WATER

Toward Further Awareness and New Discoveries of the Wonders of Water for Growing Life on the Earth

Report of the Subdivision on Resources (Outline)
The Council for Science and Technology
Ministry of Education, Culture, Sports, Science and Technology, JAPAN

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At present, problems involving water, such as water shortages, water pollution and flooding arise in various parts of the world. With future increases in population, problems relating to water are expected to be aggravated and become one of the largest environmental problems globally in the 21st century.

In our country, too, the people's awareness of the water shortage crisis is not always high, but there are fears that the trend toward less rain in recent years may cause damage through water shortages. Also, as Japan imports many agricultural and livestock products that require large quantities of water to produce, the worsening of water problems around the world will have a strong impact on our economy and society.

It is also feared that various human activities in the riverhead areas will increase the effluence of pollutants, etc., and that increase of poorly managed forests and shrinking green areas in urban settings will seriously increase water runoff in the event of flooding. It is necessary to watch closely the decreasing water quality in riverhead areas and the increasing vulnerability to flooding.

In order to secure sustainable development for mankind under various resource limitations in the future, it is necessary to achieve a society based on recycling. To achieve this, it is necessary to promote science and technology to solve water problems, and to make wide use of water, as a naturally renewable resource and with little environmental load when used, in various fields, while considering energy conservation and paying attention to its characteristic features.

It is also expected of Japan, as an economically and technologically developed country, to transfer to other countries the scientific knowledge and technological foundation necessary for water management enabling the effective use of water and the reduction of flood damage. Developing countries will be especially important recipients.

In the light of these factors, the Subdivision on Resources has organized a water resources committee of experts and conducted examinations to clarify the problems confronting water resources domestically and overseas for the purpose of enhancing the public's awareness of water, and to explore future measures and the various possibilities of water use from scientific and technological viewpoints. Based on these examinations, the Subdivision now presents its proposals on the future direction of development of water science and technology, "Toward Further Awareness and New Development of the Wonders of Water Growing Life on the Earth."

1 Measures to promote science and technology related to water and to raise the awareness of water among the general public

1-1 Toward the solution of world-wide water resource problems

(1) Promotion of research and development to solve the worldwide water resource problems

In order to solve water problems, such as water shortages, water pollution and flooding, now occurring in various parts of the world, it is necessary to promote the development of water science and technology and their proper utilization in society, specifically:

①Technologies for water productivity improvement, water conservation and water recycling, including water-conserving agriculture, and for freshening sea water efficiently;

②Technologies for minimizing the risks of hazardous chemical substances to human health and the ecological system and for assessing and controlling them;

③Technologies for securing a stable supply of safe and clean water;

④Countermeasure technologies for forecasting water circulation relating to the human living foundation and natural ecology and for assessing its social and economic effects by using the results of the forecast;

⑤Technologies for reducing water flood damage, such as preparation of flood control facilities and observation/monitoring according to local conditions;

⑥Technologies for integrated water resource management, such as technologies for clarifying and assessing water circulation systems on the basis of each river basin, and management technologies to grasp flooding, water use and water environment synthetically.

(2) Overall promotion of observation, long-term monitoring, and research studies on water

Long-term observation and monitoring are essential to grasp the actual conditions of the phenomena relating to water.

In particular, it is necessary to continue overall regional observations, including observations of the earth using artificial satellites, etc., and the government should build the national system for that purpose.

The systematic and integrated preparation of scientific data on water and related matters is also required.

Further, it is necessary to urgently prepare an observation/monitoring system in cooperation with relevant organizations using existing observation facilities.

It is also necessary to promote more powerfully such research and development as three functions of observation/monitoring, elucidation of phenomena, and model development/simulation that are continually integrated.

(3) Promotion of international cooperation

It is important to continue promoting bilateral and multilateral cooperation on science and technology and *international research programs in which our country has been engaged, and making international contributions in the scientific and technological fields.

Our country has experience in addressing water quality problems that occurred in the process of rapid economic growth and in preserving the environment, as well as technologies for developing and recycling water resources. It is, therefore, necessary for our country to transfer countermeasure technology and policy know-how on water in ways that correspond to the local situations, and to promote cooperation toward the building of sustainable economic aid social systems.

