Section 4 Water problems[1] and Japan's efforts

Discussions on water problems have recently drawn worldwide attention. In addition to talks at the UN and other international forums, the first Asia-Pacific Water Forum was held in 2007 in Oita Prefecture in Japan, where water problems were discussed as a challenge shared by Asian countries. Furthermore, in 2008, the problems were a serious topic at the Annual Meeting of the World Economic Forum in Davos, as well as at the fourth Tokyo International Conference on African Development (TICAD IV[2]).

As the interest in water problems increases throughout the world, Japan is expected to actively tackle the problems based on the technology and know-how it has accumulated through its past experience. Japan, which was never a water-rich nation, faced environmental changes caused by a rapid population increase and economic growth during a sharp economic growth period. It has tackled the problems by establishing efficient water-saving technologies and water management systems, which include the promotion of recycling industrial water (approximately 80 percent of industrial water is recovered) and lowering the leakage rate of water for domestic use (the leakage rate is below 10 percent). Such technologies and know-how can contribute to the solution of global water problems.

This chapter examines water problems mainly emerging in Asia, efforts made by other countries to tackle the problems and how Japan can contribute to their solution.

1. Economic growth and water problems

Water is not only closely related to the life of humans but also to various economic activities.

Firstly, water is essential for our survival. Without a proper water supply, many people lose their lives. A total of 1.1 billion people in the whole world are estimated to lack access to safe water, and more than 4,500 children lose their lives every day due to a lack of safe water[3].

Secondly, water is essential for economic activity and it is used to produce agricultural products, to clean industrial products and energy. The ratio of hydraulic power generation to all power generation methods is high, especially in sub-Saharan countries and Central and South America, and accounts for more than 50 percent of power generation in some countries[4].

Water has a great impact on our society and economy. This section gives an overview of current water problems in the world, the structural increase in water demand and the limited supply.

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[1] "Water" means fresh water that can be used for domestic use and economic activities unless specified otherwise.

[2] Refer to Charter 5 for TICAD IV.

[3] World Health Organization, UNICEF (2005), *Water for Life Making It Happen Decade for Action 2005-2015*. In 2004, 2.2 million lives were lost due to unclean water. Two million, or 90 percent, of them were children aged 4 or younger.

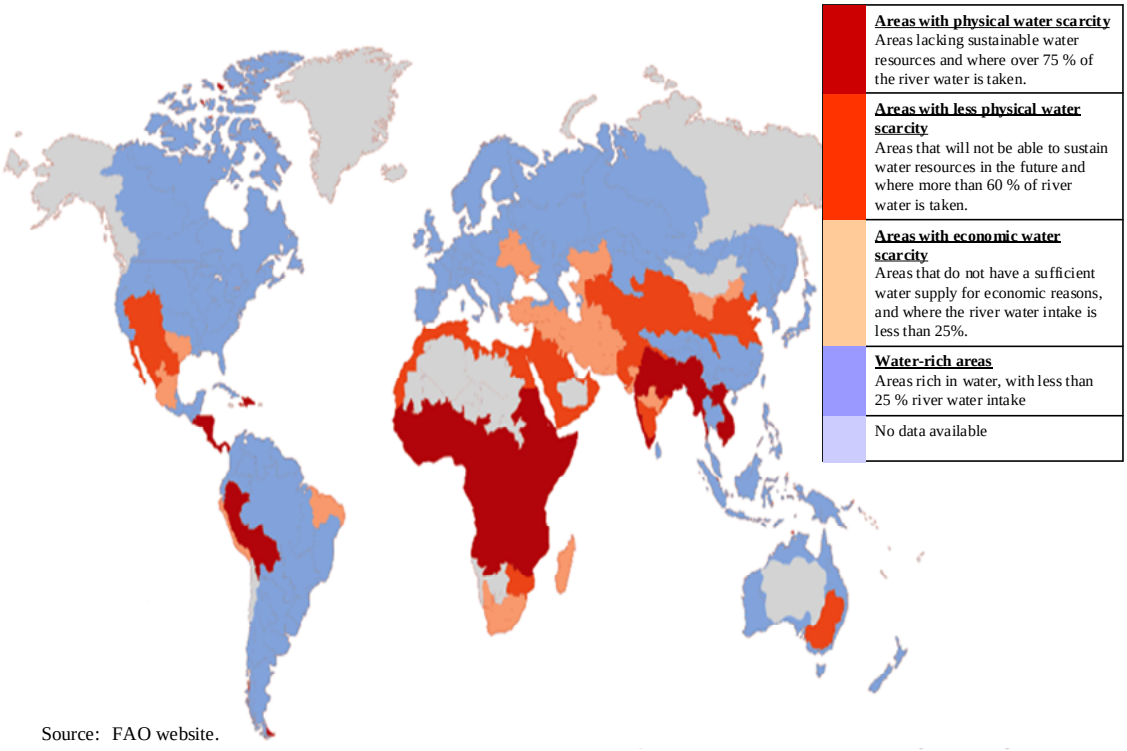
[4] The data is from 2002. Source: Inter National Hydropower Association website. Although the ratio of hydraulic power generation is 17 percent in the world, it is over 50 percent in 66 countries (UN (2004), *Energy Statistics Yearbook 2004)*. The dependence is high in sub-Saharan countries and Central and South America, where energy production may further increase. Although economically extractable hydropower is estimated to be 8 million gigawatts annually, it is mostly unused with only 802 gigawatts being consumed currently, including facilities under construction. (World Energy Council and International Journal on Hydropower and Dams, data as of 1999.)

(1) Overview of water problems in the world

An "excess" of water, such as floods, used to be the major water-related problem. However, in recent years, while "excesses" are still a problem, "shortages" of water have become the newest problem as demand for water resources increases, and proper water supplies do not increase due to the lack of sanitation facilities and water supply systems[5] (see Figure 3-4-1). Water shortages may become serious. When the changes in the precipitation pattern due to climate change are taken into consideration, the per capita annual water consumption for 1.8 billion people is predicted to fall below 1,000 cubic meters, which is "absolute water shortage," and 5.5 billion people are estimated to be exposed to "water stress" in 2025[6].

Such water shortages can trigger international conflicts. For example, of the international river basins in 145 countries, conflicts over water distribution and funding for resource development and pollution treatment between countries in the upper river basins and lower river basins have already broken out[7].

Figure 3-4-1 World Water Storage



Source: FAO website.

(2) Expansion of water demand due to population increase and economic growth

The major causes of water shortage on the global level are expansion of water demand and stagnant water supply.

