

Japan's Experience and Technology regarding Water Resources Management

1. Introduction - To realize a Sustainable Society -

The importance of proceeding with Integrated Water Resource Management (IWRM) is growing in view of the expected increase of water-related risks due to climate change, global population growth, urbanization and etc.

The key is to realize the sustainable societies. A comprehensive approach in view of both economy and environment is the key for the sustainable society, and needs appropriate investments to improve infrastructure management (building, operation and maintenance, and updating/renewing) and capacity building with governance and finance support. The approach for sustainable society is based on Water, Food, and Energy NEXUS. Water Resource is the core of the NEXUS.

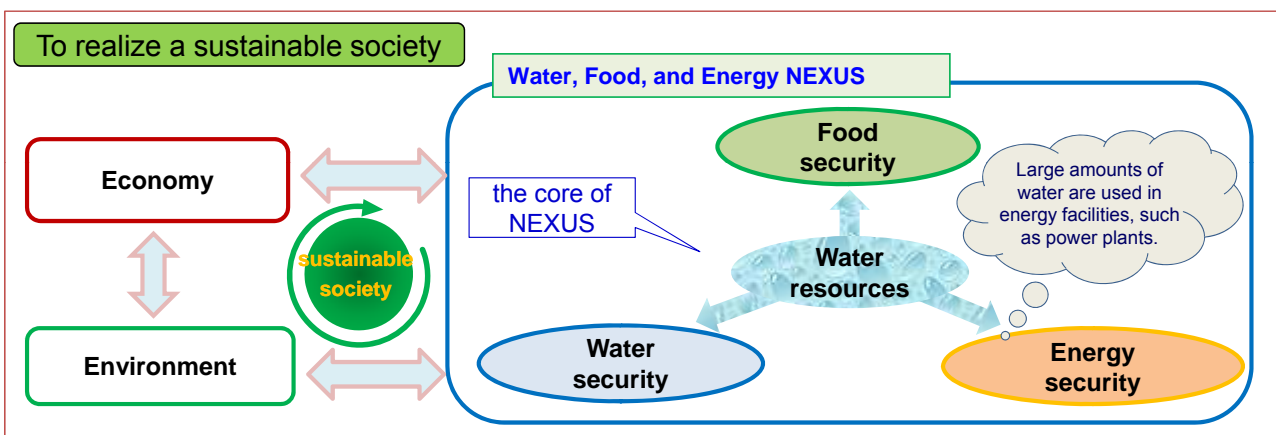


Fig. 1.1 Efforts need to realize a sustainable society

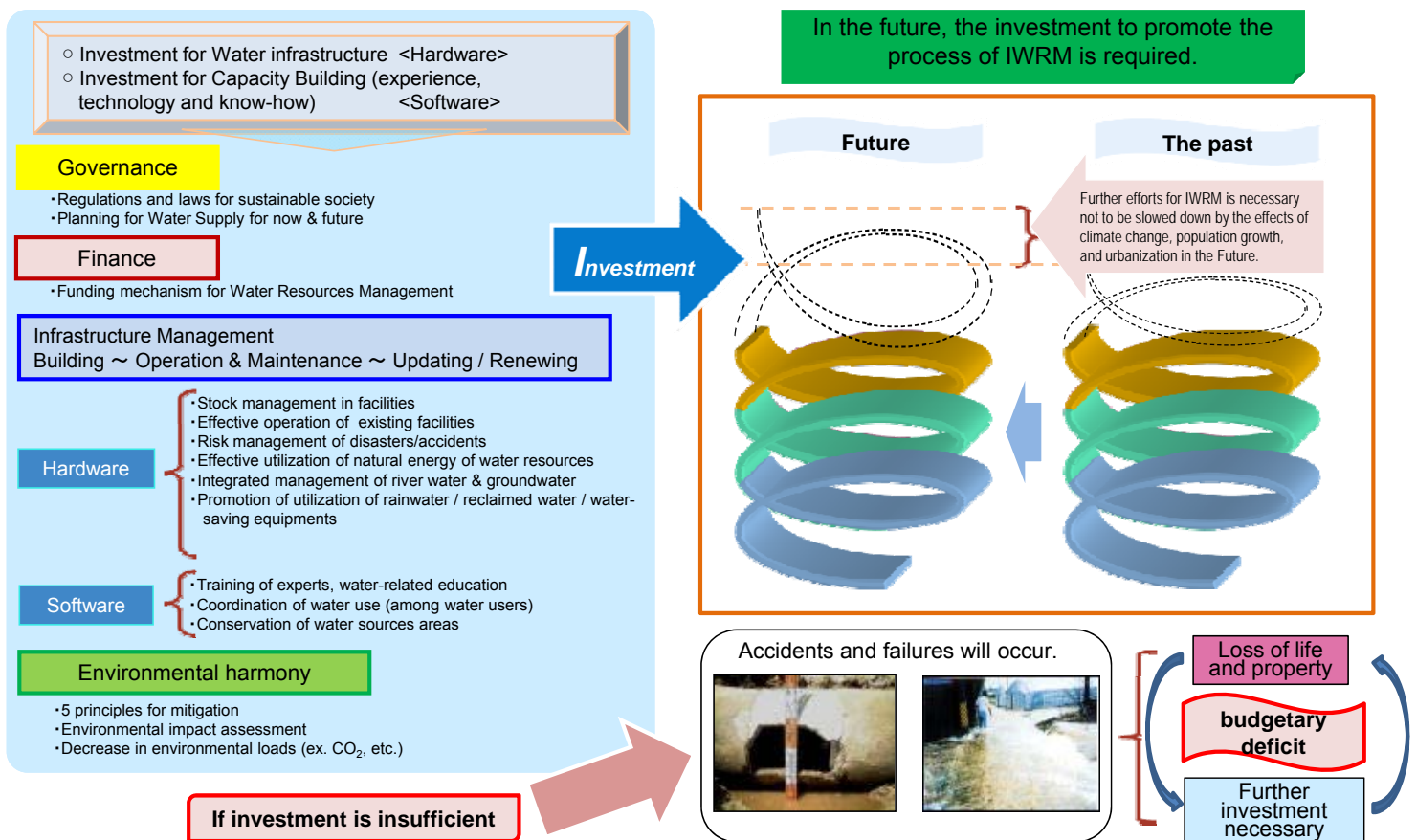


Fig. 1.2 Efforts to solve worldwide water resources problems

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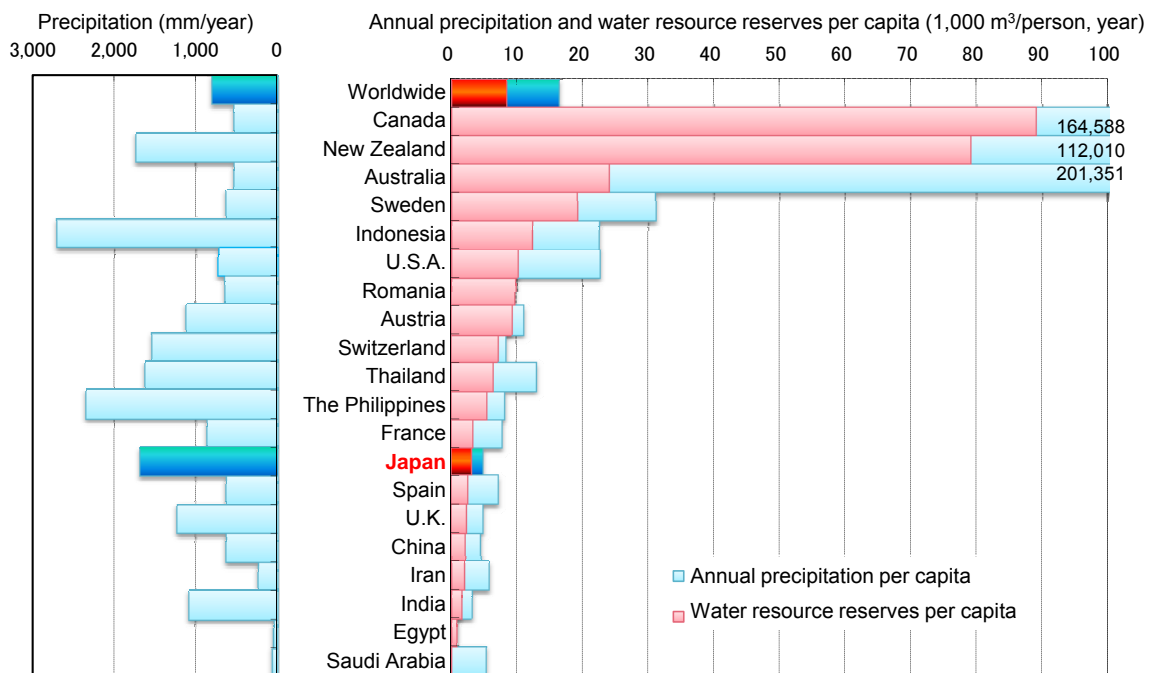