(4) Studies on reasonable charge of water supply cost

The concept of collecting full costs necessary for water supply from the users in order to promote effective use of water is one of the techniques to promote the effective and sustainable development and use of water resources. In considering collection of the entire cost, however, it is also necessary to take into account various benefits resulting from the use of water, such as environmental preservation through maintaining a sound ecological system.

As for the collection of the full cost, the natural conditions, socioeconomic situations, and historical and cultural backgrounds of individual countries and districts, as well as various benefits resulting from the use of water, should be taken into consideration. Based on such consideration, the recipients of such benefits should share the cost according to the extent of benefits they receive. Various methods, such as management of facilities by beneficiaries themselves and subsidies by public finance, should be considered.

Further, from the viewpoint of raising water-conservation awareness, there should be further examination of how best to set the price of water, including consideration of various benefits and disadvantages resulting from water use.

1-2 Making use of water properties

For our country, with limited land and scarce natural resources, it is extremely important to promote research and development (R&D) for exploring various uses of water that is relatively abundant, cheap and has little environmental load resulting from its use. Specifically, it is necessary to give priority to promoting the following:

① Technologies to help realize a recycling society, aimed at recycling water resources while making effective use of those resources and restraining the production of waste, by way of water reuse, water

treatment with little burden on the environment, etc.;

②Technologies to realize effective waste treatment and new synthetic reaction, by utilizing the characteristic properties of water at high temperatures and high pressures;

③Introduction of production systems to minimize the input of resources, effluence of waste, etc., by making use of the characteristic property of water for dissolving many substances;

④Studies on regional formations and land use based on long-cultivated cultural aspect of water as scenery.

In these activities, an overall assessment of technologies is necessary, with the emphasis on reduction of environmental load. It is also important to promote the development of life cycle assessment techniques, preparation of a database, and providing information to consumers, etc.

Further, in addition to the evaluation and R&D of traditional water quality preservation, clean water management and water resources management technologies, other requirements include the evaluation and R&D of energy- and resource-saving technologies, systems and institutions.

1-3 To raise awareness of water among the general public

(1) Let's get close to water - Promotion of nature experience activities at the water front

Activities experiencing nature at the waterfront will provide valuable opportunities to inspire feelings of awe toward nature and life, and to cultivate an understanding of the importance of living in harmony with nature.

So it is important to foster children's attitude toward, and promote parents' understanding of, getting close to nature at the waterfront.

It is also necessary to make it easy for children to join in nature experience activities and to train instructors.

In organizing nature experience activities at the waterfront, it is also necessary to make children properly aware of the danger of water and secure enough space for children to get close to water safely.

There are already public works under way that consider the water environment, and it is important to continue promoting such works with the increasing social demand for such space in mind.

(2) Let's understand the importance of water- Environmental education/learning on water

In order to build a sustainable society, it is important to urge people to take actions that consider the water environment by calling their attention to, deepening their common understanding of, improving their awareness of, raising their will to participate in, and fostering their ability to solve problems connected with the water environment through environmental education and learning on water.

It is also necessary to prepare an information infrastructure to deal with the water environment in order to promote positive and voluntary environmental learning and practical actions.

Further, it is required that environmental education and learning should be promoted in such a way that the cooperation of all entities, including administrative organs, civic organizations such as NGOs, and business enterprises, is deepened, taking root in local communities and spreading out from local communities.

In such a framework, it is important that local communities, civic organizations, educators, administrative organs, and local governments tackle the task in one united body.

(3) Let's have a deep knowledge of water-Spreading a scientific knowledge of water on water

It is important to prepare the environment where the general public can understand science and technology and judge scientifically, rationally, and independently the various problemsrelated to water.

Therefore, it is important to foster people's interest in or attention to science and technology, expand the opportunity to communicate science and technology of water to the general public in plain language, arrange water science and technology plainly, and build a system of storing scientific and technological information so that the entire society can use it widely.