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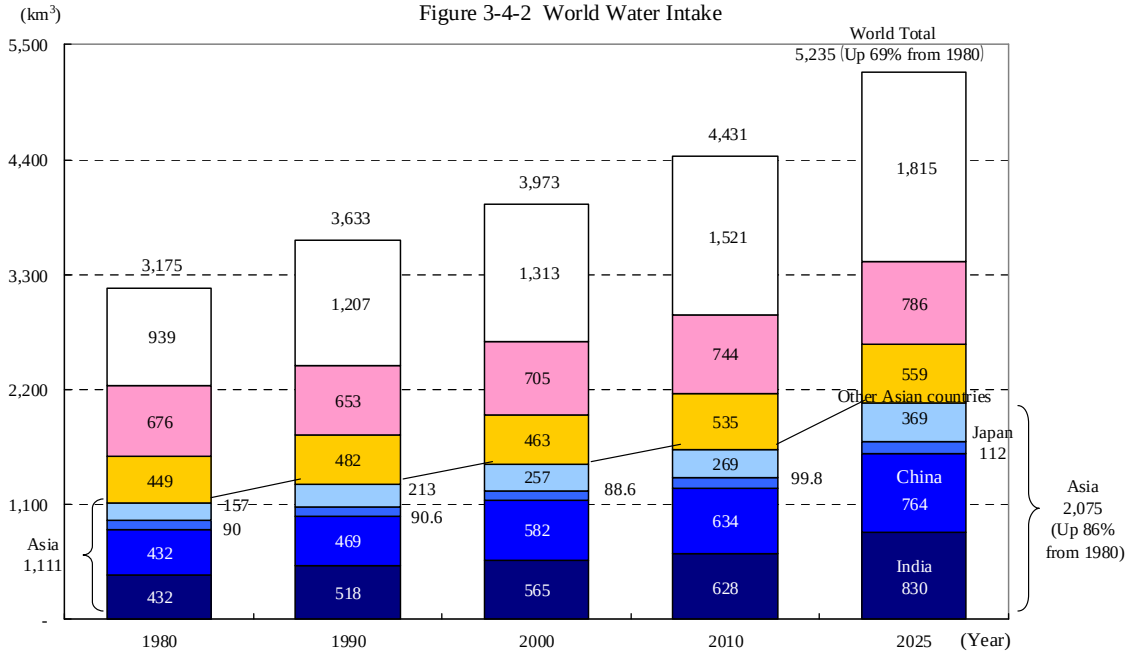
[5] According to the UN, in 2000, 700 million people were under "water stress" finding it inconvenient to lead their daily lives with less than 1,700 cubic meters of annual water consumption. (United Nations Environment Programme (2007), *Global Environmental Outlook 4*.)

[6] Source: FAO Water website. Original source: *Global Environmental Outlook 4*, cited above.

[7] UN (2005), "Water for Life Decade 2005-2015."

The water demand has increased mainly because of increasing water consumption due to a continuing population increase and economic growth (see Figure 3-4-2). As mentioned in the previous section, the world population is estimated to increase by 80 million (1.1.percent of the total population) annually until 2015[8]. In accordance with the population growth, the food demand will increase and 3,000 liters of agricultural water is needed to produce the day per capita food requirements[9]. This means water demand increases by 210 cubic kilometers annually (5 percent of the current global water intake) due to increases in population and food demand.

Figure 3-4-2 World Water Intake



Note: Other Asian countries are a total of Indonesia, Malaysia, the Philippines, Thailand, Vietnam, Australia and New Zealand.
Source: State Hydrological Institute, United Nations Educational Scientific and Cultural Organization, (1999), World Water Resources and their Use.

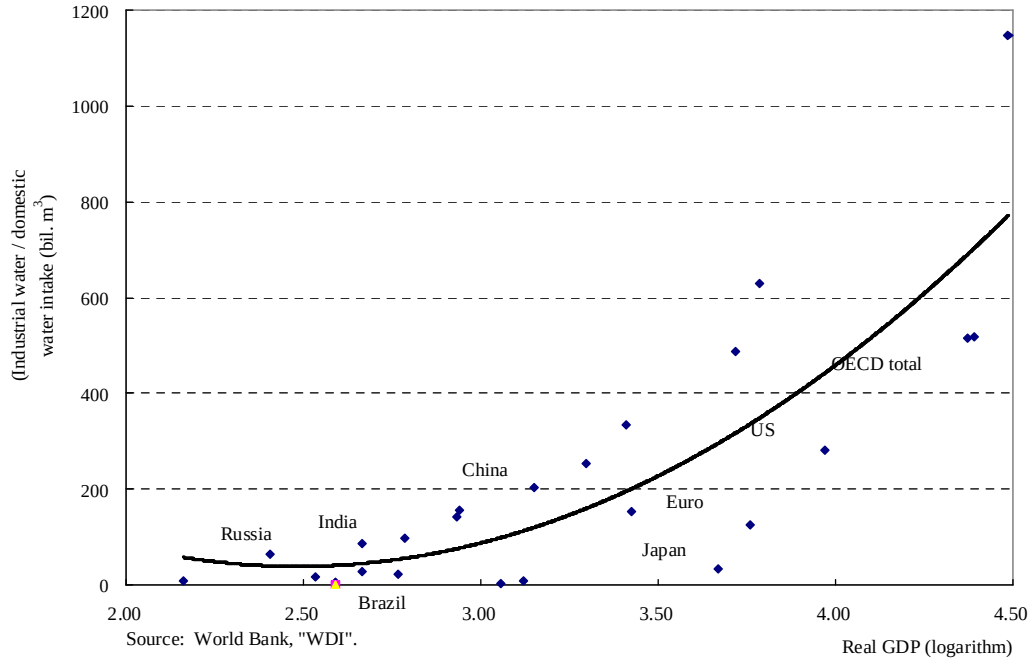
For food production to increase, it is also important to introduce irrigation facilities to raise the unit crop yield fivefold at the maximum. The food production increase was achieved as a result of an increase in unit crop while the world faced difficulties in expanding arable land. This trend is likely to continue, and the unit crop amount and water consumption have a proportional relationship. There is not sufficient rainfall, even in the tropical zone which has a large volume of rainfall, in order to have a yield of 3 tons of crop per hectare[10].

Income increases in accordance with economic growth has accelerated the demand for water due to people's changing diet and an increase in service consumption (see Figure 3-4-3). As discussed in the previous section, economic growth often promotes diversification of diet and a shift from grain-based consumption to a diet with a variety of vegetables, fruits and animal products. An increase in animal products, in particular, increases water demand several times over due to the increased production of feed grains (A maximum of 11 kilograms of feed grain and 33 liters of water are required to produce 1 kilogram of meat.) An income increase also boosts demand for domestic water

[8] UN (2007), *World Urbanization Prospects The 2007 revision*.
[9] UN (2005), cited above.
[10] UN (2005), cited above. Original source: World Water Association Programme.

partly because of the prevalence of flush toilets and washing machines[11].

Figure 3-4-3 Relation of GDP to Water Demand



Source: World Bank, "WDI".

Another cause of an increase in the water demand is urbanization (see Figure 3-4-4). The world population is estimated to grow from 6.7 billion in 2007 to 8.1 billion in 2025, and the urban population[12] is also estimated to increase from 3.3 billion to 4.6 billion during the same period. As a result, the ratio of urban population (urbanization rate) is estimated to increase from 49 percent to 57 percent[13]. Data shows that per capita water consumption tends to increase as urbanization progresses and is in accordance with the expansion in city size[14]. It is partly because city dwellers have higher incomes. However, the development of tertiary industries in accordance with urbanization promotes an increase in water demand since domestic water consumption per household is hardly likely to change even when the income of city dwellers increases. For example, in Tokyo during the rapid economic growth period, the biggest water consumers were hospitals and universities and water consumption increased per unit in relation to an increase in the daytime population[15].

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[11] One example is that daily consumption of domestic water per capita in Japan almost doubled from 170 liters in 1965 to 320 liters in 2000 due to changing lifestyles in accordance with economic growth. When looking at consumption of domestic water by purpose in 2002, drinking water is only 2 to 4 liters (0.01 percent) and the rest is mostly used for cleaning, which includes toilets (28 percent), bathing (24 percent), cooking (23 percent) and laundry (20 percent). Source: Bureau of Waterworks, Tokyo Metropolitan Government, "IPPAN KATEISUIRIYOU MOKUTEKIBETSU JITTAI CHOUSA."