2. Water Resources in Japan

Japan's average annual precipitation is 1,690mm which is about twice the world average (810mm). On the other hand, Japan's potential water resources per capita is 3,200mm³ per year, less than half the world average, which is about 8,400mm³. Recently, the gap in rainfall between years of low precipitation and high precipitation has been expanding and there is a tendency for potential water resources to decrease in years of drought.

Because of the location in the Asia Monsoon zone, rainfall is concentrated in rainy and typhoon seasons, so that a significant portion of potential water resources is discharged into the sea without being used. In addition, Japan has a mountainous topography with steep slopes and its rivers are short and flow rapidly out to sea.

There are such difficulties to store water efficiently in Japan that various and historical measures have been taken to use water effectively.



Prepared by Water Resources Department, Water and Disaster Management Bureau, Ministry of Land, Infrastructure, Transport and Tourism

Fig. 2.1 Annual Precipitation and Annual Precipitation & Water Resources Per Capita

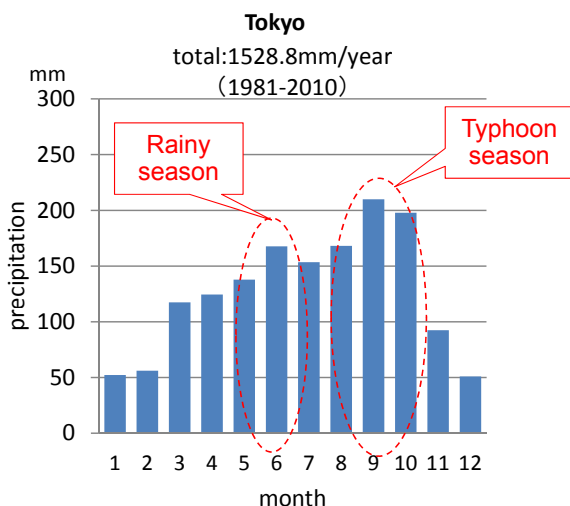


Fig. 2.2 Features of Japanese rainfall pattern (for Tokyo)

