Part Two

 Characteristics and Recent Problems of Irrigation in Japan

ACRES
In Japan, agriculture uses nearly 60 billion cubic meters of water every year. Most of this is extracted from rivers and other sources, then, led through water supply channels to inundate paddy fields. From here, groundwater slowly accumulates, or the water is returned to rivers for reuse downstream. By repeating this cycle indefinitely throughout a river basin, water is used cyclically and efficiently in the basin as a whole.

This use of agricultural water is supported by a network of irrigation facilities, as well as the ceaseless efforts of farmers and land improvement districts that manage them on a day-to-day basis. Irrigation facilities include headworks, whose function is to dam up rivers in which the water level is normally lower than the surrounding arable land, and to bring the water up to a sufficient level; water supply channels that convey water to arable land; drainage channels that drain surplus water or floodwater safely into rivers and the like; and, finally, dams, reservoirs and similar facilities that store surplus water in reserve for when the natural base flow from rivers alone is not sufficient. Of these, major water supply and drainage channels extend to a total length of 40,000 km, which is about 4 times the length of Japan's rivers (ranked Grade 1) under direct control of the national government. If branch channels are included, the length of this network is around 400,000 km.

Irrigation facilities form a network of arteries for the richly green land of Japan

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Map of agricultural land and water in Japan

Characteristics of Irrigation and Water Resources in Japan

Explanatory notes

<table>
<thead>
<tr>
<th>Elevation</th>
<th>Arable land, etc.</th>
<th>Major agricultural facilities, etc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3,000~4,000m</td>
<td>Paddy field</td>
<td>Irrigation canal</td>
</tr>
<tr>
<td>2,000~3,000m</td>
<td>Upland field</td>
<td>Drainage canal</td>
</tr>
<tr>
<td>1,000~2,000m</td>
<td>(Including orchard and pasture)</td>
<td>Agricultural dam, Head works, Irrigation pump, etc.</td>
</tr>
<tr>
<td>500~1,000m</td>
<td></td>
<td></td>
</tr>
<tr>
<td>200~500m</td>
<td>Urban district</td>
<td></td>
</tr>
</tbody>
</table>

Source: MAFF
Map reproduced from a 1:25,000 scale topographical map issued by the Geographical Survey Institute, with the approval of the Director (Approval No. 292-soshi, 2000)
Management of the "arterial network of national land" borne by land improvement districts: A management system that offers high sustainability

Land improvement districts organized by farmers mainly take responsibility for maintaining these vast networks of irrigation facilities, as well as managing the distribution of agricultural water. For example, of the 40,000 kilometers of major water supply and drainage channels mentioned above, about 80% are managed by land improvement districts.

Organizations of irrigation associations have existed in rural areas for a long time. But the enactment of the Land Improvement Law in 1949 made it possible to construct, improve and manage irrigation facilities in fixed areas using legal procedures. The Law also requires compulsory enrolment of union members and mandatory levies of fees.

Member farmers usually pay levies (union fees) and entrust the operation and maintenance of facilities to land improvement districts, as well as providing their own labor for work such as mowing grass and cleaning water channels. This system could be seen as firmly establishing a sense of responsibility among farmers concerning the management of facilities ("owner awareness"). This is also expected to be a key point in promoting Participatory Irrigation Management (PIM) by farmers all over Asia, as discussed in Part One 7.

Number of Irrigation Facilities constructed by national government by managing body (2001)

<table>
<thead>
<tr>
<th>Management Entity</th>
<th>No. of facilities</th>
<th>Ratio (%)</th>
<th>Length (km)</th>
<th>Ratio (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>National</td>
<td>20</td>
<td>1.3%</td>
<td>94</td>
<td>0.5%</td>
</tr>
<tr>
<td>Prefectural</td>
<td>247</td>
<td>15.6%</td>
<td>576</td>
<td>2.9%</td>
</tr>
<tr>
<td>Municipality</td>
<td>265</td>
<td>16.7%</td>
<td>6,939</td>
<td>35.1%</td>
</tr>
<tr>
<td>Land Improvement Districts</td>
<td>1,042</td>
<td>65.8%</td>
<td>12,133</td>
<td>61.3%</td>
</tr>
<tr>
<td>Other</td>
<td>10</td>
<td>0.6%</td>
<td>52</td>
<td>0.2%</td>
</tr>
<tr>
<td>Total</td>
<td>1,584</td>
<td>100.0%</td>
<td>19,794</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

