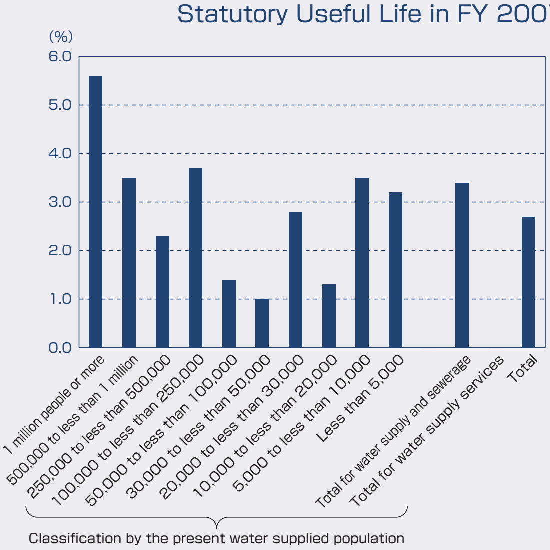
3 Efforts and Measures in Japan

(1) Aquatic infrastructure

a) Measures to cope with decrepit facilities

Waterworks and sewage systems in Japan had been constructed rapidly during the high growth period. Many of them are now becoming decrepit. In order to forestall accidents or failures due to aging facilities and use water resources effectively and appropriately, it is necessary to carry out well-planned replacement or reconstruction of water-related infrastructure, including measures to prolong the life of existing facilities from the early years of the 21st century, also giving heed to the perspective of minimizing life cycle costs (Figure 4-2-12). Water supply systems across Japan have the combined water-purifying capacity of some 88 million cubic meters per day, with the water-purifying capacity of facilities past the statutory useful life standing at some 2.4 million cubic meters per day, or about 2.7% of the total (Figure 4-2-13). The total extension of water conduits, water pipes and distributing pipes runs about 610,000 kilometers, with the extension of these pipes past the statutory

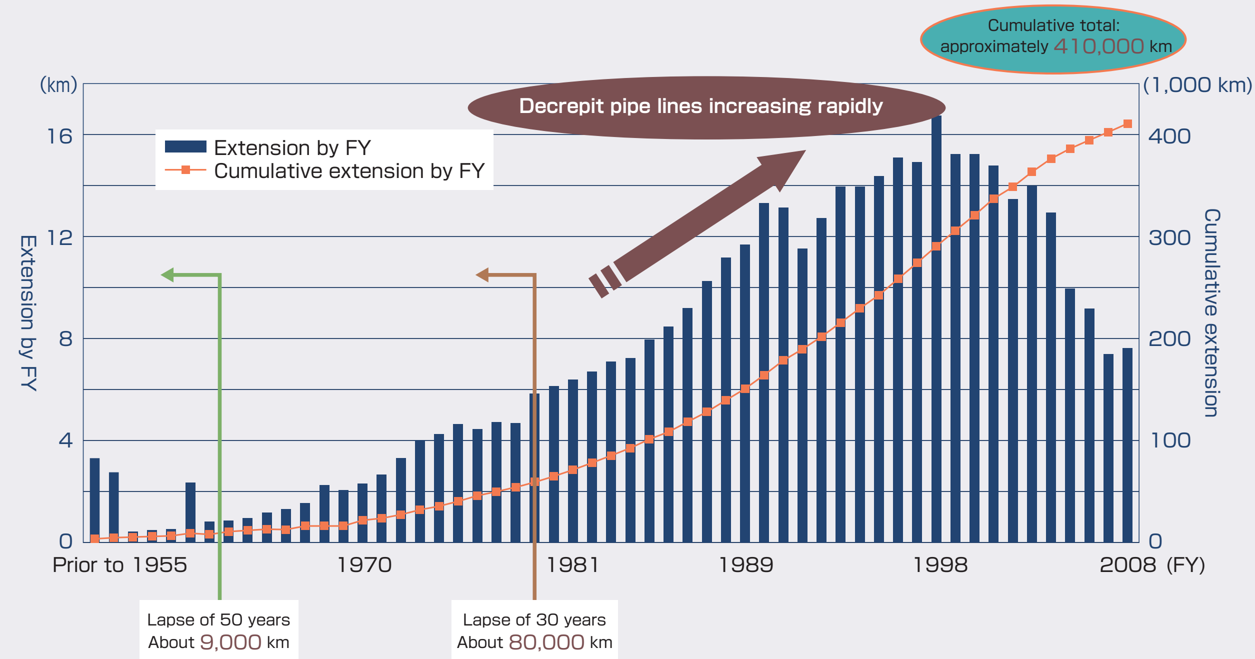
Figure4-2-13 Water Purification Capacity Past Statutory Useful Life in FY 2007



Note: The total water-purifying capacity stands at some 88 million cubic meters per day, with the water-purifying capacity of facilities past the statutory useful life standing at some 2.4 million cubic meters per day, or about 2.7% of the total

Source: Health, Labour and Welfare Ministry, "Water Works Statistics"

Figure4-2-12 Extension of Sewage Pipe Lines by FY (Nationwide)



Source: Sewerage and Wastewater Management Department, City and Regional Development Bureau, Ministry of Land, Infrastructure, Transport and Tourism

useful life coming to about 38,000 kilometers, or some 6.3% of the total extension.