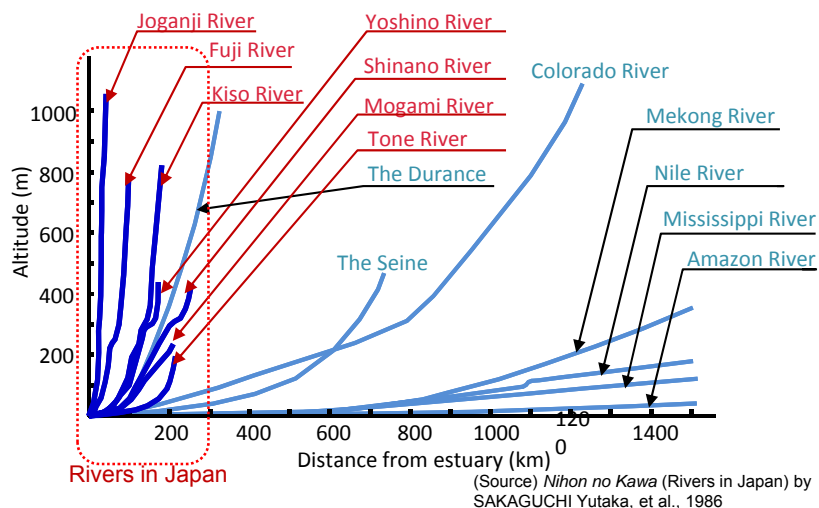


Fig. 2.3 Features of Japanese Rivers



3. History of Water Resources in Japan

Water Use for Stable Food Production — from Ancient Times to the 17th Century

Water use in Japan has developed over the centuries to ensure a food security mainly by rice cropping. The introduction of paddy agriculture also meant the beginning of the construction of irrigation ponds. Small and medium-size rivers began to be used for irrigation as the manorial system expanded and rice production increased under the management of feudal lords. Further advances were made in irrigation and flood control in the 17th century, as paddy fields were cultivated on the alluvial plains of the Kanto area. Flood prevention works were undertaken along large rivers, including the Tone River. Channels for domestic water such as the Kanda Waterworks and Tamagawa Waterworks were later built to meet demand for water in Tokyo and other large cities.

Building the Foundation for a Modern Economy — from 19th through mid-20th Century

The beginning of modern foreign trade and internationalization in the 19th century spurred the development of new industries in Japan. The rise of heavy industry, including chemical industries, triggered a rapid rise in demand for industrial water. Also, modern water supply and sewerage systems were installed to cope with population growth in urban areas and prevent epidemics of cholera and plague in urban areas such as Yokohama. Hydroelectric power generation projects were promoted in the course of urbanization and industrialization.



Fig. 3.1 Japan's first modern waterworks pipe from Yokohama water supply started in 1887



Fig. 3.2 Japan's first modern sewerage built in Yokohama 1881-1883

Important Role for Water in Socioeconomic Development - from Latter Part of 20th Century until Now

In response to the steady rise in demand for domestic water, industrial water and agricultural water triggered by rapid economic development and population growth, thus Japan embarked on comprehensive development of water resources. This included building multipurpose dams to secure stable water supplies. In the 1960's, a legislation for water resources development was enacted, including dam construction, provision of water for each purpose and prevention of ground subsidence. From the 1970s on, another legislation on development in water resources areas, water quality and environmental conservation, were enacted.