Source: MAFF

General Maintenance and Management System by Land Improvement Districts

- Proving stable supplies of water
- Ensuring the drainage function
- Providing labor
- Maintenance and control using the levied charges
- Facility operation, development and repair
- Canal grass cutting, removal of algae, sand and soil
Land improvement districts and farmers strive to conserve water at times of abnormal drought

Japan occasionally experiences abnormal droughts, with continuous periods of dry weather after the end of the rainy season around mid- and late-July, an important time for paddy rice and other summer-growing crops. During this season, temperatures are high, exceeding 30°C for days on end. The demand for domestic water supply also increases. At such times of drought, farmers cooperate with each other, mainly through land improvement districts, and devote much time and money on forms of water conservation, including rotation, repeated use, and rigorous inspection of water channels.

With paddy field irrigation in humid regions, the manpower needed for water management can be reduced when rainfall is plentiful, even without advanced facilities, as stated in Part One 7. The other side of this is that, at times of drought, efforts can be made to minimize water usage by putting more manpower and expenditure into water management, for example by prioritizing water for the domestic water supply. Practical examples of this were seen in various parts of Japan during the droughts of 1994 and 2001.

Withdrawal restrictions in major river basins at the time of depletion

<table>
<thead>
<tr>
<th>Basin</th>
<th>Maximum water conservation rate</th>
<th>Max. water conservation period</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Domestic use</td>
<td>Industrial use</td>
</tr>
<tr>
<td>Tonegawa River</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Toyokawa River</td>
<td>27%</td>
<td>43%</td>
</tr>
<tr>
<td>Kisogawa River</td>
<td>35%</td>
<td>17%</td>
</tr>
<tr>
<td>Yahagi River</td>
<td>40%</td>
<td>50%</td>
</tr>
<tr>
<td>Yoshino River</td>
<td>20%</td>
<td>20%</td>
</tr>
</tbody>
</table>

Source: MAFF

Economic burden on the land improvement district as the result of water conservation measures

<table>
<thead>
<tr>
<th>Average year 1</th>
<th>2001 2</th>
<th>Rate of increase 2/1</th>
<th>Primary expense increases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Land Improvement District A</td>
<td>4,260</td>
<td>5,400</td>
<td>127%</td>
</tr>
<tr>
<td>Land Improvement District B</td>
<td>5,320</td>
<td>9,720</td>
<td>183%</td>
</tr>
</tbody>
</table>

Source: MAFF

Agricultural water conservation methods at times of drought conditions (examples)

1. Sequential water distribution: Water distribution management for the purpose of water conservation. Various methods are possible, such as:
   1) Segmenting the water use area and allotting water in sequence.
   2) Allotting water according to the rotation of farm fields and time set in advance.
   3) Withdrawal from water sources at intervals of several days

2. Repeated usage: Drainage water from fields upstream is dammed, removed by pump, etc., and reused

3. Water replenishment: If there is still a shortage of water after sequential and repeated use, emergency wells are dug and groundwater is used or bottom water from inactive dams or reservoirs is used or water is received from other users.

4. Rice paddy sacrifice: If there is an absolute shortage of water that cannot be covered by sequential or repeated use or by water replenishment, some paddy fields are sacrificed by withholding water in order to save the others.
Recent Problems with Irrigation in Japan and Efforts to Find Solutions

Paddy field irrigation and irrigation systems, i.e. water supply channels and other irrigation systems in Japan have evolved over a long history of development, and have come to serve as "veins and arteries" that bring moisture to the land. Since the era of rapid economic growth, however, the aging of farmers and the lack of successors, among other problems, have become increasingly serious. The problems faced by agricultural water, moreover, have also become more complex and severe.

In Japan, too, agricultural water needs to be secured appropriately in order to achieve a stable supply of food into the future, and to ensure that the multifunctional roles of agriculture are manifested appropriately. An important element in forming a healthy water cycle will be to make sustainable use of agricultural water.

To this end, it is essential that appropriate management of agricultural production by farmers and agricultural groups, and of agricultural water by land improvement districts and others, is continued hereafter. Similarly, each and every one of us, as citizens who are sustained by eating food cultivated by agricultural water, should be concerned about the need for agricultural water, the roles played by land improvement districts, and so on. In order to form healthy water cycles, cooperation with land improvement districts is desired.