(4) Let's make use of information on water- Spreading knowledge of water through information telecommunications technology

In order for the general public to have an accurate knowledge and awareness of water problems and the role of science and technology in solving them, it is important to provide them with information on various observation data and research results in plain language. It will help deepen their awareness of water and foster civic agreement on the necessity of countermeasures, contributing to the choice of proper policies and measures.

At present, measures are being taken in our country to provide the general public with information on water, too, as part of the reforms in industrial and social structures through information telecommunications technology.

In the future, it is desirable to continue such efforts actively, arrange the knowledge, technology and data on water, both domestic and foreign, plainly in such a way that anyone can understand according to his or her level of ability or interest, build storage systems (digital archives) of technology information which can be used widely by the whole society, and create an infrastructure to respond to changes in various situations, including technological advances.

*Note: UNESCO International Hydrological Program etc.

Problems common to water science & technology

(1) Cooperation among the parties concerned-Cooperation with administrative authorities, industries, etc

Research and development (R&D) on water are expected to bring about results that can be reflected in policies and put to practical use. At present, we do not always have enough systems to tackle new problems caused by a complex tangle of various causes and factors, or arising globally spanning national boundaries.

In the future, it is essential to intensify cooperation between researchers and technical experts on one hand and policy makers and business operators on the other. Policy makers and business operators should clarify what scientific knowledge is required for policy making and practical use, while researchers and technical experts should actively provide in an understandable form the scientific knowledge necessary for policy decisions and practical use.

For that purpose, it is necessary to establish, and make effective use of, windows for the exchange of information between researchers/technical experts and policy makers/business operators.

(2) Science suitable to solve water problems-Interdisciplinary approach

In order to solve water problems, we must find the proper directions for problem solving as soon as possible and promote R&D of necessary countermeasure technologies.

In taking specific measures, it is important to discuss multiple choices, facilitating better decision-making.

Further, water use is closely related to land use, and there is a public nature to water in rivers and lakes. Water use also has a long history involving social systems, traditions and cultures. Thus, social scientific approaches and policies with these points in mind, as well as natural scientific or economic rationality, are required in solving water problems.

For that purpose, it is desirable for researchers and technical experts in various water-related fields to cooperate and create a new type of science and technology into which natural, cultural and social sciences are blended.

(3) To meet regional specific needs on water problems - Practicality

Science and technology of water will truly display their results and serve the society when they are rooted in a specific region, such as a river basin, and are actually applied in that region. Therefore, universities and administrative organs should take the lead in implementing measures according to the actual state of affairs in the region in cooperation with local governments, local businesses, research institutions, the general public, etc.

In particular, it is important to make R&D conducive to decision- and policy-making after grasping the needs of science and technology in the specific region and while considering various conditions in the region, such as natural conditions, socioeconomic situations, historical and cultural backgrounds, etc.

It is also important to build a mechanism enabling wide sharing of information on measures to solve regional problems and various experiences including failures.

(4) Nurturing human resources necessary to solve water problems-a broad outlook and flexibility

In order to cope with broad and complex problems such as water problems, interdisciplinary coordination among natural, cultural, and social sciences as well as international cooperation is required. It is, thus, necessary to nurture human resources capable of responding flexibly to such coordination and cooperation from a long-term viewpoint.

Further, an integrated approach of multidisciplinary studies is required, and it is necessary to foster project managers with a broad outlook who can manage the progress of an entire research project and properly compile the results.

It is also necessary to nurture human resources, especially engineers and technicians in developing countries, to realize international technical cooperation and technology transfer to developing countries.

Chapter 1 the Properties and Role of Water

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Summary

Water is very close to us Japanese as we can see in many expressions in Japanese, such as "Water (city life, for example) does not agree with me" or "He spends money like water". But water has a unique property, as compared with other substances in the natural world, and because of its property, it plays an important role in our living environment.

For example, although many substances in the natural world expand to be less dense with a rise of temperature, water reaches its highest density at a temperature of 4℃ after ice melts to water, and becomes less dense with a rise of temperature thereafter. Therefore, even if ice of 0℃ covers the surface of a lake, more dense water of 4℃ (water is most dense at 4℃) will fall to the bottom of the lake. So the water at the bottom will remain at 4℃ and fish will not be frozen to death in the lake.