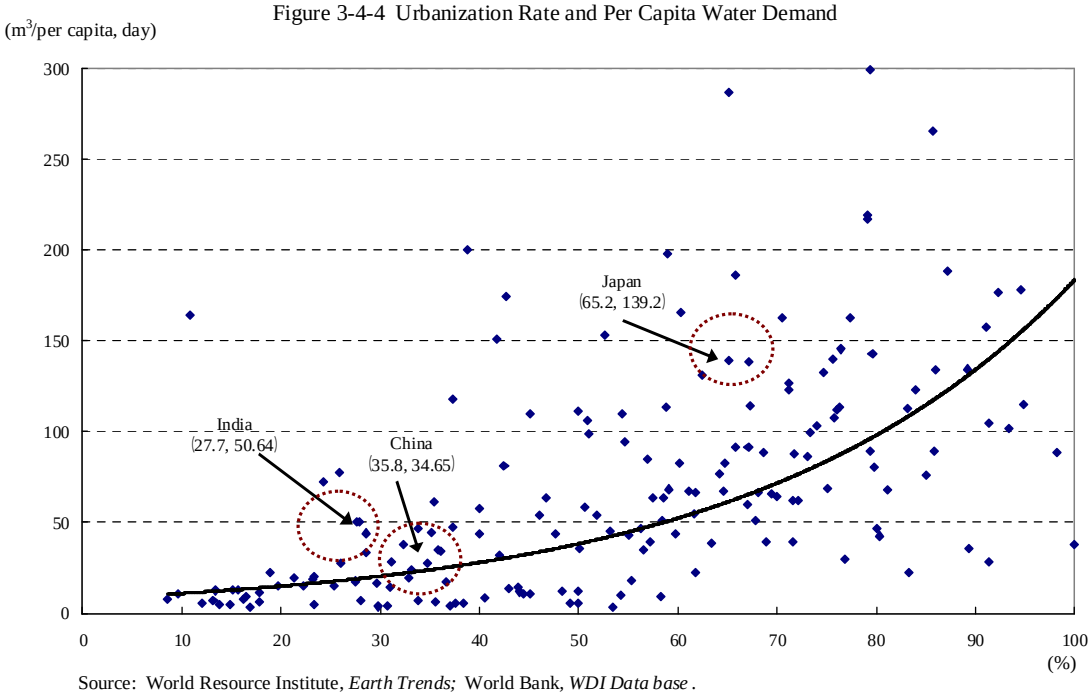
[12] Although the definition of "city" differs from one country to another, a city means a municipality with a population of 50,000 or more in Japan.

[13] UN (2007), cited above.

[14] Economic Planning Agency, Japan, *SHOWA 45NENJI SEKAI KEIZAI HOUKOKU ZU 70*.

[15] Economic Planning Agency, Japan cited above.

Figure 3-4-4 Urbanization Rate and Per Capita Water Demand



Source: World Resource Institute, *Earth Trends;* World Bank, *WDI Data base* .

(3) Water supply restrictions

(Unevenly distributed water and yet-to-be developed water supply systems)

The water supply is restricted because of the geographically uneven distribution of water. For example, in Asia, water storage is small in comparison to its population. While 60 percent of the world's population is concentrated in Asia, only 36 percent of the world's water is available there. Thus, it is prone to water shortages and water depletion. China and some parts of India (Tamil Nadu Province, for example) depend on groundwater due to a lack of rainfall. In accordance with the increasing water demand, water pumping exceeds groundwater recharge and the groundwater level is dropping by 2 to 3 meters annually. This has led to a concern over a sharp decline and potential depletion of groundwater and absolute water shortage in the future.

Secondly, the development of water supply systems which include proper water supply facilities and sanitation facilities lags. For example, in Asia, water supply facilities and sanitation facilities are in short supply for 5.5 billion people (50 percent of the total world population) and 1.6 billion people (more than 60 percent of the total world population), respectively[16].

The third problem is water pollution caused by the shortage of drainage facilities. As shown in Chapter 1-3, a small percentage of water resources in seven river systems in China can be used as sources of drinking water, although the ratio differs. Chinese water pollution is becoming serious, particularly in areas that suffer from water shortages. Even though the amount of pollutants is small, they are heavily concentrated and thus less and less water can be consumed.

Against this backdrop, the development of new water supply systems has become an urgent issue in various parts of the world. This includes a shift of water sources from rivers and rainfall to

16 World Bank. "WDI."

desalination of seawater and recycling of wastewater, measures that have recently drawn attention as new water sources[17].

[Column 32] Water transported through trade

Virtual water trade is the concept of importing and exporting water mainly through the trade of agricultural products. According to the U.N., the amount of "virtual water trade" in the whole world is 1.6 trillion cubic meters annually (80 percent is through agricultural trade.) International water interdependence through trade is increasing. When the output of agricultural products per water unit in each country is taken into consideration, 25 percent (352 billion cubic meters) of water is saved in the world in comparison to an absence of trade[18].

Japan is estimated to be importing 62.7 billion cubic meters of water annually through agricultural products[19]. There is a concern over water shortages in the U.S., Australia and China, countries from which Japan imports farm products. A decrease or discontinuation of food production due to water shortages in these countries may adversely affect food supply in our country. In 2007, Australia had a poor wheat harvest due to droughts, which caused a concern over the shortage of wheat. As a result, international wheat prices rose and import costs and burden to consumers increased in Japan. It is important for Japan to create a food supply system that does not excessively depend on imports. This can be done by improving the food self sufficiency rate and cooperating internationally to improve the efficiency of water use from the viewpoint of food security.

2. Efforts by various countries and regions

(1) Global trend of privatization of water supply projects

As part of the effort to tackle the water shortage, there is an increase in participation by the private sector in the development of water and sewerage infrastructure and in water supply projects in many countries. As of 2004, 80 percent and 35 percent of the total water supply projects in the world were outsourced in part (some process of the project such as design, acquisition, construction or operation) in developed countries and developing countries, respectively[20]. The total investment in water supply projects from 1991 to 2006 is estimated to have reached 530 billion yen[21] (see Figures 3-4-5 and

[17] Seawater desalination projects are expected to continue to increase in the Middle East. (Kaisui no Tansuika ni Kansuru Kentoukai, Japan Atomic Industrial Forum, Inc. (2006), "KAISUI TANSUIKA NO GENJOU TO GENSHIRYOKU RIYOU NO KADAI—SEKAITEKI MIZUBUSOKU NO KAISHOU WO MEZASHITE.")

[18] UN (2006), "World Water Development Report 2."

[19] Ministry of Agriculture, Forestry and Fisheries, Japan (2007), "HEISEI 19 NENDO SHOKURYOU, NOUGYOU, NOUSON NO DOUKOU." Original Source: an estimate by Professor Oki, etc., University of Tokyo.