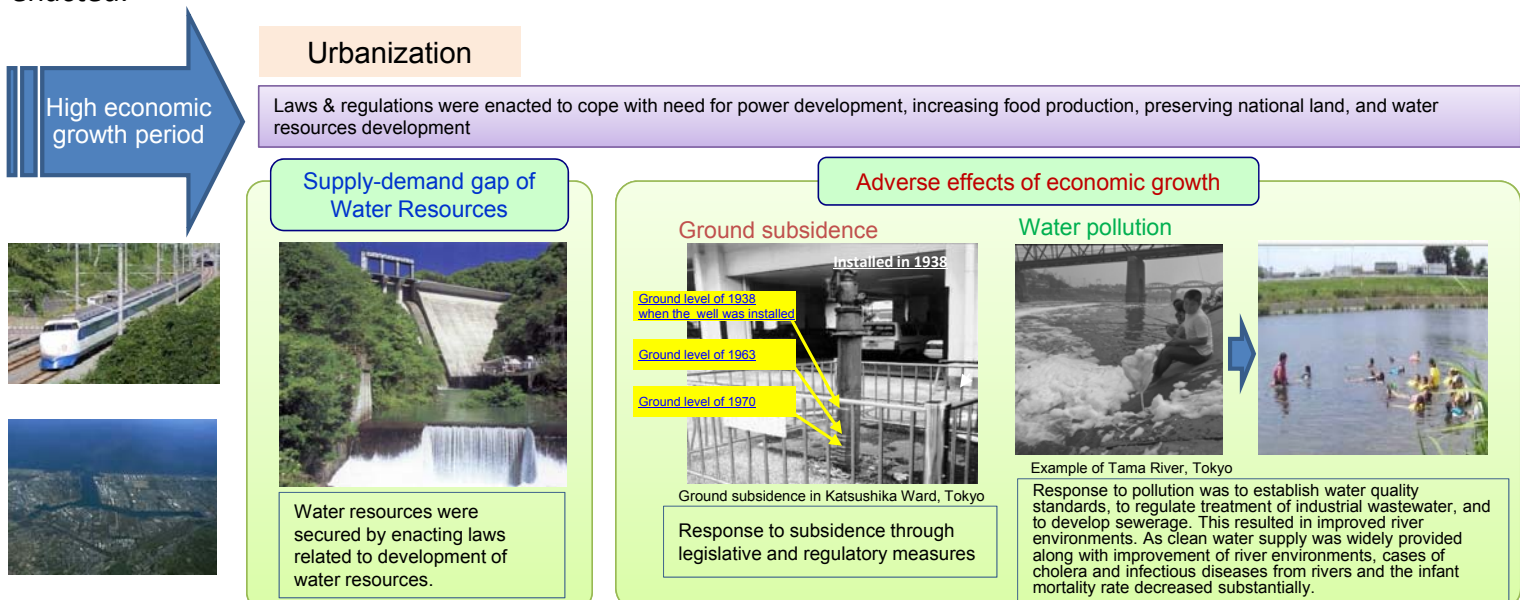


Fig. 3.3 Water resources development in response to adverse effects of economic growth

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4. Water Resources Development in Japan (Response to Urbanization)

Water demand in Japan dramatically increased as a result of remarkable industrial development. The rapid increase in the urban population and the improving living standards during the high economic growth period that started in the late 1950s. It was against this background that the Water Resources Development Promotion Law was enacted in 1961. It designates river systems in need of broad-based water supply measures with due consideration given to industrial development and population growth in urban areas. Along with this, a basic plan for water resources development ("Full Plan") was formulated as an integrated water supply plan for the designated river systems.

Water Resources Development Promotion Law

Enacted in 1961 to cope with water shortage caused by urbanization

Water Resources Development Public Corporation* Law

Enacted in 1961 to implement the Water Resources Development Promotion Law.

* Currently, this is the Japan Water Agency, which acts also as secretary of NARBO.

Basic Plan for Water Resources Development

This plan deals with water supply/demand. Based on the Water Resources Development Promotion Law, this is the basic plan for integrated water resources development and rationalization in water utilization (for seven designated river systems).

• The plan is modified as required according to changes in socioeconomic conditions.

[Contents]

- (1) Water demand forecasts by water use and supply target
- (2) Basic points for construction of facilities required to achieve supply targets
- (3) Important points for integrated water resources development and rationalization of water use

River systems in need of comprehensive development and rational use of resources to ensure the supply of water to regions where it is required for industrial development to meet the needs of urban populations and where extensive water supply measures are urgently needed.

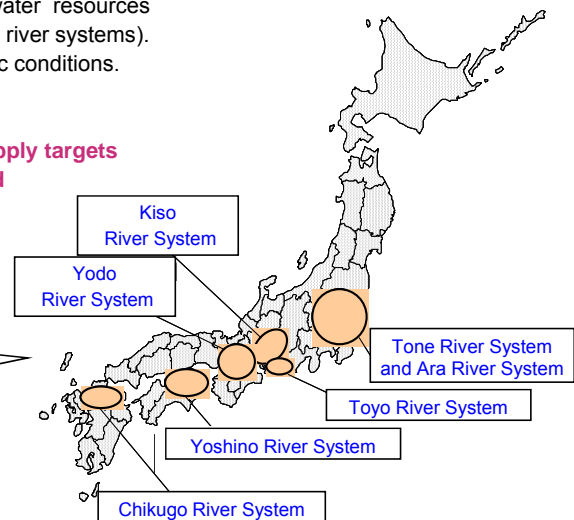


Fig. 4.1 Water Resources Development Systems

Procedures used to formulate the Basic Plan

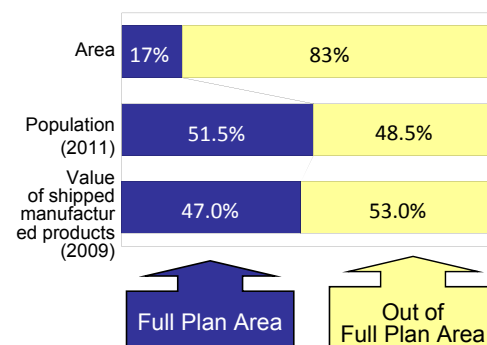
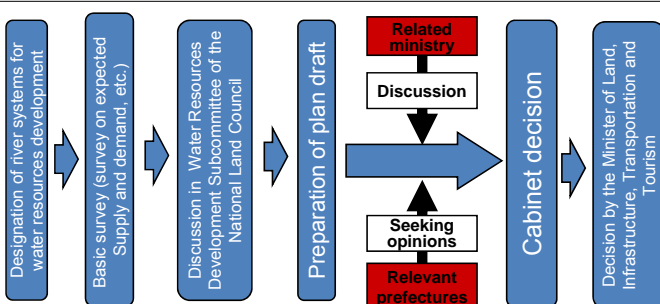