Further, the specific heat capacity of water is higher than that of other substances; water is "hard to warm and hard to cool". So differences in temperature between day and night or between seasons are smaller at the beach or at the waterside than in inland areas.

Water came into existence in the process of the earth being formed as part of the solar system. Life born in such water maintains its life in a close relationship with water, and cannot live without water. It is very important to living creatures, therefore, that water is preserved in good quality.

Water was one of the important themes at the Johannesburg Summit held in September 2002. In its Implementation Plan, the Summit adopted a target of halving the proportion of people who have no access to safe drinking water by 2015.

The total quantity of water on the earth is estimated at 1.4 billion km³. Of the total, 97.5 % is accounted for by salt water, and only about 0.01% is around us as liquid fresh water in lakes, marshes, rivers, etc. Using such water, man lives his life, and the life of living creatures are maintained.

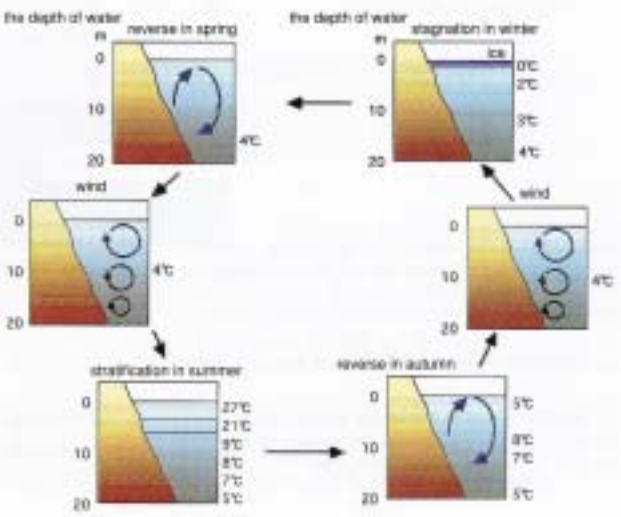
On the earth, 40 trillion tons a year of seawater is distilled, with the sun as a heat source, into fresh water, which is transported to the land. From the land, 75 trillion tons a year of water evaporates into clouds, then falls again as rain or snow. In the process, polluted water on the land is cleaned once it is evaporated. Water has the function of cleaning the air because it dissolves dirt in the air when it falls as rain or snow.

Recent years have seen reports that the global climate has been suffering a big change. Such a change is closely related to the movement of water, and in considering countermeasures, it is necessary to elucidate water circulation on the earth. It is also important to promote the science and technology of water, such as the technology to increase the quantity of agricultural and industrial products that can be yielded by the use of water and water-conservation technology.

If the present tends of population increase and urbanization continue, estimates project that about two-thirds of the world's population will be experiencing water shortages by 2025. In order to properly cope with the world water problems, such as water shortage, water pollution and flooding, it is necessary to promote scientific and technological research for providing technical assistance on water and for solving water problems.

As for water resources in Japan, our country is geographically blessed. In our country, with its small land area and scarce resources, it is desirable to promote science and technology to make good use of water. The precipitation per capita in Japan is only about one-quarter of the world average. According to the results of the "Survey of public opinion on