Deteriorating quality of agricultural water due to domestic effluence, etc.

In the period of rapid economic growth from the 1960’s to 70’s, there was an increase in pollution damage affecting agricultural water, mainly due to the influx of polluted domestic and industrial effluence. This was subsequently addressed by a variety of measures, including statutory regulation under the Water Pollution Control Law and other legislation. Measures were also taken to promote the development of farm community effluence processing facilities, which purify domestic effluence in rural communities and reuse it as agricultural water. In future, it is hoped that these measures will continue to be promoted, and that an even better water environment will thereby be formed.

Transitions in the area sustaining damage by source of agricultural water contamination

Source: MAFF
The importance of harmony with the environment

Rural areas in Japan experience the cold of winter, the heat of summer, and mild spring and autumn seasons in between. They are blessed with a rich water environment, thanks to paddy field irrigation. Meanwhile, appropriate intervention in the natural environment by farming has resulted in the habitation and growth of many species.

In recent years, however, increasing importance has been placed on harmony with the environment. Much is exemplified by the designation of killifish, once common in Japan, as an endangered species.

Seasonal cohabitation of species in paddy field

- Spawning of "Shioya tombo" dragonfly
- Mid-air spawning of "Noshime tombo", "Natsu akane" dragonflies.
- "Aki akane" dragonfly lay eggs in puddles left after harvesting
- Breeding of "Hiki gaeru", "Ban" birds
- Breeding of "Daruma gaeru", "Tososama gaeru", "Ao gaeru", "Shnegri's aogaeru" frogs
- Overwintering of "Tagen", "Tashig" Birds
- Rice planting
- Harvesting

Source: ACRES
Appropriate management of irrigation facilities

The system of irrigation in Japan has developed over the long course of history and has come to serve as “a network of arteries for the land”. The majority of irrigation facilities (for example, about 80% of the 40,000 km of major water supply and drainage channels for agriculture) have been managed, with considerable efficiency when seen in global terms, by land improvement districts formed by farmers. Land improvement districts, as the principal managing bodies, shoulder some 70% of the costs required to manage irrigation facilities. However, these costs are in an increasing trend, owing to the need to process waste, install safety facilities, and other factors accompanying the urbanization and progressive co-habitation of rural areas.

Furthermore, forms of land use and other aspects of the environment surrounding agriculture are in a process of change. This, too, calls for even more sophisticated and meticulous management of agricultural water.

Land improvement districts are required to manage irrigation facilities appropriately while responding to these changing circumstances.

### Management costs for agricultural water use facilities

<table>
<thead>
<tr>
<th>Cost burden category</th>
<th>Managing body</th>
<th>Labor</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Central &amp; local governments</td>
<td>Land improvement districts</td>
<td>Total</td>
</tr>
<tr>
<td>Central &amp; local governments</td>
<td>450</td>
<td>225</td>
<td>—</td>
</tr>
<tr>
<td>Land improvement districts</td>
<td>17</td>
<td>805</td>
<td>740</td>
</tr>
</tbody>
</table>

Total | 467    | 1,030    | 740         | 2,237 (100%) |

Source: MAFF

### Causes of rising maintenance costs

- Facility repairs, painting: 46%
- Operation of drainage pumping stations: 6%
- Processing of algae, etc.: 10%
- Water purification measures: 7%
- Installation of safety facilities: 11%
- Others: 18%

Source: Midori-Net

### Numbers of full-time employees in each land improvement district

Many land improvement districts are small in scale (47% of them manage less than 100ha of land), and more than half of them (54%) have no full-time employees.

Source: MAFF
Irrigation facilities in Japan manifest a variety of social and economic effects (multi-functional roles), besides the aspect of agricultural production. Together, they form a stock of about 25 trillion yen, based on reconstruction costs in 2002. Many of these facilities, with the lapse of their serviceable life, will gradually grow obsolete and become ripe for renewal in future. Therefore, facilities now need to be protected and renewed efficiently.

**The increasing obsolescence of irrigation facilities**

![Stock of Agricultural Water Use Facilities](image)

**Number of facilities reaching renovation age due to the elapse of durable life**

![Number of facilities reaching renovation age due to the elapse of durable life](image)

Source: MAFF
Japan’s self-sufficiency in food is about 40% (on a calorie basis). In other words, more than half of the nation’s food is imported. Let us view this situation from a different angle, focusing on the agricultural water used when cultivating these imported agricultural products. From this perspective, we could say that, via these imported agricultural products, we use agricultural water from regions outside Japan, and thereby enjoy a rich and diverse dietary lifestyle. The areas that produce these imported agricultural products are dispersed around various regions of the world. But they could also include arid regions where water resources are not so abundant.