Fig. 4.2 Current State of Water Resources Development

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5. Future Challenges and Measures on Water Resources

Until recently Japan's population has steadily increased along with rising nominal and per-capita GDP - until the mid-1980s. However, now that population has started to decrease and is expected to continue to decrease. It is important to maintain the quality of life without reducing the scale of the economy. The past water resources policy was based on the need to secure a stable supply of water. The country has built water supply facilities such as dams, intakes, and canals to meet increasing water demand. Nowadays, a stable water supply is possible except for a few areas. The basic need has shifted from building facilities to their management.

We are also facing new challenges such as climate change and problems related to aging facilities that could affect supply capabilities. Therefore, Japan's aim is to provide management that will meet demand even when faced with problems related to climate change, aging facilities and the need to respond to natural disasters. In this situation, the challenge will be to develop highly integrated water resources management.

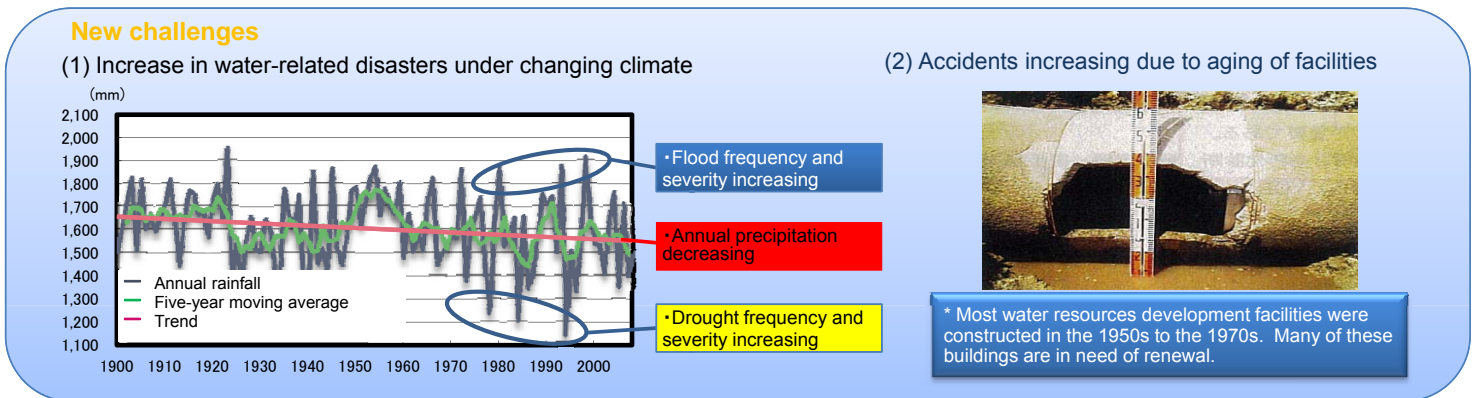


Fig. 5.1 Future challenges

We are implementing IWRM for moving toward integrated management of the quantity and quality of water used, the conservation and utilization of groundwater, and the conservation of river basins. This effort is designed for more effective water utilization, efficient operation and maintenance, updating, and renewal of facilities at the river basin level in a comprehensive as unified manners. These challenges are outlined below.