seasonal temperature-change of lake water

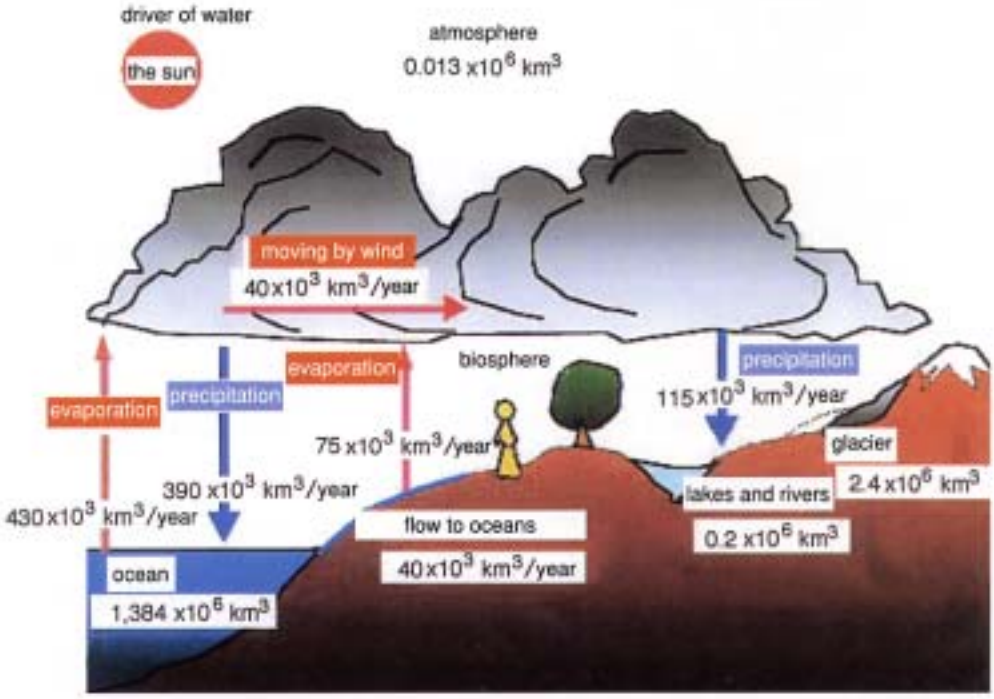


water" by the Cabinet Office, 34.5 % of the respondents cited "a safe life without fear of flooding" as "a rich life in relation to water", and nearly the same percentage cited "a life nearby the waterside giving comfort and peace of mind". As suggested by the Dragon God legends in many parts of Japan, water beyond human control in rapid and often-flooding rivers was an object of awe to the Japanese from olden times. The view that water is a terrible and hard to control thing seems to remain even in modern times, even though the society is modernized and flood control is advanced. In fact, there are many calls for improving flood control facilities.

According to a public opinion survey, people's interest in world water problems is high enough, but the proportion of people who "use water abundantly" is also high at about 30% of the population, and people's awareness of the crisis of water problems is not high.

In order to cope with the impending water crisis worldwide, it is important to raise people's awareness of water by providing them with the opportunity to get close to water and gain a scientific knowledge of water. Taking these points into consideration, we should aim at building a recycling society by promoting science and technology and technical cooperation to solve water problems.

water circulation on the earth



Chapter 2 Trend of Water Supply and Demand

1 Prediction of water circulation

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Summary

Generally speaking, three important characteristics of water resources are as follows:

① Renewable, and sustainable resources;
② Low cost per weight or per volume, as compared with other material resources;
③ Worthless unless water of necessary quality is available when and where necessary.

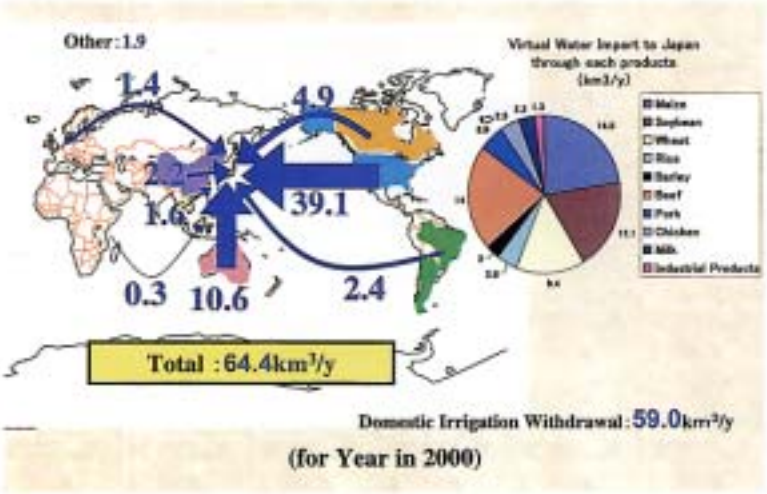
The characteristic of "low cost" leads to "relatively high cost to store or transport," and as a result, the value of water as a resource will decrease unless it is available whenever and wherever it is needed. "Water shortage" means that "inexpensive fresh water is not easy to access", not that "water as a material is lacking."