What can we, as individual citizens of our nation, do to solve the problems of water that the world now faces? Firstly, we can have concern for issues such as the necessity of agricultural water and characteristic of this in each region, the relationship between our lives and global agricultural water, and so on. Secondly, we should develop this concern and recognize that making sustainable use of agricultural water is important both for Japan and for the world as a whole.

Directions for agricultural water with a view to forming healthy water cycles in Japan

Originally, rural areas in Japan were places where people engaged in agriculture and lived in close touch with nature, going about their lives as they maintained the national land and ecosystem. Agriculture, making cyclical use of rice straw, human waste, and various other resources, was a central activity of a cyclical society in symbiosis between man and nature. Agricultural water also played an important role, and was deeply connected with the traditional culture and mindset of the Japanese people.

Later, in pursuit of economic efficiency in agricultural production, many production resources came to be introduced from outside the resource cycles of these rural areas. Nevertheless, agricultural water still today, as part of a resource cycle of water in each region, supports not only agricultural production but also the manifestation of multi-functional roles inherent in paddy rice irrigation. In Japan, agricultural water needs to be secured appropriately in order to achieve a stable supply of food into the future, and to ensure that the multi-functional roles of agriculture are manifested appropriately. Furthermore, to build a society in which man and nature are in symbiosis, with harmony between agricultural production and the natural environment, we need to make sustainable use of agricultural water and form healthy water cycles in which the water cycle created by the use of agricultural water is integrated with the water cycle inherent in nature, based on the experience of cyclical societies that have been created in rural areas.
In order to form healthy water cycles by appropriately securing and sustainably using agricultural water, the appropriate management of agricultural production by farmers and agricultural groups, and of agricultural water by land improvement districts and others, needs to be continued in the future.

In particular, land improvement districts need to overcome the problems that face them now, and to continue to fulfill the role of managing agricultural water and irrigation facilities.

Expectations of land improvement districts, playing central roles in the management of agricultural water

Agricultural water accounts for the majority of water use and is an important element in attempting to form a region's healthy water cycle. To form this healthy water cycle, however, it is important that the use of water is sustainable in all its various purposes.

Therefore, everyone concerned with water in each region should be aware of the roles played by land improvement districts, as well as the problems faced by them in fulfilling these roles (such as the need to process waste, install safety facilities, and other factors accompanying the urbanization and progressive co-habitation of rural areas), and should, moreover, cooperate in overcoming these problems.

Land improvement districts, for their part, should not only continue to fulfill roles such as managing irrigation facilities, but should also encourage activities aimed at positively appealing to all the people in each region, in order to gain their understanding and cooperation concerning their roles and the problems they face.

Efforts to form healthy water cycles by land improvement districts and all people of a region
Global Water Resources and Water for Agricultural Use in Japan

The Planning Subcommittee
The Committee of Agricultural and Rural Development
The Council of Food, Agriculture and Rural Areas Policy

February 2003

Introduction

International concerns regarding water and water use have recently increased. Following discussions in forums such as the Water and the Environment Conference (Dublin conference) and the United Nations Conference on Environment and Development (Earth Summit) in 1992, the 12 World Water Forum was held in Morocco in 1997. This forum sought to promote in-depth discussions among the international community aimed at solving water-related problems, and to heighten global awareness of the critical importance of this issue. Since 1997, discussions have continued. In particular, the 3rd World Water Forum will be held for the first time in Asia when it opens in Japan next month, and is expected to become the starting point for launching concrete actions intended to solve water-related problems.

When contemplating global water resources, water for agricultural use is an important factor because such use accounts for 70% of all water use worldwide. Moreover, given current circumstances in which the world's population continues to grow, ensuring supplies of water for agricultural use will be indispensable to achieve stable food supplies. Appropriate use of water resources for agriculture is also necessary in order to achieve sustainable development of the rural village regions that are home to the majority of the world's poorest citizens. Based on such concerns, the Planning Subcommittee of the Committee of Agricultural and Rural Development of the Council of Food, Agriculture and Rural Areas Policy (in Japanese Ministry of Agriculture, Forestry and Fisheries) has met three times to study these issues. Together with analyzing the current state of global water resources, subcommittee members have conducted investigations concerning topics such as the position of water for agricultural use as one component of global water resources, the regional characteristics of water for agricultural use, and the direction of water use for agricultural use in the future.