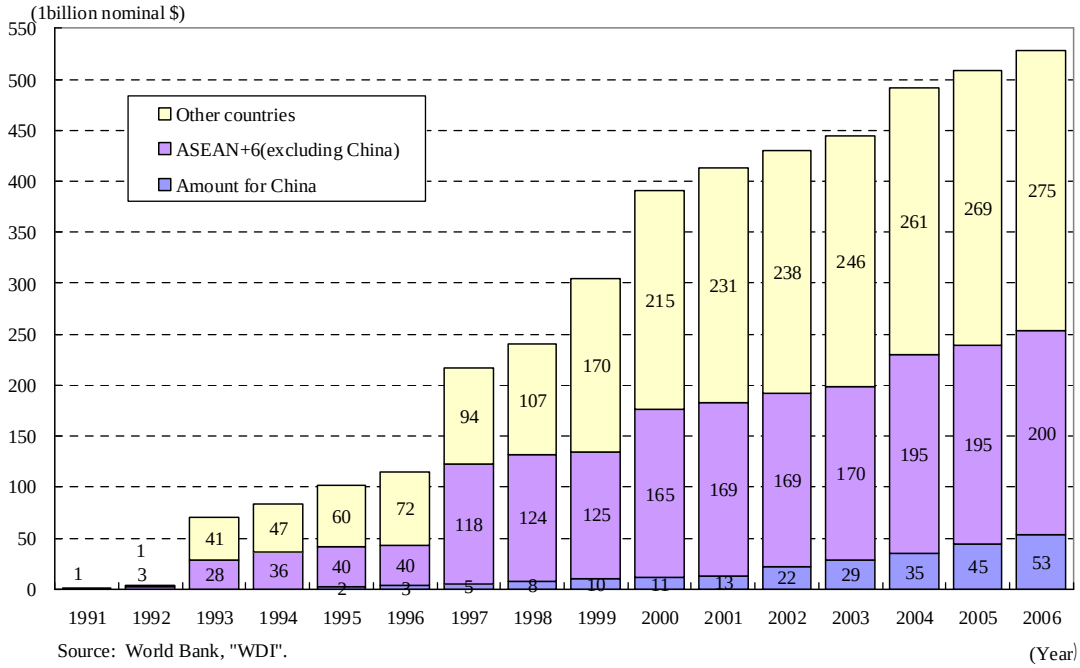
[20] Estache, Antomio; Goicoechea, Ana (2005a), "How widespread were private investment and regulatory reform in infrastructure utilities during 1990s?"

[21] In developing countries, because public funds from the national government are not sufficient for the increasing demand for infrastructure, private funds and loans from the World Bank and other international organizations as well as ODA funds are utilized.

3-4-6). As a result of the increased participation of the private sector, the total population of those who receive water from the private sector is estimated to have increased from 300 million in 1990 to 700 million in 2007, and is likely to further increase to 1.2 billion in 2015[22].

The timing and reason for the privatization of water supply projects differ from one country to another. For example, in France, water supply projects were privatized in the late 19th century, while they were only privatized in the 1980s in the U.K. and some U.S. states. In South America and ASEAN member countries, the private sector participation increased in the 1990s, partly because of the need for improving efficiency and because the World Bank and the IMF required privatization of state-run corporations as a condition to receive funds in the structural adjustment program.

Figure 3-4-5 Cumulative Investment in Water and Sanitation (private participation, cumulative)



Source: World Bank, "WDI".

Table 3-4-6 Contract Type and Responsibilities of Private Sector for Water and Sewerage Projects

Contract type	Content	Facility ownership	Service level decision	Fees decision	Operation	Investment	EPC (Engineering Procurement & Construction)	Operation	Maintenance	Customer management
Concession	Gives the private sector the authority to operate water projects. The entire project, from facility construction to operation, is commissioned to private sector.									
Affermage	Facility developed by the public sector is leased to the private sector on a long-term basis and the operation is commissioned.									
PFI	Facility construction and funding is outsourced to the private sector and the public sector is in charge of operations.									
Operation and maintenance	Comprehensive outsourcing of management and operations as labor alternative for 5 to 10 years									

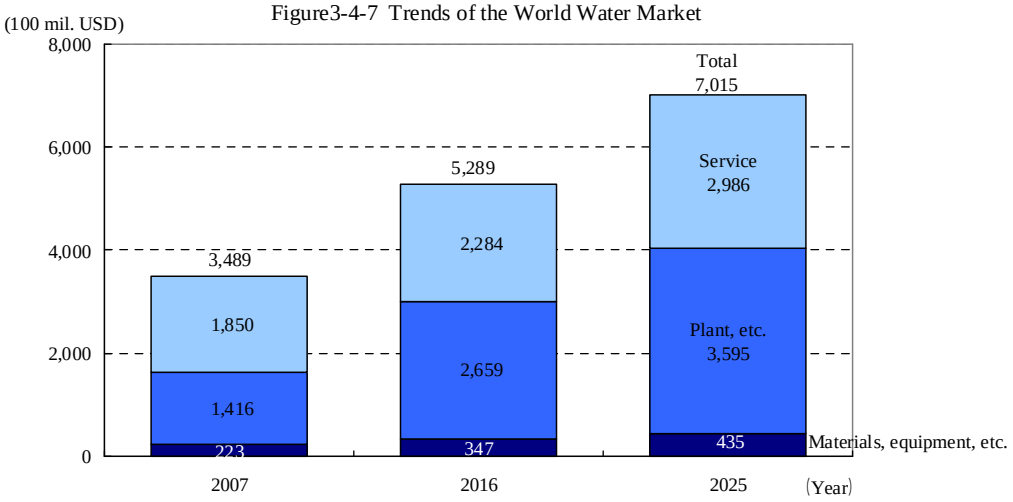
Source: Council of Competitiveness-Nippon, *MIZUSHORI TO MIZUSHIGEN NO YUUKOU KATSUYOU GIJUTSU.*

[22] Pinsent Masons (2007), "Water Yearbook 2007-2008."

(Expansion of world water business market in accordance with privatization)

As the privatization of water supply projects advances, opportunities for water-related businesses have increased. The world water-related market that combines water and sewerage systems and industrial water is estimated to reach 53 trillion yen in 2016, from 35 trillion yen in 2006[23]. If the estimated annual growth continues, the market will reach 80 trillion yen in 2025. If the estimated annual growth rate continues, the market is expected to reach 80 trillion yen. When seawater desalination and recycling of wastewater projects are included in the market, it is expected to reach 100 trillion yen (see Figure 3-4-7).

Figure3-4-7 Trends of the World Water Market



Notes: 1. Material, equipment, etc. is a total of costs for industrial chemicals, water equipment and sewage equipment.
2. Plants is a total of capital investment for water and sewerage.
3. Service is a total for operation of water and sewerage systems.
4. Figures for 2007 and 2016 are those on reference materials.
5. Figures for 2025 are the estimates based on the average annual growth rate between 2007 and 2016.
Source: Global Water Intelligence (2007) Global Water Market 2008.

(Industrial structure of water-related business and world development of global water companies)

Water demand is expected to increase significantly as the water problems become serious at the global level. The entities that manage entire water supply projects are limited to a few global firms. Global water-business companies such as Veolia (France) and Suez (France) manage the entire "water value chain" from water intake to acquisition of material and equipment, water purification, supply to customers and collection of wastewater, as well as acting as maintenance, management and operation service providers[24] (see Figure 3-4-8). Global water-business operators have recently expanded their businesses[25]. The top five operators in the world—Veolia, Suez, SAUR (France), Agbar (Spain) and RWE (Germany) conduct their business in more than 70 countries and, in 2007, supplied water for 300

[23] Global Water Intelligence (2007), "Global Water Market 2008."
[24] Although Veolia and Suez often obtain material and equipment externally, their plants are constructed by their subsidiaries, Sidem and Degremont, respectively. As a result, the two companies have a large share of the plant production market and are increasing their business competitiveness, according to some sources (interview by the Ministry of Economy, Trade and Industry, Japan)
[25] In Japan, Saitama and Hiroshima outsourced its water supply projects to Veolia in 2006.

million people (45 percent of the population receives its water supply from a private entity)[26].