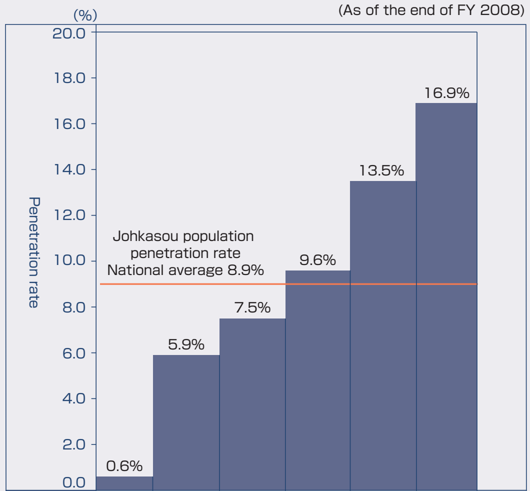
b) Spread of Johkasou

The Water Quality Pollution Control Act provides for the promotion of measures to treat domestic sewage as well as for regulations on waste water discharges from factories and business offices and underground permeation.

In Japan, particularly in intermediate and mountainous areas, the declining population density stemming from the decreasing population and the progressing aging of residents led to drops in the diffusion ratio of sewage system treatment population particularly in municipalities with the population of less than 50,000, underscoring the widening problem of domestic sewage treatment. Under these circumstances, Johkasou are spreading. Johkasou, individual waste water treatment facilities can treat wastewater efficiently even in areas with small populations. As they are compact, it is easier to install them. Because of these advantages, Johkasou are now being introduced into intermediate and mountainous areas as an important means of treating domestic sewage (Figure 4-2-14). The transfer and spread of this technology to developing countries, which often cannot afford to introduce expensive, large-scale water treatment equipment, while ensuring the protection of intellectual property rights, can be one of forms of Japan's visible international contributions.

Figure4-2-14 Penetration Rate of Johkasou by city size

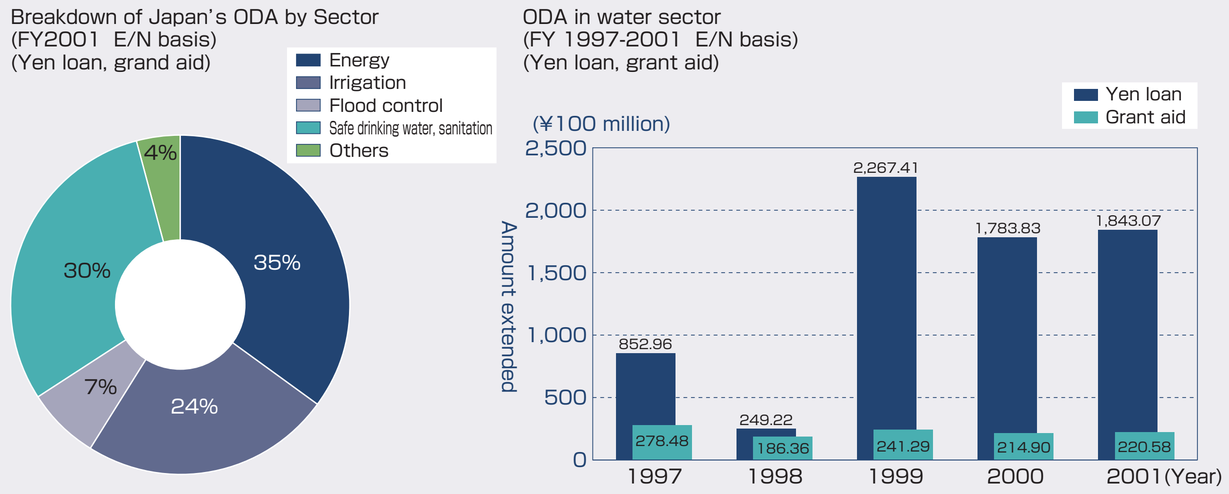
(As of the end of FY 2008)



Population size	1 million or more	500,000 to 1 million	300,000 to 500,000	100,000 to 300,000	50,000 to 100,000	Less than 50,000	Total
Total population (10,000)	2,766	1,040	1,776	3,048	1,892	2,185	12,708
Composition ratio	21.8%	8.2%	14.0%	24.0%	14.9%	17.2%	100%
Penetration population (10,000)	15	61	132	293	256	370	1,127
Penetration rate	0.6%	5.9%	7.5%	9.6%	13.5%	16.9%	8.9%
Number of municipalities	12	15	46	190	271	1,244	1,778
Composition ratio	0.7%	0.8%	2.6%	10.7%	15.2%	70.0%	100%

Note 1: The total number of municipalities of 1,778 is broken down into 784 cities, 802 towns and 194 villages (wards in Tokyo are included in cities)
2: The total population and penetration population may not add up due to rounding
Source: Ministry of the Environment

Figure4-2-15 Breakdown of Japan's ODA by Purpose



Source: Japan's ODA on Water - Japan's Contributions to the Resolution of Water Issues (Ministry of Foreign Affairs brochure)