This report summarizes the results of these investigations, and is organized as follows.

The first part is a general summary of water use and water use issues. The report then looks at the characteristics of water for agricultural use. The report highlights the fact that water for agricultural use exhibits many regional characteristics that depend upon natural conditions, and divides the major water use issues according to dry and wet climatic regions, respectively, based on what is considered to be the most obvious difference among regions. The report also touches on the current status of water for agricultural use in Japan, which is located in a humid region. Finally, based on the conditions and characteristics observed, the report suggests several approaches that we consider to be necessary for future policy for water for agricultural use in Japan and around the world that seek to resolve the various water resource-related issues.

1. Current status of global water resources

1.1 Potential water resources

Our earth is sometimes called the water planet, for abundant water covers the earth's surface. The majority is seawater, however, and only about 2.5% of the earth's total water is fresh water. Moreover, most of this fresh water exists in regions such as Antarctica and the Arctic. The quantity of fresh water available in rivers, lakes and marshes and which is comparatively easy to use is no more than 0.008% (104,620 km3) of all the water on the earth's surface.

Among the most indispensable resources that sustain all living things including the human race, water is also an indispensable material for productive activities such as agriculture and manufacturing. We therefore must share this limited water resource through the water circulation process (hydrologic cycle) not only among all people, but also with all other living things, and use it in a sustainable manner.

1.2 Quantity of water resources

The history of mankind is the history of water resource use. Together with the increase in human population, improvement in living standards and an expansion of various human activities, such as the development of agriculture, the quantity of water resources used has increased. Indeed, the increase in the quantity of water resources used was necessary for the spread of human activities. For example, for the four great ancient civilizations nurtured by the catchment basins of the Tigris and Euphrates rivers, the Nile River, the Indus River, and the Ganges River valley, the development of farming using the water of their rivers enabled people to accumulate wealth through stabilization of their food supplies, and gave birth to city-states and great dynasties. Although it required several thousand years from ancient times to the present day to reach an annual water use quantity of 1,000 km3, it took less than 30 years to double water usage to 2,000 km3, and less than 20 years to increase to 3,000 km3. In recent years in particular, the annual quantity of global water use has been increasing rapidly. Water use has been estimated to have grown by a factor of 2.6 during the 45 years from 1950 to 1995. By category of use, during this same period the quantity of water use per person for agricultural needs was nearly unchanged, but the quantities of water used for industrial purposes and daily domestic needs showed remarkable increases of 1.8 times and 3.0 times, respectively.

Today, roughly 70% of all fresh water used around the world is used for agriculture, and approximately 70% of all agricultural water use is in Asia. This means that when contemplating the use of the world's water resources, it is essential that we thoroughly understand water resources in Asia, including Japan, and the characteristics of water for agricultural use in this region.

Furthermore, water use possesses its own unique characteristics in each region of the world. For example, despite the fact that Asia has the highest quantity of water use as a region, on a per capita basis North America ranks first in all categories of water use, whether for water for daily necessities, water for industrial purposes or water for agriculture.

2. Water resource-related issues

2.1 Future quantity of water use

a. Increases in population and grain consumption

According to the United Nations, by 2050 the world will have a population of approximately 6.6 billion, and by 2050, it is estimated to exceed 9.3 billion. Moreover, in 1961, the world's annual grain consumption was about 800 million tons, and within 30 years, consumption had increased 2.3 times to approximately 1,800 million tons in 1999. This rate of increase exceeds the global population growth rate during the same period. Such a change can be attributed to the result of factors such as more diverse and higher quality dietary habits that accompanied increases in living standards, in addition to population growth. Furthermore, the global trend of rising per capita calorie consumption is expected to continue in the future, particularly because of changes such as increased consumption of meat and dairy products in developing countries. Coupled with the rise in population, the world's annual grain consumption is forecasted to climb to approximately 2.8 billion tons in 2030.