Figure 3-4-8 Water Business Value Chain

The water business value chain is led by water service operation and management bodies (primary contractors and the market is large.)

Ratio of world water-related spending

		100 mil. $	Ratio	
material, equipment, etc.	**Facilities for domestic water**	**434.7**	**12.5%**	32.7%
	Water pipe overhaul	104.6	3.0%	
	Water pipe construction	330.1	9.5%	
	Facilities for domestic sewage	**484.1**	**13.9%**	
	Drainage pipe overhaul	135.5	3.9%	
	Drainage pipe construction	348.6	10.0%	
	Facilities for industrial water	**111.7**	**3.2%**	
	Water facility	34.2	1.0%	
	Sewerage facility	77.5	2.2%	
	Chemicals for industrial water	**111.5**	**3.2%**	
	Chemicals for industrial water	111.5	3.2%	
Plant	**Water treatment plant**	**229.2**	**6.6%**	14.2%
	Wastewater treatment plant	**267.6**	**7.7%**	
Service	**Domestic water service**	**1,058.1**	**30.3%**	53.0%
	Domestic wastewater service	**775.4**	**22.2%**	
	Industrial water service	**16.9**	**0.5%**	
World water market		**3,489.2**	**100.0%**	
	Domestic water	3,249	93.1%	
	Industrial water	240	6.9%	

Sources: Global Water Intelligence (2007), Global Water Market 2008; New Energy and Industrial Technology Development Organization (2008), Mizu Sutoresu Chiiki ni okeru Mizu Bijinesu no Kanousei, Gijutsu Kaihatsu Kadai ni kansur

Example Case

Business development by Veolia and Suez: Global Development after establishing its business foundation in the European market

Veolia Environment is a French firm that provides a variety of infrastructure-related businesses, which mainly consist of water-related services but also include industrial waste treatment, energy supply and traffic services. It provides water supply and treatment services for 110 million people in 59 countries, with 5,000 contracts and 77,840 employees in its water business section. Its water business accounts for 35 percent of its total sales, and at 11 percent, the profit rate of the business segment is high. By country, in 2006, 47 percent of its total sales came from France and 80 percent when Germany and the U.K are combined with it.

Suez's development is similar to that of Veolia. They show that Europe-based global companies can expand their business in emerging countries such as China and the Middle East, while establishing the foundation of their income in Europe[27].

(2) Response of various national governments to water problems

Creation of comprehensive water supply systems from water intake to sewerage systems in

[26] Pinsent Masons (2007), cited above. Although the top five companies accounted for 73 percent of the global market share in 2001, it has dropped to 45 percent as a result of business downsizing of SAUR, Agbar and RWE and increasing local supplies as a result of privatization in developing countries, in spite of the business expansion of Veolia and Suez.

[27] Ministry of Economy, Trade and Industry, Japan. "KAIHATSU KINYUU NI OKERU ARATANA KANOUSEI NI KANSURU CHOUSA HOUKOKUSHO."

addition to improvement of business operation efficiency by the introduction of private-sector initiatives (utilization of the private sector to operate the entire, or large portions of the project) are in progress at municipal or national levels. Examples of such initiatives in Singapore, the Middle East and China are introduced.

(Use of recycled wastewater embedded in city planning in Singapore[28])

Because Singapore is small in size and has little precipitation, it is capable of satisfying only 50 percent (7 million cubic meters) of its annual water demand (14 million cubic meters) domestically through rainfall and other water sources. It has imported or used recycled water to satisfy the rest of the demand. Against this backdrop, efficiently securing and managing water has been a strategic goal for the country. It has worked to create a comprehensive water management system for a sustainable water supply based on water collection in the city zone (Catchment) and renewal of wastewater (NEWater) since the 1980s.

The core of the water strategy in Singapore is the "Singapore Green Plan 2012" formulated in 2006. The Four Tap Strategy, which was formulated in the same year under the plan, are measures to diversify water sources, which include (1) collection of rainwater in the region (main source), (2) import of water from Johore Province in Malaysia, (3) utilization of NEWater, and (4) desalination of seawater.

Utilization of NEWater is the reuse of wastewater after treating it in a sophisticated manner[29]. Use of NEWater began in February 2003 and daily consumption of NEWater was 18,000 cubic meters as of 2006 (5 percent of daily water demand in Singapore). Although it is still a small portion, the national government aims to increase it to 45,000 cubic meters (15 percent).

The Singaporean government aims to supply 25 percent of the water demand with such new water sources as NEWater and desalinated seawater[30] by 2012. Cities with insufficient water sources can learn a lot from the experience of Singapore which combined water supply planning with city planning[31]. Singapore has actually launched this model in Chennai, India.

(Prevalence of sea water desalination in the Middle East)

In the Middle East, with an absolute shortage in water storage due to scarce rainfall and groundwater, excessive water pumping is leading to the depletion of the groundwater (see Figure 3-4-9).

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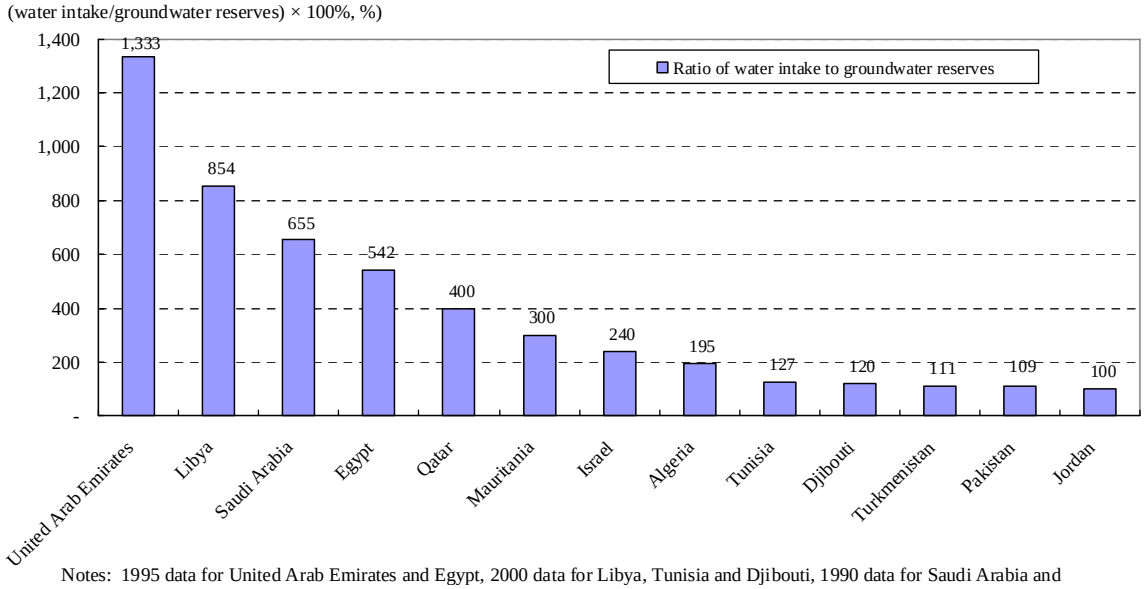
[28] World Bank (2006a), "Dealing with Water Scarcity in Singapore: Institutions, Strategies, and Enforcement."