(2) Organizations, partnerships and measures to tackle water problems

a) Japanese organizations and measures involved with water problems

As water problems involve policy measures in a variety of fields, the Japanese government organizes a liaison conference among ministries and agencies involved in water problems, bringing together the Cabinet secretariat, one office and 12 ministries and agencies for better policy coordination through exchanges of information and views on water problems at home and overseas. Japan also provides much international support in water and sanitation fields through official development assistance (ODA) (Figure 4-2-15). Aside from the quantity side of Japanese ODA in these fields, which accounts for about 40% of global assistance, the ratio of untied aid is very high, demonstrating the fair and exemplary nature of Japanese assistance.

b) Task Force on Water Environment Strategies

In January 2010, the Ministry of the Environment established Task Force on Water Environment Strategies, chaired by Parliamentary Secretary of the Environment Nobumori Otani. The taskforce is investigating into policy issues for the conservation of the aquatic environment and also discussing not only domestic administrative issues but also ways of internationally contributing to solving global water problems. Regarding international contributions as of urgency, the taskforce is considering Japan's support for Asia and Africa facing serious water shortages in such areas as water quality purification and sanitation measures.

c) Water Environment Partnership in Asia

As an initiative proposed by the Ministry of the Environment at the 3rd World Water Forum held in 2003, under the partnership among 11 countries in East Asia, we are providing support for relevant countries in their policy implementation by carrying out construction of information database, information sharing among stakeholders, and human resources development and capacity building in an integrated manner for the purpose of strengthening environmental governance in the region.

The WEPA (Water Environment Partnership in Asia) database Japan provides consists of four databases on "policy information," "water environment conservation technology," "information on NGO and CBO activities" and "information on information sources," offering basic background information for policy development and implementation.

d) Japan-China water environment partnership

In April 2007, Japan signed the "Joint Statement by Japan and the People's Republic of China on the Further Enhancement of Cooperation for Environmental Protection" with China, where water contamination has become a problem of urgency. The statement, on the first area of bilateral cooperation, says, "Cooperation will be implemented … in particular water pollution prevention measures in vital waters …" In May 2010, the two countries concluded the "memorandum of understanding on the implementation of cooperation in the model project for decentralized wastewater treatment in rural areas, etc.," which called for efforts for the penetration of compact wastewater treatment systems suited to local conditions in each of decentralized rural communities. Under these agreements, the Chinese government is pushing ahead with efforts to spread wastewater treatment systems to rural villages. Japan is cooperating with China in holding seminars and policy dialogue, making demonstrative research on wastewater treatment technology through model projects, evaluation and analysis of outcome, and considering management guidelines and measures to spread these systems.

Column Restoration of Riparian Areas by *"Fuyu Mizu Tanbo"*

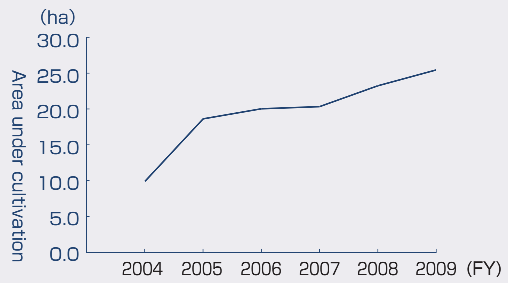
Around Izunuma and Uchinuma straddling Tome City and Kurihara City in the north of Miyagi Prefecture and also Kabukurinuma in Osaki City of the same prefecture, all registered wetlands under the Ramsar Convention, rice paddies after harvesting are flooded with water during winter. These paddies are called "*fuyu mizu tanbo*," literally rice fields covered with water throughout winder.

The "*fuyu mizu tanbo*" rice-growing method is practiced across Japan, though on a limited scale, as an environment-friendly method as it does not use agricultural chemicals or other chemical substances.

Come spring, rice farmers can plant seedling without tilling as required in the conventional way of rice growing. Keeping rice paddies flooded during winter precludes the need to take in large quantities of water right before planting, thus avoiding concentrated water intake in a short span of time and promoting effective utilization of water resources.

These wetlands are wintering places for migratory waterfowls. Rice paddies flooded with water during winter offer good roosts for these birds, and they in turn play an important role in promoting biodiversity of rice paddies as their dung encourages propagation of microorganisms.

"Fuyu Mizu Tanbo" Area under Cultivation in Tajiri, Osaki City (Formerly Tajiri Town)



Source: Industry Promotion Section, Tajiri General Branch, Osaki City

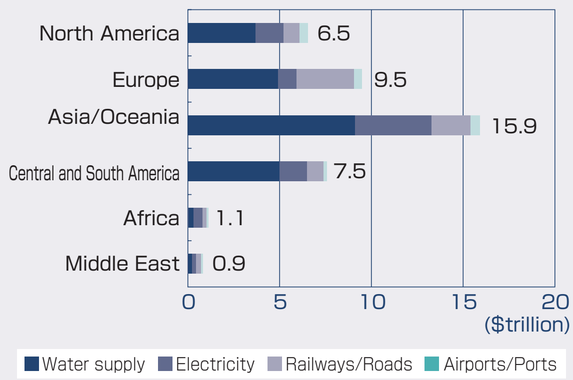
Rice fields adopting the "*fuyu mizu tanbo*" method are expanding, particularly around Kabukurinuma. This is not an easy way of growing rice, but expanding acreage evidently show rice farmers' endeavors to coexist with nature.