Until about 1990, the total area of arable land, an important production factor for producing grains and other farm products, showed an increasing trend, but since then, it has leveled off. Because the increase in population is particularly remarkable compared to the increase in cultivated acreage, the arable land acreage per person is continually declining.

b. The need for irrigation

As the demand for grains and other farm products is expected to continue increasing, in contrast to the stabilized amount of cultivated acreage, increasing farmland productivity will become even more important for increasing the production of grains and other products. The total worldwide area of irrigated arable land has expanded by more than 3 million hectares annually over the past 40 years, and it is considered that the improvement of land productivity through methods such as irrigation has helped increase food production.

Particularly in Asia, where a small arable land area per person is low, the irrigation rate (the ratio of irrigated arable land to all cultivated acreage) has increased greatly in recent years, which is also thought to be the result of a number of efforts to improve productivity through irrigation, though in other regions. We should not overlook the fact that in agriculture there exist critical factors other than irrigation for improving land productivity, such as crop improvements and the use of fertilizers and pesticides. A major factor that contributed to increases in Asian rice production in 1965-1980, one study suggested that irrigation made the greatest contribution. We believe that irrigation is a very important farm management activity for meeting current demands, and that it will be difficult to supply food for the planet's expanding population in the future if further improvements to land productivity through irrigation are not pursued.

c. Future outlook for water use volume

Because the world population and the demand for food are expected to continue growing into the future, the quantity of water for agricultural use is also expected to increase. It has been estimated that in 2025, annual water use will be 26% higher than that in 1995. Additionally, the quantities of water for industrial purposes and daily domestic necessities are projected to jump by 55% and 82%, respectively, as economies grow and living standards improve.

When these factors are combined, the annual quantity of water use in 2025 will increase by approximately 1,300 km3 from that in 1995. The world will have to provide for this massive increase, roughly equal to 15 times Japan's annual quantity of water use, by developing new water resources.

Given that development of many locations well-suited for dams or related infrastructure has already been completed, however, the development of new water resources is expected to become more difficult, not only because of lower economic efficiency but also because of the impact of developmental processes on the environment, ecosystems, etc.

Furthermore, in arid regions where water resources are inadequate, examples of water-related disputes and political tensions abound. Because the demand for water resources is expected to increase steadily, international cooperative efforts to achieve peaceful solutions to such disputes and prevent conflicts will become even more necessary in the future.

2.2 Environmental impact

In every corner of the world, improper water use has resulted in diverse negative effects on the environment. For example, freshwater water systems nurture diverse networks of living organisms. Over 9,000 types of freshwater fish are known to exist around the world, but in recent years it has been reported that 20% of these species have become extinct or endangered. In addition, even though underground water supplies 19% of the world's needs, examples can also be found where the volume of water pumped is greater than the annual volume of water available to replenish underground aquifers, raising concern that underground aquifers may run dry. Furthermore, the accumulation of salt from causes such as improper irrigation practices and drainage water management are increasing, making large areas of once-arable land unsuitable for production of farm products and in some cases is one of the leading causes of desertification.

2. Global water for agricultural use by region

2.1 Regional characteristics of water for agricultural use

As described above, various issues concerning water use for agricultural use have been highlighted. Water for agricultural use in particular is the sector that uses most water, and so individuals involved with water for agricultural use must take aggressive actions to solve these problems. On the other hand, the characteristics of water for agricultural use differ according to region. Conducting discussions about water for agricultural use by assuming uniform characteristics throughout the world is therefore not a reasonable approach.

Because agriculture involves cultivating useful plants under natural conditions that include soil, solar radiation, temperature and rainfall, it is an industry intimately and inseparably linked to the natural environment. Therefore, the water supplied for agricultural use will entail purposes, methods or related issues that differ depending upon factors such as the natural conditions including rainfall, or the volume of water used for various farm product growth. Coupled with water for industrial purposes and daily necessities, water for agricultural use possesses a variety of regional characteristics. In some situations this fact will even apply within a single country, as can be clearly seen in the case of comparing the arid northwest and humid southeastern regions of China, for example.