[29] Test operations of wastewater treatment were launched in 1998 and the expert committee that conducted the survey on the use of NEWater for two years announced that it safely satisfies the standards of drinking water quality of the U.S. and the World health Organization (WHO). World Bank (2006a) cited above.

[30] The Singaporean government calls the new water sources "water from non-conventional sources." World Bank (2006a) cited above.

[31] Japan has contributed significantly to NEWater planning. Nitto Denko Corp. with experience in RO filters provided its RO filter technology to a number of NEWater plants. Together with Mitsubishi Rayon Engineering Co., Ltd. who also has excellent RO filter technology for next-generation NEWater, and the PUB (Singapore's national water agency, Nitto Denko Corp. developed an efficient wastewater recycling system and is working to create a technically and economically sustainable system.

Figure 3-4-9 Depletion of Water in the Middle East



Notes: 1995 data for United Arab Emirates and Egypt, 2000 data for Libya, Tunisia and Djibouti, 1990 data for Saudi Arabia and 1994 data for Qatar and Turkmenistan,
Source: World Resource Institute, "Earth Trends".

Seawater desalination projects[32] are carried out aggressively to secure water based on the high per capita GDP of over 10,000 dollars. In fact, the Middle East accounts for nearly 50 percent of the world's seawater desalination market[33].

Desalination is carried out with an evaporation technique in which seawater is evaporated to extract fresh water and a reverse osmosis method in which freshwater is created via a reverse osmosis filter by applying pressure to seawater.

The evaporation technique was formerly used for seawater desalination as the equipment was installed along with boilers at power generation stations. However, energy consumption for the reverse osmosis desalination method is low at 5 to 7 kW/m^3 in, compared to 10 to 15 kW/m^3 for the evaporation technique. As a result, the reverse osmosis method has become the method of choice at large plants because of energy efficiency. The reverse osmosis method exceeded the evaporation method in accumulated volume in 1999 and the former accounted for 51 percent in 2003[34].

As the volume of desalinated water production per plant is increasing due to water shortages, the reverse osmosis method is expected to be more widely used[35].

Like Singapore, the Middle East has begun to link development of infrastructure with city planning[36].

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[32] According to an FAO survey on irrigation in 11 countries and 23 regions in Asia, Africa and South America, the cost for seawater desalination has dropped by nine-tenths over the last 20 years, at about 50 yen (exchange rate of 1USD to 100 yen) per cubic meter. However, it is more than twice as expensive as irrigation water intake from rivers and groundwater, and thus it is still costly for agricultural water. Future technical advancements may enable the use of the water for agricultural production near cities along the coastline. Technological advances may help expand the food supply in addition to the water supply.

[33] Kaisui no Tansuika ni Kansuru Kentoukai, Japan Atomic Industrial Forum, Inc. (2006), cited above.

[34] Council of Competitiveness-Nippon (2007), "MIZUSHORI TO MIZUSHIGEN NO YUUKOU KATSUYOU GIJUTSU"

[35] Council of Competitiveness-Nippon (2007), cited above.

[36] For example, in Abu Dhabi in the United Arab Emirates, the Urban Development Council has formulated the Plan Abu Dhabi 2030: Urban Structure Framework Plan. Its objective is to develop Abu

(Promotion of water transfer plan in China)

China is tackling its water problems in a comprehensive manner, combining river development, city cyclical use and water management.

In addition to the South-North Water Transfer Project of supplying water from the Yangtze River to Beijing, Tianjin and other cities with relatively scarce water resources via three eastern, western and central routes (total budget of 500 billion yuan[37] to be completed in 2050), China promotes a special plan for seawater utilization that consists of (1) a cyclic use policy through water saving and recycling, (2) seawater desalination and (3) direct use. It aims to reduce water usage by 30 percent per unit of industrial production value in the next five years by 2010 (see Table 3-4-10).

Table 3-4-10 China's Northeastern Region (2006)

Nominal GDP	Population	Arable land	Water resources
41.2%	28.3%	32.3%	**8.2%**

Notes: 1. Figures show the ratio of provinces and cities in northeastern China (Beijing, Tianjin, Hebei Province, Liaoning province, Jilin Province, Heilongjiang province, Jiangsu Province and Shandong Province) to the total national figures
2. Arable land data in 1996.
Source: China Statistical Information Network, *Chinese Annual Statistics 2007*.

It also promotes the introduction of private-sector initiatives which include foreign capital. For example, private sector initiatives with foreign capital accounted for 2 percent of added value in water-supply business in 2000, and this increased by more than six times to 13 percent in 2006[38].

[Column 33] Introduction of Water Rights Trading Programs in the U.S. and Australia

Although promotion of water production, water saving and recycling is important for the fundamental solution of water shortages, the U.S. and Australia introduced the water right trading program as an institutional system to support the solution. In California, U.S., the California drought water bank (hereinafter referred to as water bank) program was launched in 1991 based on its experience of water shortages caused by droughts.

In Australia[39], where exportation of agricultural products is an important economic activity, and thus a stable water supply that affects crop situations is a national concern, water right trading began in 1994.

3. Japan's effort to overcome global water-related problems

Dhabi as one of the most attractive international cities and it aims to develop the necessary infrastructure, including water systems, with an assumption that its population reaches three million by 2030.

[37] About 7.5 trillion yen when the exchange rate is 15 yen to one yuan.

[38] China Statistical Information Network. "Chinese Annual Statistics." Japanese corporations are entering the market. Marubeni Corp., for example, was commissioned a waterworks project in Chengdu in Sichuan Province.

[39] In Australia, national plans such as the national water charter (June 2004), Australian water resources fund (July 2004) and the National Water Security Plan (January 2005) have been formulated.

Japan has developed industrial technologies for water usage and treatment and water-saving, founded on environmentally-friendly cyclic water management technologies and society. This is based on its experience of tackling pollution in the 1970s and sharp increases in the population and water demand during the rapid economic growth period through, for example, water-saving efforts. Spreading the technologies and social systems Japan has developed to countries that face water issues will help solve their problems.

(1) Japan's water problems and water-related business

(Japan's experience of water management)

Japan's water and sewerage projects had long been carried out by municipalities as public works projects.

Because water and sewerage projects require enormous investments including, but not limited to, water purification facilities and pipe work throughout the city, municipalities capable of the funding under the most advantageous conditions used to control the projects with the partial participation of the private sector. This combination was economically reasonable. In fact, the water-supply system coverage rate reached almost 100 percent. The occurrence of water-related diarrhea almost disappeared by 1975 and the sewerage system coverage rate exceeded 70 percent[40].

However, in recent years, water facilities have deteriorated[41] and the demand for renovation and renewal is expected to grow significantly, whereas now municipalities suffer under strict financial conditions. There is an estimate that the demand for renewal will exceed the amount of investment in Japan as early as 2020 if investment continues to decrease by one percent on a year-to-year basis[42]. Thus, systems were revised to utilize the vitality of the private sector. For example, the PFI law[43] in 1999 and the revision of the water supply law in 2002 enabled the transfer of technical operations of water systems, including operation and management of water purification facilities, to a third party including private entities, which are responsible in relation to the water supply law. However, of the projects that were commissioned to a third party, only 93 projects were commissioned to private entities in 2007[44], which is still a very small portion as there are 1,700 water-system operators. It is said that in Japan there will never be a private water-supply service provider that controls the whole value chain to take the place of municipalities[45].

(Entry of Japanese water-related business operators into overseas market)

Japanese water-related business operators that face domestic market shrinkage due to the declining population and downsizing of public works projects, or manufacturers of mainly material and

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[40] ADB (2007), "Asia Water Development Outlook 2007."