Section 3 International Contribution and Water Business

1 State of Global Water Business

The world water business market is estimated to grow to ¥100 trillion by 2025, with $22.6 trillion of investment in water-related infrastructure expected between 2005 and 2030, according to the Council on Competitiveness-Nippon (COCN) (Figure 4-3-1). While the market for the supply of membrane materials, an area Japan excels in, is only about ¥1 trillion, and the market for water purification systems, including membrane engineering, procurement and construction, is just about ¥10 trillion, the dominant area of the global water business market is management, such as facility management and operations for water intake, raw water transmission, water purification and water distribution. Japan has excellent technologies, but there are only a modest number of examples of Japanese entities moving into the water management market. Given successes of European and Asian companies in this market, it is desired that Japanese firms will also enter this vast and promising market aggressively. Japan has excellent technologies that contribute to environmental conservation and effective utilization of resources, including wastewater treatment and leakage prevention technologies. It is necessary for Japan to promote efforts in the water business market going forward through deeper cooperation among the industry, academic and public sectors.

Figure4-3-1 Projected Infrastructure Investment by Region (2005～2030)



Source: Morgan Stanley Flash Report (February 2009)

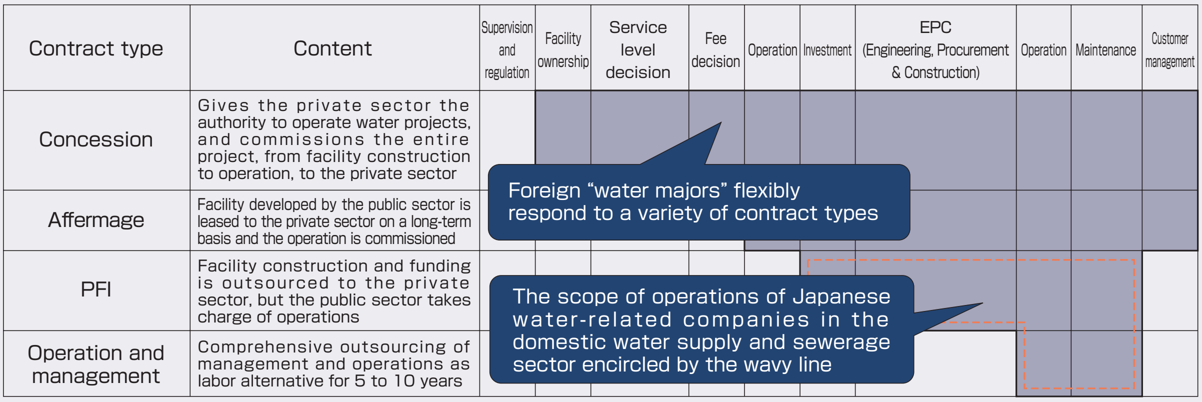
Table4-3-1 ODA Disbursements for Water Supply and Sanitation Sectors

Disbursements by aid type (¥100 million)

FY	Grant aid	Yen loan	Technical cooperation		Contributions to multilateral institutions	Total
			Provided by JICA	Provided by other ministries		
2003	187.67 (22.7)	1,956.52 (35.1)	11.56 (0.8)	– (–)	– (–)	2,155.75 (27.6)
2004	200.62 (24.3)	2,040.48 (31.2)	10.10 (0.7)	– (–)	– (–)	2,251.20 (25.5)
2005	235.16 (29.2)	1,783.37 (31.5)	12.40 (0.8)	– (–)	– (–)	2,030.93 (27.6)
2006	216.04 (12.1)	3,385.17 (40.1)	8.95 (0.1)	– (–)	– (–)	3,610.16 (30.8)
2007	245.56 (6.9)	2,542.61 (26.9)	7.82 (0.3)	6.74	32.58 (3.7)	2,835.32 (20.7)

Note 1: Grant aid and yen loans are on an exchange of note basis. Technical cooperation covers the acceptance of trainees, sending of experts and provision of equipment, on the basis of actual expenses of JICA.
2: Figures in parentheses other than those in the total column indicate the ratio (%) to the sum of ODA by each type of aid.
3: Figures in parentheses in the total column indicate the ratio (%) to the cumulative total of all types of aid.
4: Figures for grant aid are for disbursements of non-project grand aid from FY2003 through FY2006 and for disbursements of project-type grant in FY2007 aid (non-project grant aid, grant aid to support community development, grant aid for security, such as antiterrorism, grant aid for disaster prevention and support for disaster-hit areas, grant aid for fisheries and grant aid for research support).
Source: Ministry of Foreign Affairs, "Japan's ODA White Paper 2008 Statistics and Reference Materials"

Figure4-3-2 Contract Type and Responsibilities of the Private Sector for Water Supply and Sewerage Projects in the Global Water Business Market



Source: Prepared by Ministry of the Environment based on the Council on Competitiveness-Nippon (COCN), "Project Report on Technologies for Water Treatment and the Effective Use of Water Resources"

2 What Japan Can Do for the World

Compared with countries in the world constantly feeling water stress, we in Japan are given to losing a sense of crisis over water as we have relatively free access to water in our daily livelihood. However, as discussed in subsection 4 of Section 1, we should not forget the fact that our social and economic activities depend on the rest of the world for water almost in the same quantity of water we consumer at home. We must recognize that Japan's active international contributions to other countries in the world are essential in terms of the stable supply of water and lead to the protection of our daily livelihood.