The annual use of water resources per capita in Japan totals about 700m³, comprised of about 130m³ for municipal water use, about 110m³ for industrial water use, and about 460m³ for agricultural water use. It is generally said that developed countries need about 1,000m³ of fresh water resources per capita per year, but Japan's national use of water resources is relatively low because the country imports a large quantity of agricultural and livestock products. Importing agricultural and livestock products saves domestic water use, therefore it is like importing water. In this sense, agricultural and livestock products are sometimes called "virtual water" from the viewpoint of water resources. In this paper, we use the term "indirect water." since the water resources is not used in the importing country but virtually required if the same amount of agricultural and livestock products are produced in the country.
Japanese import of "indirect water" totals about [1]64.4 billion m³ annually, or about [2]500m³ per capita per year. Thus, the Japanese total consumption of water resources amounts to [3]1,200m³ per capita per year, including the 700m³ of domestic water resources. From this point of view, our country consumes a little more than the standard for industrialized countries.

As shown above, the Japanese depend on foreign countries for nearly half of the water resources supporting their living standard. Even if it is based on sound economic activities and puts no environmental load on developing countries, etc., it is still necessary to keep in mind the state of world supply and demand of water resources in that the quantity of available water resources is subject to a drastic change over time.

The potential quantity of global water resources is estimated as approximately 40,000km³ per year. According to an estimate by Shiklomanov (1997) for 1995, 2,500km³ is withdrawn for agriculture, 750km³ goes for industrial use, 350km³ is for municipal water use, and 200km³ evaporates from reservoirs, and 3,800km³ is used by human beings in total. Thus, mankind was possibly using approximately 10% of the potential water resources at the end of the 20th century.

Virtual Water Import to Japan



Note1 It was 74.4 billion m³ annually in the final report, however, revised to 64.4 billion m³ annually here with philosophical change in using the crop yield in Japan but not in the exporting countries for estimating virtual water trade with its original sense.

Note2 It was 600m³ per capita per year but revised to 500m³ per capita per year with the same revision as Note 1.

Note3 It was 1,300m³ per capita per year but revised to 1,200m³ per capita per year with the same revision as Note 1. Please refer to the following URL for details.(http://hydro.iis.u-tokyo.ac.jp/~taikan/)

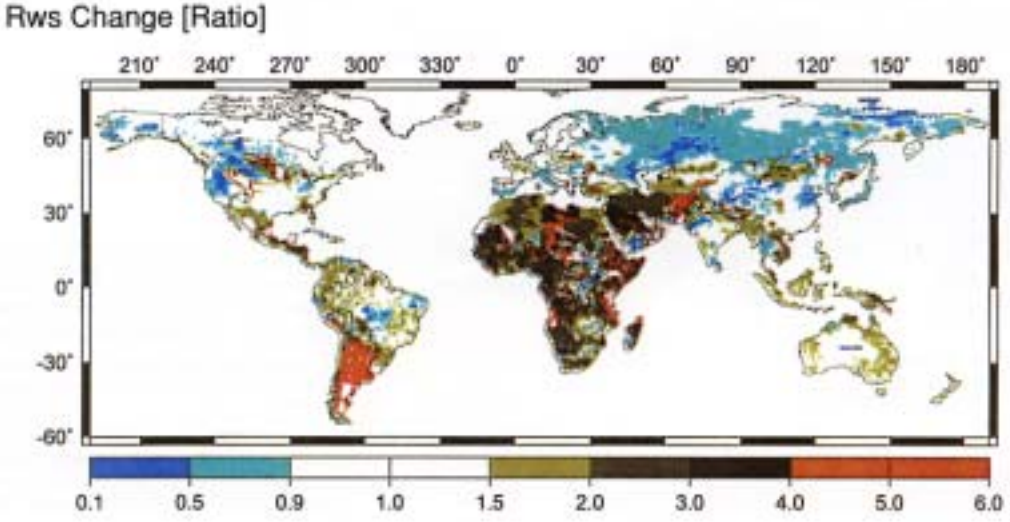
The ratio of water use to water availability is called "water stress ratio." If the ratio is over 40%, the situation is considered to be a "high water stress condition."