[41] The deterioration of water-supply facilities progressed, as the depreciation rate of tangible fixed assets of the projects reaching 34.6 percent in 2005. (Ministry of Health, Labor and Welfare, Japan (2007), materials for SUIDOU BIJON FOROUAPPU KENTOKAI. Original source: Water Statistics.)

[42] Ministry of Health, Labor and Welfare, Japan (2007), cited above.

[43] PFI is the abbreviation of Private Finance Initiative. The formal name of the law is “The law concerning promotion of development of public facilities by utilizing private funds, etc.”

[44] Nihon Suido Kogyo Dantai Rengokai (2008), "SUIDANRE NO KAIGAI ENO TORIKUMI."

[45] Interview with private firms conducted by the Ministry of Economy, Trade and Industry, Japan.

equipment, and trading firms, are entering overseas markets aggressively. They are participating in projects such as seawater desalination in the Middle East and wastewater treatment projects in China, etc. Japanese firms have advantages especially in element technologies, with five Japanese companies holding 70 percent market share of the reverse osmosis filter[46].

However, the reverse osmosis filter, etc. Japanese firms are strong at accounts for only five percent of the total revenue of water-supply projects. Because Japanese companies have little experience in providing management and operation services for such projects in their entirety[47], they lag behind their foreign competitors, failing to secure sufficient revenue and market share outside Japan. As a result, their advanced element technologies and water-saving systems are not fully utilized to solve water problems overseas.

Although Japan provided the largest amount of overseas development aid in water and sanitation categories compared to all the countries in the world, with a total of 3.69 billion dollars from 2003 to 2005 (which accounts for 37 percent of the world total)[48], the funds were mainly spent on transient construction work and human resource development, and little was spent on the management or operation of water-supply systems. Some point out that Japan has not built a strong relationship with recipient countries through international contributions[49].

(2) True strength of Japan: Experience of water saving during rapid economic growth period ahead of Asian experiences

(Technological and knowledge superiority Japan gained from its experience of pollution and water-saving and lack of abundant water)

The per capita water volume in Japan is ranked 91st among 156 countries in the world. The per capita annual precipitation is about one-third of the world average and the per capita annual volume of water resources is about 50 percent of the average. This shows that Japan has never been rich in water[50].

On the other hand, Japan improved water-saving technologies and technologies to tackle water pollution in response to increased demand for industrial water and water environment pollution in the 1970s. Through its efforts, Japan realized efficient water use, sustainable economic development and consumption growth even with limited water resources. This promoted technological advancement.

In fact, Japan has one of the highest per capita GDP in spite of water scarcity compared to international standards (see Figures 3-4-11 and 3-4-12). This was made possible as a result of

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[46] Council on Competitiveness-Nippon. "MIZUSHORI TO MIZUSHIGEN NO YUUKOU KATSUYOU GIJUTSU."

[47] Overseas water projects conducted by Japanese firms include Manila Water (Philippines) by Mitsubishi Corp. and Thailand Tap Water (Thailand) by Mitsui & Co., Ltd. However, there are not very many projects. (Japan Foreign Trade Council, Inc. "NIHON BOUEKIKAI GEPPO, February 2008.)

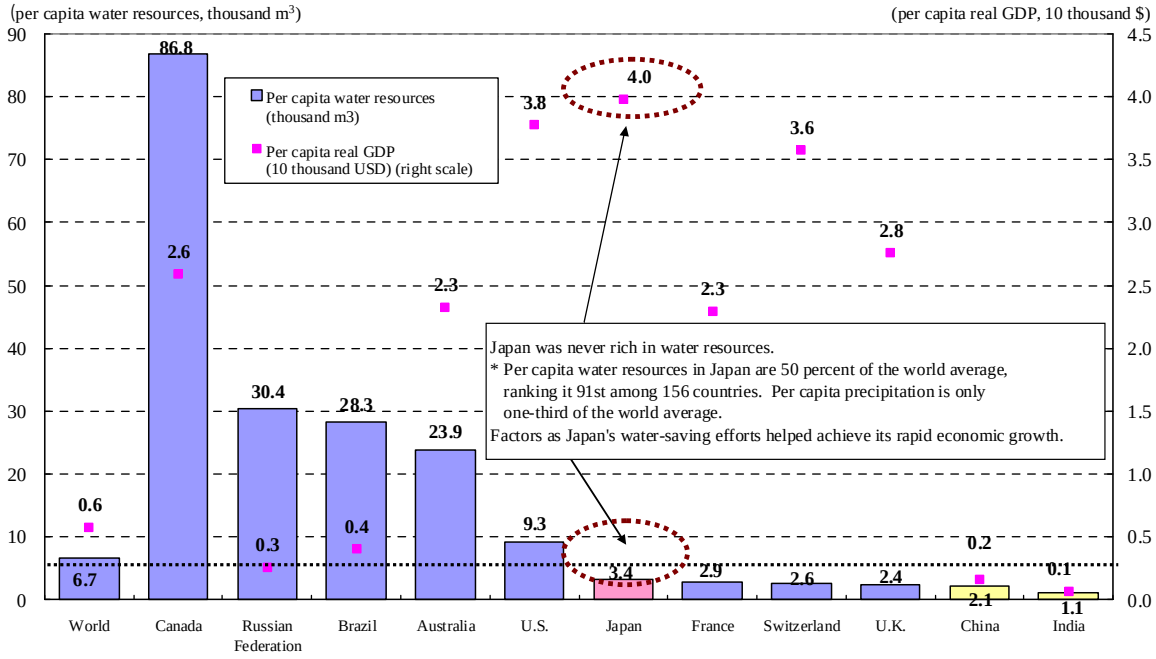
[48] OECD Development Assistance Committee (DAC) website

[49] Council on Competitiveness-Nippon (2007), "MIZUSHORI TO MIZUSHIGEN NO YUUKOU KATSUYOU GIJUTSU." World Resource Institute. "Earth Trends."

[50] Ministry of Land, Infrastructure and Transport, Japan, "HEISEI 19NENBAN NIHON NO SUISHIGEN."

improvements in the recycling rate of industrial wastewater (about 80 percent[51]) and a reduction of revenue loss caused by water leakage, etc[52] (hereinafter referred to as non revenue water rate). For example, the non revenue water rate is 34 percent on average in Asia, whereas it is low in Japan at 4 percent in Tokyo and 7 percent in Osaka, indicating that Japan has relatively efficient water system operations[53]. Water-related problems in both quantity and quality are becoming more and more serious in Asian countries, including China. China is like Japan in the 1970s when it faced the same problems as a result of pollution and economic growth. Japan demonstrated that the economy can grow with a limited amount of water by overcoming difficulties through water-saving efforts and industrial technology. Its experience serves as a role model for China and India who are now facing water problems. It is important for Japan to contribute to solving global water problems by utilizing its wisdom.

Figure 3-4-11 Per Capita Water Resources and Per Capita GDP)



Source: World Resource Institute website; World Bank, WDI.

[51] Ministry of Economy, Industry and Trade, Japan, "KOUGYOU TOUKEI."

[52] For example, Tokyo cut the loss rate from 20 percent to 10 percent in the last 50 years, which is equivalent to the water volume of a city with a population of 2.5 million. (Ministry of Health, Labor and Welfare (2007) cited above.) Original source: SUIDOU TOUKEI OYOBI SUIDOU BINRAN, document of the presentation delivered by Tokyo Governor Ishihara at the Summit Conference of Major Cities of the World in New York in May 2007.