What, then, can Japan do by way of contributing to other countries in the world? Japan suffered from serious pollution in the past. Knowledge and technologies we have accumulated in the process of overcoming pollution problems one by one cannot be matched anywhere in the world, and the wealth of these experiences should prove massively helpful in the transfer of technologies to and human resources development in developing countries. Public-private cooperative efforts to utilize Japan's excellent technologies and experiences also can be expected to greatly help expand business opportunities. Until now, Japan has been helping countries with which it has close relations through ODA-based infrastructure projects undertaken by Japanese water supply corporations and the waterworks industry (Table 4-3-1). From now on, Japan should make further international contributions beyond the ODA framework, with Japanese water supply-related companies sharpening their international competitiveness and expanding their overseas businesses.

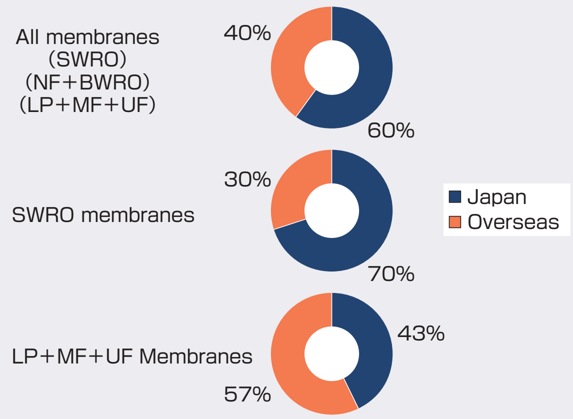
Developing countries where water-related infrastructure is under development have strong needs for post-construction maintenance and sound management services. However, since Japan's water services have long been undertaken mainly by publicly-operated corporations, private-sector companies, despite their strength in element technologies such as facility design and construction, have only limited experiences in integrated maintenance, management and operations of water facilities and are often disqualified in competitive international tenders. In fact, in water infrastructure projects funded with Japan's ODA, European and U.S. companies come in at the stage of commissioning private-sector entities for maintenance, management and operations of water supply facilities. Japanese companies cannot immediately respond to these developments in recent years (Figure 4-3-2).

In order to bring Japan's advanced technologies and knowhow to the world, it is necessary to transfer operation and maintenance knowhow accumulated by municipalities that have undertaken water supply services to private-sector companies. To do this, joint initiatives between the public and private sectors are essential.

3 Japan's Technological Prowess

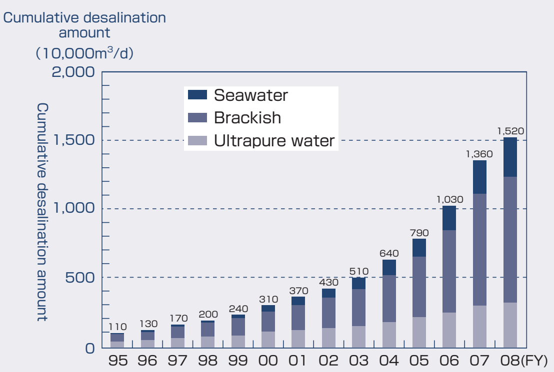
In some Asian cities, for example, large amounts of sewage sludge or food waste and other wastes are disposed by landfill without incineration, giving rise to sanitation problems. As they are sources of methane gas, projects to reduce sludge and wastes, recycle them and collect methane gas for reducing carbon dioxide emissions can earn emissions credits under the Clean Development Mechanism (CDM) of the Kyoto Protocol. Japan has the advanced bio-recycling technology that covers from water treatment to energy collection. The business model for constructing and operating a string of facilities for adequate water treatment, biomass recycling and biomass power generation can be expected to grow going forward (Figure 4-3-8). Japan ranks the world's top-tier league in water treatment technology. In particular, Japanese membrane technology for seawater desalination commands a large share of about 70 % in the world (Figure 4-3-3).

Figure4-3-3 Japanese Membrane Manufacturers' Share in the Supply of Membranes for Water Treatment



Note: Japan includes Japanese companies' group firms operating overseas.
Survey method: data provided by membrane suppliers (14 companies cooperation with the Association of Membrane Separation Technology of Japan) plus publicized materials (IDA Inventory Report 2006)
Source: Association of Membrane Separation Technology of Japan (2007)

Figure4-3-4 Trends in Membrane Shipments



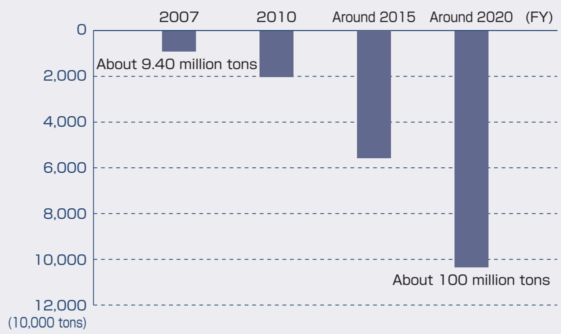
Source: Toray Industries, Inc.