Calculating the water stress ratio in 2050, taking into account population increases, climate changes, and increased water consumption resulting from economic development, the ratio is especially high in the Midwest of the U.S.A., the Near and Middle East, the Indian-Pakistani border or the Indus River basin, the North China plains, etc. This distribution is similar to that in 1995, and those regions with a high ratio at present are expected to remain high in the future, as well.

Looking at the projected numbers for world population in 2050, we have estimated the numbers expected to live in regions falling within various ranges of water stress ratio values, in cases where: ① only population increase is taken into account, ② climate change as well as population increase is taken into account, and ③ water intake per capita as well as population increase and climate change is taken into account. The estimated number of people exposed to a high water stress ratio of 40% or over is expected to increase 90% by 2050, rising from about 1.4 billion today, in the case of ① taking population increase alone into account. But the number is expected to increase only 74% in the case of ② taking population increase and climate change into account. In the case of ③ taking water intake per capita as well as population increase and climate change into account, the number is expected to increase 79%. These figures suggest that the population explosion is the most serious problem in light of the tightening water supply-demand conditions in the future.

Comparing the estimated values of water stress ratio in 2050 with those in 1995, the values are expected to show a large increase in the region extending from Africa to the Middle and Near East. This means that demand for water will increase rapidly in the region where water resources are already insufficient today. If this situation is left alone, the balance of water supply and demand could be lost in developing countries in the region. In order to avoid this, it will be necessary to begin coping with poverty problems, stimulate economic growth, improve social infrastructure, and build effective and integrated water resource management systems in such countries right away.

The term "sustainable development" gives the impression that it is important to sustain development or growth. I think, however, that its original purport was probably "sustainability development," that is, to develop sustainability in our society.
In order to promote a global, integrated management of water resources, it will be necessary for Japan to give more attention to global water circulation and water use, and take appropriate actions if the need arises.



2 Water Supply and Demand

Riota Nakamura Professor, College of Bioresource Sciences, Nihon University

Summary

The atmosphere surrounding the earth is heated in the equatorial region, where it ascends, and cooled in the Polar Regions, where it descends. It is understood that this circulation is split into three parts under the influence of the rotation of the earth, and the resultant circulation systems move a little northward then southward in a one-year cycle. As a result, the rainy season comes in some countries while in other countries the dry season sets in. this mechanism of atmospheric circulation contributes to a regionally unequal distribution of precipitation. In addition, mountain ranges and ocean currents influence the uneven distribution as well. The annual average precipitation in Japan is about 1,700-1,800 mm, about two times the world average. But precipitation per capita is not so much in Japan because of the large population. As for the temporal unevenness in water distribution, the existence of rainy and dry seasons is important. In a country like Japan, where rainfall comes at any time of year, the distinction between rainy and dry seasons is not so conspicuous. Even compared with dry regions of the world, the peak of maximum rainfall is not low.

According to the "PODIUM" model, one of the models on the supply and demand of water in the future, the world total water intake is predicted to increase from the present 3,800km^3 to 4,300-5,200km^3 in 2025 (an increase of 13-37%), and about a half of the world population will live in regions where there is strong water stress.

On the demand side, the world food demand is projected to double by the middle of the 21st century, as a result of the population increase and the change of taste for protein due to an increase in living standard. Most effective and indispensable for increasing food production is agricultural water. Agricultural water, accounting for about 70% of the world water demand at present, must increase 17% from the present level to keep pace with increasing food production. On the supply side, dam construction is effective for meeting the demand for water. Judging from the present state of dam construction, however, there will be only limited increases in water supply in the future.

At present, the efficiency of agricultural water usage is said to be low. As a countermeasure, it is proposed to manage water through farmers' own voluntary participation, especially participation in construction of facilities, such as water channels, to increase their awareness of water.

Further, some have pointed out that when governments supply free water in some developing countries, this has caused wasteful use of water. They propose placing water as an economic commodity and achieve an optimum distribution of water, based on the market principle. This suggestion, however, raises some controversial points. One is that it will lead to taking water away from the poorest. The idea is now being discussed at various places.