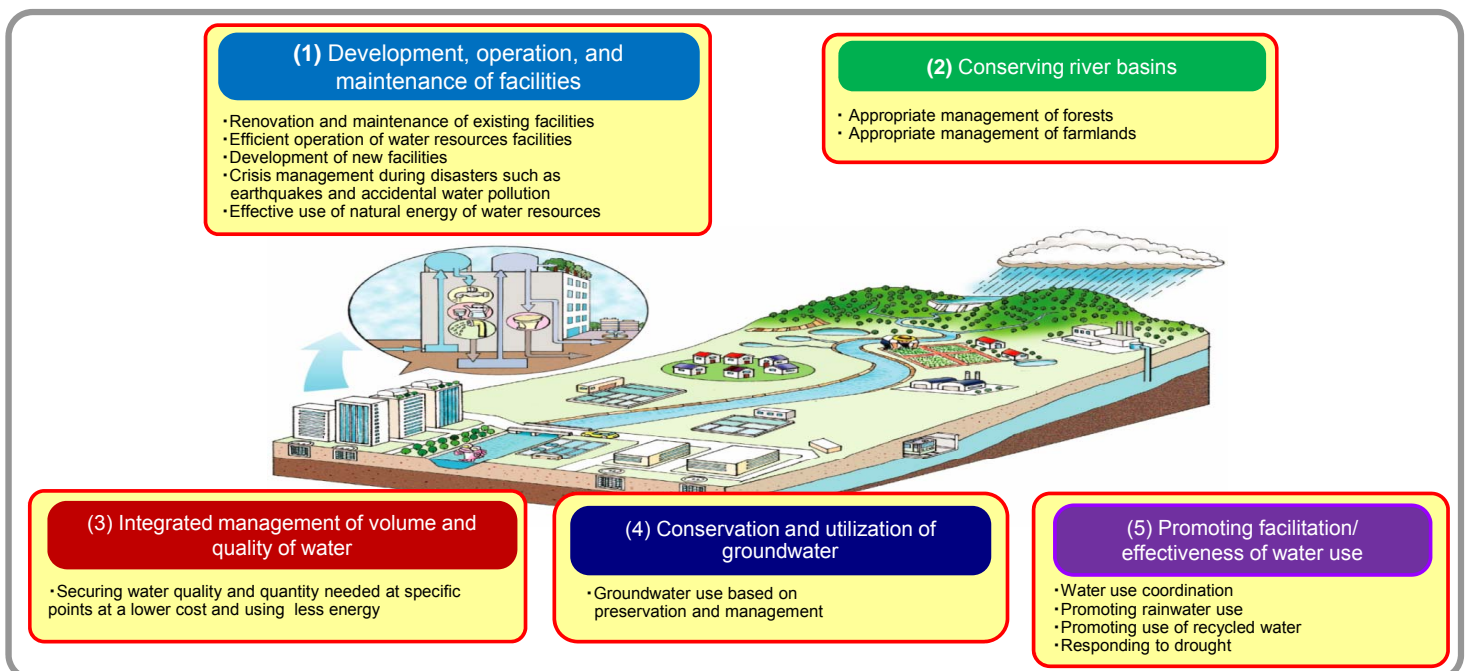


Fig. 5.2 Japan's Efforts to achieve IWRM

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6. Technologies for Water Resources Management in Japan

Japan has developed the diverse technologies for efficient utilization of available water resources and they have built foundations for economic social growths in other countries. In view of projections of population growth and economic trends, it can be foreseen that new water demand will greatly increase worldwide. Furthermore, it is pointed out that serious water problems exacerbated by climate change will have grave impacts. The technology and framework we have developed enable us to continue to make steady advances in water-related technologies that can help others meet the challenges ahead.