Reverse osmosis (RO) membranes by a Japanese manufacturer have been adopted at a total of 100 plants in 26 countries/areas in the world by March 2009, and the combined desalination capacity of facilities using its RO membranes exceeds 15 million cubic meters a day (equivalent to the quantity of domestic water consumed by over 60 million people) (Figure 4-3-4). The manufacturer estimates that the desalination process using RO membranes consumes less than one-fifth of heat, power and other energy required by the conventional evaporation method. Assuming that the use of RO membranes spreads at the same rate as in the five years from 2010, desalination using RO membranes are estimated to reduce carbon dioxide emissions by some 100 million tons by around 2020 (Figure 4-3-5).

As a result of continued efforts to develop the RO membrane technology, energy consumption in the desalination process was reduced to about one-sixth, to less than the cost of the evaporation method. Thus, the RO membrane technology is expected to produce the co-benefit of water quality improvement and emissions reduction as a measure to cope with global warming (Figure 4-3-6).

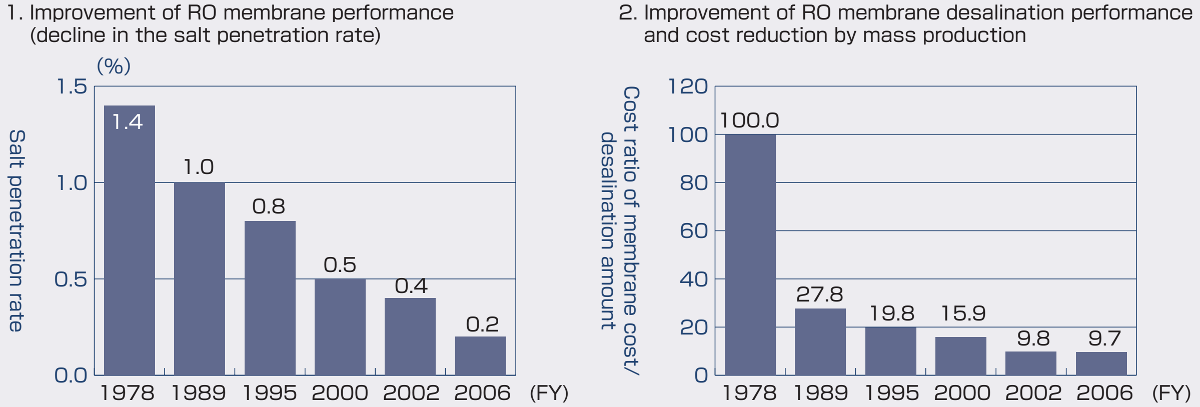
Japan also has a broad range of technologies that can greatly contribute to water infrastructure development in the world, including the heat pump technology that focuses on the thermal potential of groundwater and Johkasou technology quite useful in wastewater treatment. The heat pump is the technology to move heat from one location at a lower temperature to another location at a higher temperature using heat media and semiconductors, etc., commonly adopted in refrigerators and air conditioners. In particular, Japanese companies excel in the heat pump technology to use groundwater, whose temperatures are stable throughout the year, as the heat source. As for Johkasou, the installation of Gappei-shori-Johkasou (which treat kitchen and toilet waste) is required when introducing flush toilets in areas

Figure4-3-5 Carbon Dioxide Emissions Reductions in Water Treatment

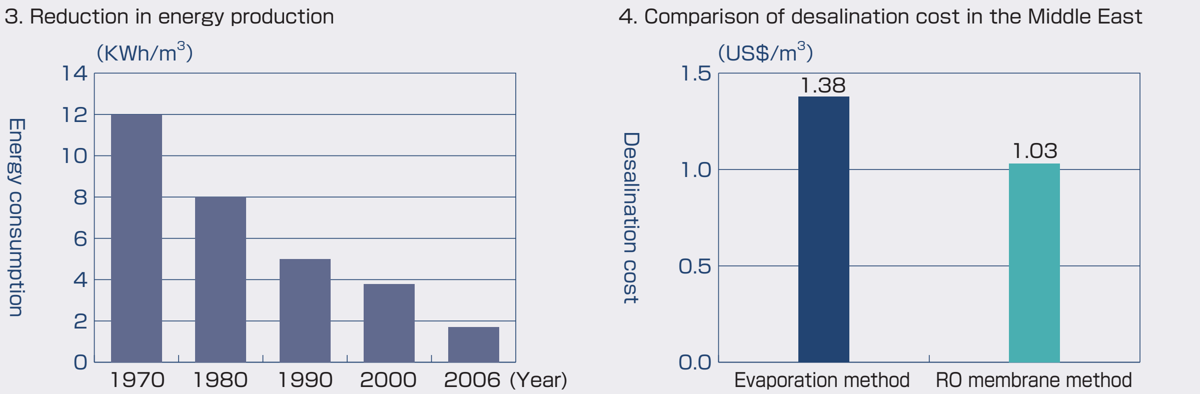


Source: Toray Industries, Inc.