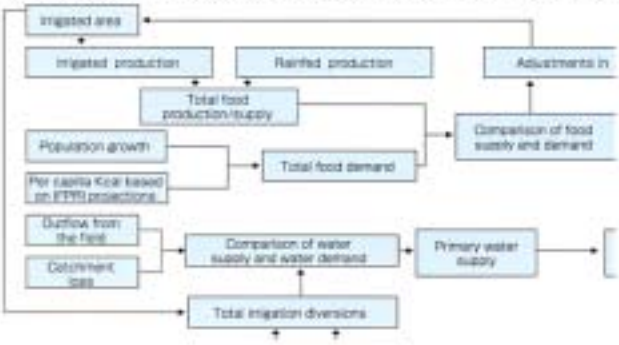
Some people say that countries with little water have only to grow and export high value added products using little water, and with the money received, import grain from countries with much water. They say this is nothing but importing virtual water. This idea leads to the assertion that trade barriers should be abolished, and is related to discussions at the WTO. In this regard, Japan maintains that agricultural water is very helpful not only to preserve the environment but also to foster agricultural society.

In particular, paddy fields foster the ecosystem for organisms. It is noted that agricultural water is useful in many ways in various aspects of rural life.

As for assistance to developing countries, it is important that "life-size technology" should be rendered. Development of technology required locally in developing countries needs conceptions that differ from those for developed countries, and it is also necessary to develop technology specific to developing countries.

Adjusting the supply and demand of water resources in the future depends to a large extent on policies. Thus, policy proposals are important, and for that purpose, even closer cooperation is needed between people from liberal arts courses and from science and engineering courses. The prediction of water supply, including prediction of rainfall, is the task of people from the science and engineering fields, while the prediction of food accounting for a large part of water demand is the task of people from the economic field. It is important to promote cooperation between them to realize the true fusion of liberal arts and science/engineering fields.

2025 Water Projection Model (from portion of the PODIUM



Chapter 3 tPreservation of Water Quality and Water Environment

1 Preservation of Water

Norio Ogura Professor, Graduate School of Agriculture, Tokyo University of Agriculture and Technology

Summary

Once clear rivers, such as the Tama River, were polluted and became like bad-smelling drains during economic development in the late 1960s to 1970s. In Tokyo Bay, into which these rivers flow, a large quantity of organic matter and nutrient salts flowed in, causing red tide and blue tide outbreaks mostly in summer.

Since then, water quality in rivers and inner bays has been gradually improved with the construction of sewer systems in the basin, and has become generally good in the last 10 years.

However, trace amounts of chemical substances formerly not seriously considered, such as endocrine-disrupting chemicals (so-called hormone disruptors) have been detected in various rivers, presenting new problems. It is urgently needed to elucidate their actual state and effect on organisms and to deal with them properly.

There are many sources of pollution in various areas of the basin. In order to preserve and restore the quality of water in Tokyo Bay, therefore, it is important to take a comprehensive view of the whole basin from the riverhead to the rivermouth and coastal area (from forest to sea), and reduce pollutants at their respective sources.

Forests have the capacity to restrain flooding and to level the quantity of river water, and to keep water in good quality. Paddy fields have the capacity to store rainwater temporarily, and they play an important role in fostering underground water. Paddy fields also play a role in cleaning water by removing excess nitrate ions. Further, paddy fields help to ease the urban climate, and so it is preferable to preserve the remaining paddy fields as much as possible to make use of them in preserving the urban environment.

It is also important to reduce the pollutant load at point or surface sources. For that purpose, it is effective to take measures to reduce pollutants of atmospheric origin in rain water, to reduce excess use of fertilizers in farmland, to reduce the pollutant load in factories and businesses, and to treat miscellaneous wastewater from households.

In side ditches and water channels, it is effective to use charcoal, for example, for cleaning water. It is also reported that when rivers are improved to enable organisms to live, this assures good scenery, and they are effective in cleaning water.

The fundamental measure to solve red tide problems and water masses with poor oxygen content in

Change of Methylene Blue Active Substances Concentration at Chofu Weir in the Tama River