[53] ADB (2003), "Water in Asian Cities, Utilities' Performance and Civil Society Views." (data as of 2001.) The paper compares the non revenue loss rate of the following 18 cities: Osaka, Manila, Colombo, Delhi, Jakarta, Kuala Lumpur, Dhaka, Ho Chi Minh, Kathmandu, Ulan Bator, Kalach, Vientiane, Tashkent, Phnom Penh, Hong Kong, Seoul, Chengdu, and Shanghai.

Table 3-4-12 Water Production by Country

productivity for water intake (real US$/$m^3$)

Country	All industries	Agriculture	Industry	Service
U.K.	157.9	48.3	49.2	461.4
Japan	53.0	1.5	89.9	182.4
Germany	40.9	2.2	15.9	208.5
France	34.2	8.8	9.4	144.6
Republic of Korea	30.6	2.4	66.7	42.2
U.S.	20.9	0.5	9.6	116.2
Australia	17.9	0.6	43.2	77.7
World	8.6	0.4	11.4	54.8
China	2.2	0.4	4.0	13.8
India	0.8	0.2	3.4	4.7
Japan / China	23.6	3.5	22.2	13.2
Japan / India	68.2	8.9	26.1	39.0

Note: Data of 2002.
Source: World Bank, *WDI Data Base* .

(Markets where Japanese water supply systems should be implemented)

In order for Japan to introduce its technologies and water management systems and help support emerging and developing countries that face water problems it is important to provide products and services as a water-supply system that includes not only equipment but also plant construction, maintenance and operation facilities.

In other words, in the creation of a water value chain that has Japan's environmental strength and training it is important for the entity that manages the chain allow Japan to contribute to solving global water-related problems by utilizing its technologies.

To make it more specific, Japan needs to suggest the introduction of a water-saving environmentally-friendly water management system by comprehensively managing water intake and drainage of industrial parks[54], etc. in foreign countries.

The demand for the Japanese-style water management system is likely to be high especially in industrialized areas without sufficient water resources such as rainwater and groundwater in comparison to their high per capita GDP, which include the Middle East (Saudi Arabia and Abu Dhabi in the United Arab Emirates), some parts of Henan Province in China, Tamil Nadu Province in India and Singapore. These areas need to create unconventional water resources using technologies such as seawater desalination and wastewater reclamation. They need to produce water.

In this field, global water-related companies have yet to establish a firm foundation and thus Japanese companies, with the strength of their technology to systemize efficient energy use and element technologies that support production of materials, have a great chance to enter the market.

However, GE (U.S.), Siemens (Germany) and Doosan (Republic of Korea)[55] have increased their

[54] According to JBIC's "CHUUGOKU NO TOUSHI KANKYOU REPOTO", there are several thousand industrial parks established by the national government in China and thus it is a high potential market for Japanese firms.

[55] GE acquired filter companies such as Osmonics, Ionics and Xenon one after another, considering seawater desalination and wastewater recycling as its major markets and has implemented strategies to dominate the world with its filter technologies. Siemens purchased US Filter in 2004 and four other

presence in the water business market, taking the place global water-related companies are trying to fill by entering the water production market aggressively. Because they have rapidly increased their strength, Japanese companies cannot secure their future so easily. In the world trade of element technology (RO filter, etc.) an area Japan is strong in, for example, German and South Korean companies have increased their presence mainly in the Chinese market as well as in India and the United States, which accounts for 40 percent of its global market (Table 3-4-13). As global competition intensifies, Japanese companies urgently need to develop their own business model to establish a Japanese business model and have a large lead in technology through research and development efforts.

Figure 3-4-13 Global Market Share of Filter and Centrifugal Pump in 2000 and 2006: China, India and US

Filter: World Trade Market Share

2000

	Canada	Japan	U.S.	China	Germany	Republic of Korea
Chinese market	3.5%	12.9%	18.8%	0.6%	5.7%	3.9%
Indian market	0.2%	15.4%	35.9%	0.8%	8.0%	8.5%
U.S. market	63.5%	3.1%	—	0.6%	2.6%	2.5%
Totals for the 3 markets	46.6%	5.9%	5.5%	0.6%	3.5%	3.0%

2006

	Canada	Japan	U.S.	China	Germany	Republic of Korea
Chinese market	4.6%	11.2%	14.1%	1.4%	12.5%	6.2%
Indian market	0.2%	0.3%	5.9%	83.8%	1.6%	0.6%
U.S. market	42.2%	6.4%	—	9.0%	5.1%	3.1%
Totals for the 3 markets	28.7%	6.6%	3.7%	17.9%	6.1%	3.4%

Notes: Exports embedded in plants, etc. are not counted.
Source: UN, Comtrade .

Centrifugal Pump: Export Share by Major Market

2000

	Germany	Japan	China	Mexico	U.S.	Republic of Korea
Chinese market	13.4%	25.0%	—	0.0%	17.7%	1.9%
Indian market	12.1%	18.6%	0.0%	0.0%	20.9%	0.0%
U.S. market	15.6%	13.7%	7.3%	3.8%	—	0.2%
Totals for the 3 markets	15.2%	15.3%	6.1%	3.2%	2.9%	0.4%

2006

	Germany	Japan	China	Mexico	U.S.	Republic of Korea
Chinese market	18.1%	23.5%	—	0.0%	12.2%	3.6%
Indian market	15.6%	5.2%	11.3%	0.0%	9.5%	0.4%
U.S. market	8.1%	9.2%	21.8%	13.0%	—	0.2%
Totals for the 3 markets	11.9%	13.9%	14.4%	7.9%	4.7%	1.4%

Notes: Exports embedded in plants, etc. are not counted.
Source: UN, Comtrade .

(For the realization of aggressive entry of Japan's water-related industry into foreign markets)

To acquire a share in the market, it is important to (1) propose and develop a water cyclic system of extensive water cycles and reuse of wastewater for areas that suffer serious water shortages and water pollution, (2) make excellent use of industrial water as international standards for water environment and (3) develop innovative filter technologies by combining the micro filter and the reverse osmosis filter, for example.

To support this, the government should take such measures as (1) removal of takeover risk in

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activated carbon and other related companies in 2007. It recently entered the Chinese and Singaporean markets. (Council on Competitiveness-Nippon (2007) cited above.)

investment destinations by using EPAs and investment agreements that include the investment chapter and (2) lowering the exchange risk and trade risk by applying investment insurance[56] by NEXI. Because a substantial amount of investment is required for water projects, market measures for exchange risk hedges are also expected to be established[57].

[56] Investment insurance means insurance for compensation of the loss of rights as shareholders and creditors for investment (funding and acquisition of rights, etc.) made by firms in foreign countries. Investment insurance is provided by the Overseas Private Insurance Corporation in the U.S. and the Export Credits Guarantee Department in the U.K., as well as by governmental bodies in Germany and France. (Ministry of Economy, Trade and Industry, Japan, "KAIHATSU KINYUU NI OKERU ARATANA KANOUSEI NI KANSURU CHOUSA HOUKOKUSHO.")

[57] Financially, utilization of Japan's personal financial assets which reach 1,500 trillion yen is desired. However, such funds are not invested in infrastructure at home or overseas, partly because of the absence of an infrastructure fund in Japan. The possibility of actively opening of the Japanese infrastructure market to the private sector needs to be examined in order to promote investment in infrastructure.