Figure4-3-6 Progress in Seawater Desalination RO Membrane and Technology and Comparison of Energy Consumption and Desalination Cost



IDA news Water, 15, 9-10 (2006).

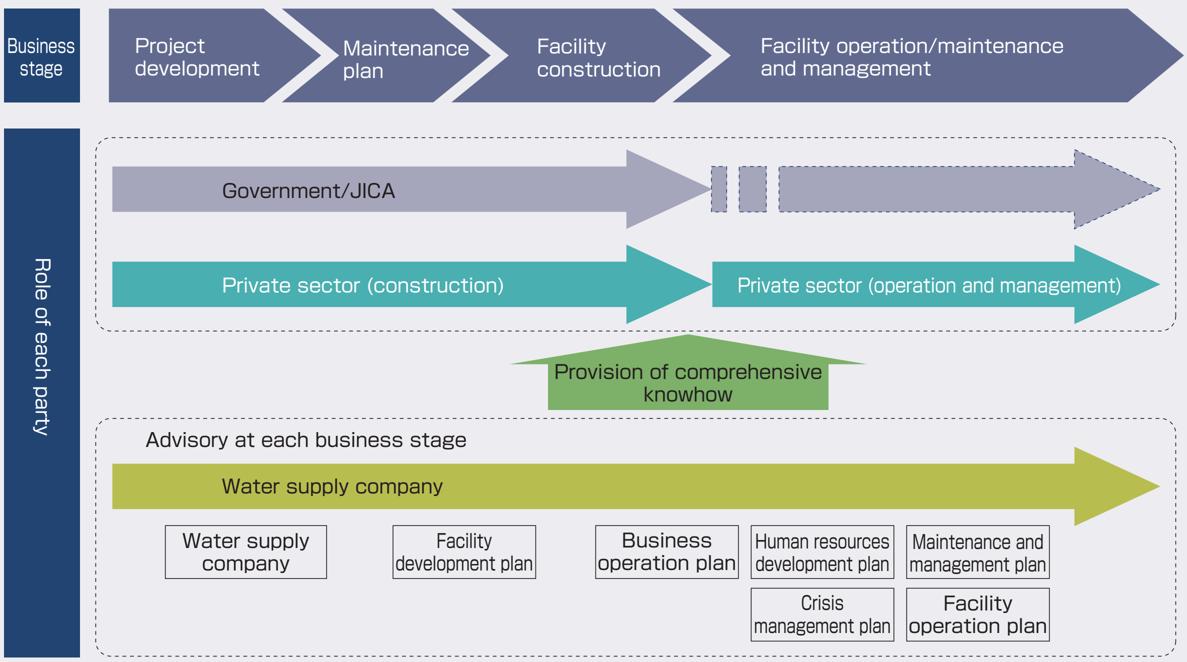


D&WR, 16 (2), 10-22 (2006).

Global Water Intelligence, August (2006).

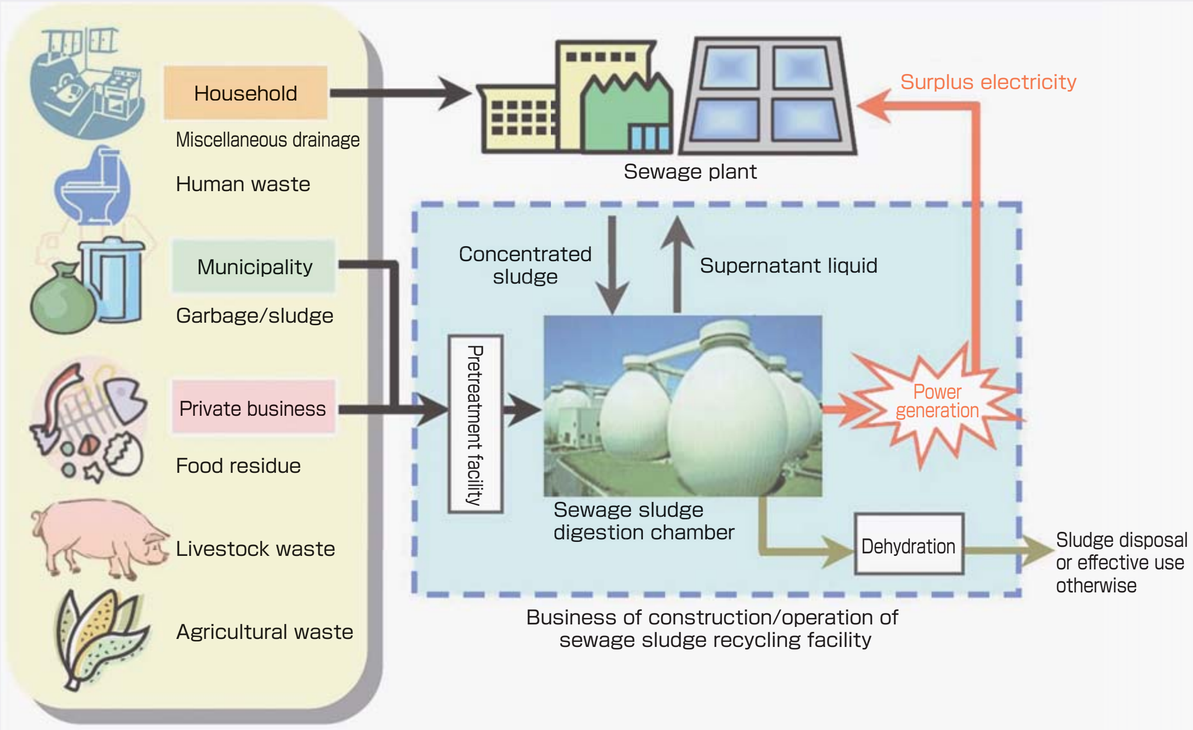
Source: Toray Industries, Inc.