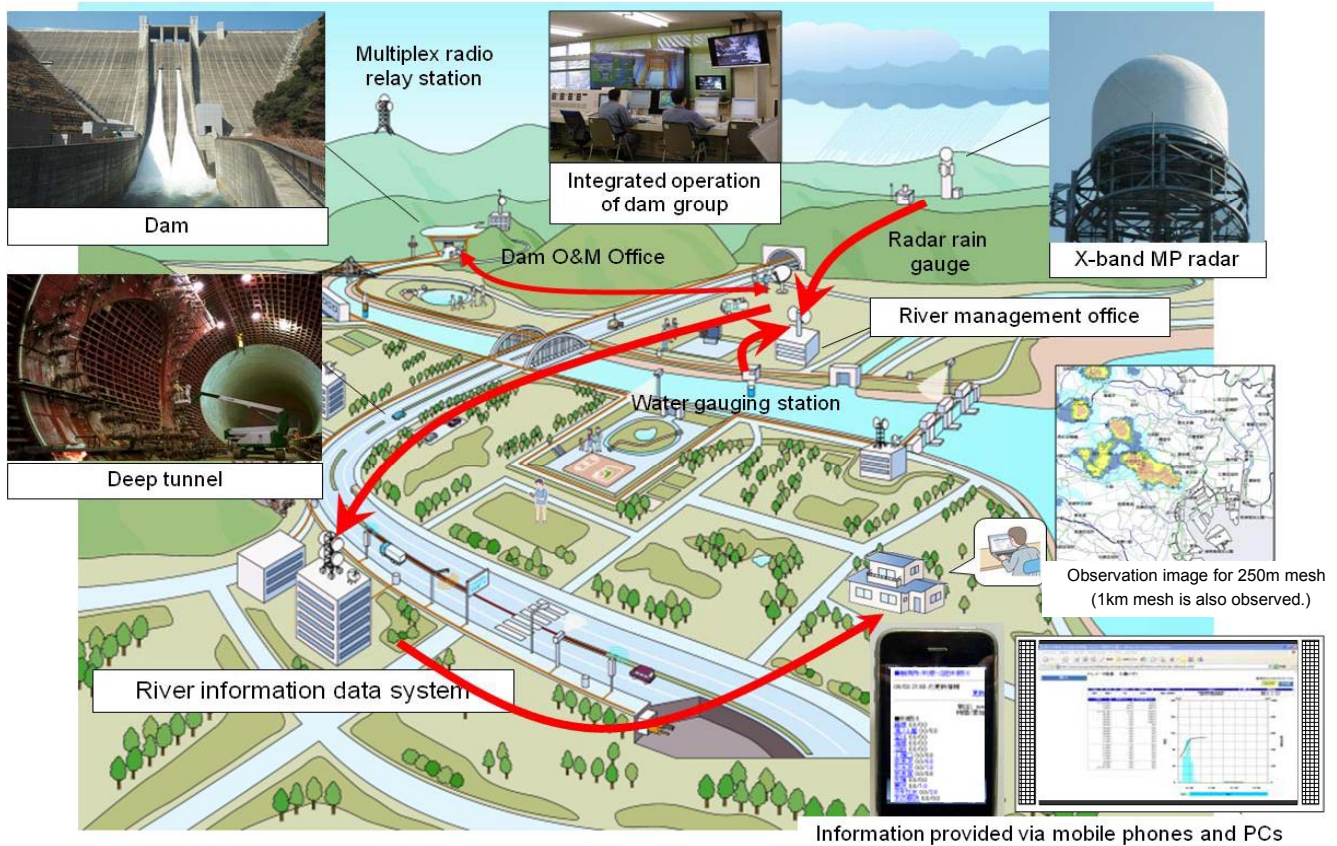


Fig. 6.1 Package of Technologies in River Basin

- ◆ **Leakage Prevention Technology**
 - Material Improvement of pipes (Lead→Stainless)
 - [Rate of leakage in Tokyo: 8% (1998)→3%(2009)]
 - Engineering to prevent leakage
 - Investigation Equipment (Maintenance Engineering)
- ◆ **Technology for reuse of industrial water**
 - Recycling rate of discharge from factories is approximately 79% in 2008.
- ◆ **Desalination technology**
 - Membrane treatment technology

Membrane equipment

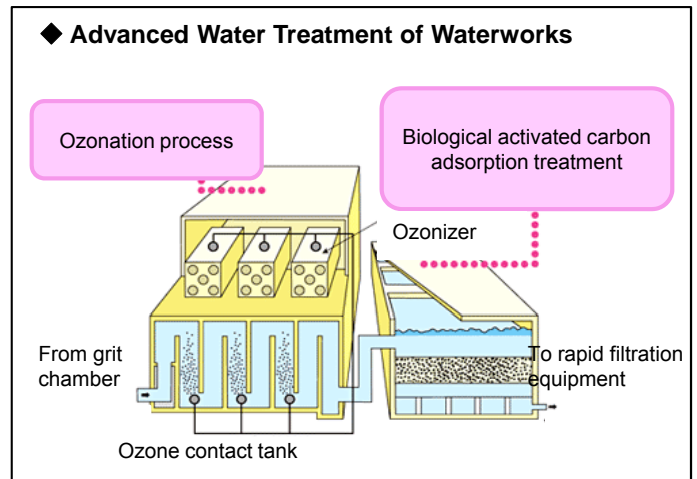


Fig. 6.2 Advanced water-related technology in Japan