Figure4-3-7 Image of International Contribution as a Water Supply Company



Source: Japan Water Works Association (JWWA), "Report by the Study Group on Security of Water Supply (March 2009)"

Figure4-3-8 Model of Construction/Operation of Sewage Sludge Recycling Facility Using CDM Project



Source: Council on Competitiveness-Nippon (COCN), "Project Report on Technologies for Water Treatment and the Effective Use of Water Resources"

Column Major Players in the Global Water Market

The water business market is expected to continue expanding going forward, including privatization of water supply and sewerage businesses, and maintenance and management services for existing facilities. Currently, a handful of conglomerates, called "water majors," dominate the world's privatized water supply and sewerage market.

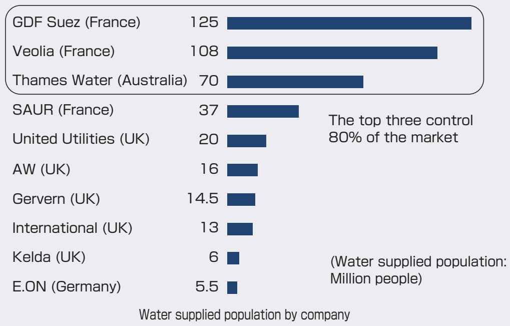
Veolia of France is the company whose predecessor was Compagnie Generale des Eaux, founded in 1853 as a water supply firm. As of 2008, Veolia Water, the Veolia group's general water business subsidiary, provides water to 80.5 million people and operates water purification facilities at 5,176 locations.

GDF Suez, also of France, originally started water supply and sewerage services in Cannes, France, in 1880. In 1997, it merged with Compagnie financiere de Suez and changed its corporate name to Suez Environment. As of the end of 2008, the company provides water to 76 million people and operates water purification facilities at 1,746 locations.

Thames Water was born out of London's Thames waterworks department in the 1980s when the British government deregulated the water supply and sewerage market following the power and gas services. It is the giant company that single-handedly undertakes the 100% privatized water supply market in Britain.

Current State of the Global Water Supply Market

Domination of the global water supply market by the top three



Water supplied population by company

Source: Council on Competitiveness-Nippon (COCN), "Project Report on Technologies for Water Treatment and the Effective Use of Water Resources"

These three companies alone are believed to cover about 80% of the water supplied population in the world's privatized water services.

One of the reasons behind their huge market shares is said to be the support provided by their home governments. In France particularly, then President Jacques Chirac reportedly put his efforts into the French firms' advances into overseas water businesses, earning himself the nickname of "the world's top water business salesman."

without public sewerage systems, rural community sewerages, community plants or other wastewater treatment systems. The penetration rate of this Gappei-shori-Johkasou is almost 10% in Japan at present. Gappei-shori-Johkasou use microorganisms to purify sewage from homes. The importance of these Johkasou is being recognized anew from the viewpoint of protecting the natural environment as final effluent adequately treated in Gappei-shori-Johkasou can be recycled back to communities.

Despite the world-leading technologies described above, Japan has yet to enter the global water business market on a full scale. For its advances in the global market, the public and private sectors need to cooperate as mentioned in 2 above (Figure 4-3-7).

Conclusion

In Chapter 4, we discussed the role Japan should perform in conserving water resources that are limited and unevenly distributed on the earth. Compared with countries constantly in the state of water stress, Japanese people, thanks to Japan's advanced water supply technology and systems, tend to become unconscious of the preciousness of water, the resource that is directly linked to our subsistence and livelihood. But we should not forget that economic and social activities in Japan depend on the rest of the world for water in the amount equivalent to water consumed at home. In return, Japan can contribute to solving the issue of securing sanitary water around the world by appropriately taking advantage of its clean water supply and wastewater treatment technologies while paying due heed to intellectual property rights. Needless to say, water is the subject of business in the international community. Japan's position in the global water business market warrants no optimism, as competing technologies, while inferior to Japanese technologies, may be more price competitive, and Japan has only a modest track record in the market for maintaining and managing water treatment systems that is far more massive than that for element technologies where Japan particularly excels. But we see the promising spouting of seeds there. We need to push forward with the conservation of the water environment and the promotion of water businesses further with the cooperation of all parties concerned and greater support from the government.