A more thorough understanding of the relationship between water for agricultural use and natural conditions is the starting point for launching concrete actions intended to solve water-related problems.
(2) Regulation of farm products and water for agricultural use by the natural environment

1. Precipitation

As a typical example of the natural conditions regulating the regional characteristics of water for agricultural use, consider the volume of precipitation. Precipitation levels will affect the quantity of water circulating in a region, and will affect the selection of cultivated farm products and the consumption of water for agricultural use. Of course, even in regions where precipitation is plentiful, the shape and variety of farm products and agricultural water use will be limited when the amount of evapotranspiration is large. Alternatively, when the amount of evapotranspiration is small, a region will be suitable for cultivation of farm products even if the region has comparatively little precipitation. Moreover, the selection of farm products and water for agricultural use is likely to differ depending upon differences in precipitation patterns. Nevertheless, the characteristics of agriculture and water for agricultural use will generally differ among regions with large amounts of precipitation and those with scant rainfall.

2. Farm products

Because natural conditions such as precipitation differ according to region, farm products are grown in regions where natural conditions are the most suitable for each crop. For example, even considering only rice, wheat, and corn, the three largest grain crops, each cultivation region has its own characteristics. For example, over 90% of the world’s rice production volume is produced in countries and regions centered on eastern and southeastern Asia, where annual precipitation exceeds 1,500 mm per year, reflecting the unique plant physiology of the rice plant, which requires comparatively large quantities of water for growth and suffers minimal damage even when inundated. The planting ratios for rice in these countries often exceed 75% of the total planted acreage for all grains, a condition very close to single cropping. Thus, the regional characteristics of rice production in humid regions are extremely strong. To take another example, three-quarters of the world’s wheat is produced by the ten top-ranking wheat-growing countries. Nearly all of these countries are located in regions having comparatively small annual precipitation (3,000 mm or less). This reflects the fact that while a comparatively small quantity of water is necessary for growth, the physiology of the wheat plant makes it susceptible to damage from large quantities of water.

3. Purposes of irrigation

Just as the selection of farm products will differ depending upon precipitation, the purposes of irrigation also basically differ depending upon the amount of precipitation. Generally, the purpose of irrigation is to provide the quantity of water needed in order to grow crops - that is, to supply agricultural water in the difference between evapotranspiration and precipitation.

In other words, supplementing quantitative shortages in rainfall and the supply of water for agriculture is often the major purpose of irrigation in arid regions with scant precipitation. In humid regions boasting ample precipitation, when dry spells continue, the purpose of irrigation resembles those in arid regions. But usually, the primary purpose of irrigation is to supplement the non-uniform, temporal and spatial distribution of rainfall. Furthermore, paddy field irrigation, which accounts for the lion’s share of irrigation in the humid regions of eastern and southeastern Asia, achieves a broad range of farm management objectives including simplification of tilling activities, control of thickly growing weeds, application of nutrients suspended in irrigation water, and elimination of salts from the soil, by flooding level fields through irrigation. Moreover, other possibilities are also created, such as preventing typhoon damage immediately prior to harvesting or ensuring effective water supply to the plants when precipitation is insufficient, for example, and in this manner the amount of freedom to choose planting or harvesting periods may also be increased by irrigation.

(3) Irrigation in arid regions

1. Traditional irrigation

Although the cultivation area of arid regions is limited, such regions generally enjoy abundant sunshine. If water resources can be secured, it is possible to anticipate stable and efficient production and the cultivation of high-quality farm products. For this reason, irrigation including extraction of underground water using simple excavated underground water channels, water channeling and water damaged rainy season floods and catchment-saving rainfall have been carried out for hundreds of years.

Such traditional irrigation is a highly sustainable system that follows the natural pattern of water circulation. However, because simple excavated underground water channels and earthen dikes frequently are built by sediment and are subject to collapse, in recent years there are numerous examples where traditional methods have been replaced with modern irrigation systems, such as pumping of underground water, as described below.

2. Modern irrigation systems and their related problems

a. Large-scale water conveyance systems (use of precipitation from remote locations)

To further improve production and grow high-quality crops, one example of overcoming the uneven temporal and spatial distribution of water resources to irrigate crops is the building of reservoirs to store rainwater and groundwater flows in remote areas. Where precipitation is comparatively plentiful, and the construction of such large-scale water conveyance systems to supply the water to regions where precipitation is inadequate. Although desert and arid land can be radically changed and converted into a vast green area when these systems are constructed in arid regions that enjoy other advantages such as much sunshine, problems related to irrigation may also occur due to the characteristic of the arid region. For example, constructed large-scale water conveyance and irrigation systems but faces severe shortages of water resources and the quantity of water demanded still exceeds the volume that can be supplied. Another example is the state of California in the United States, where a number of problems have been noted, including an inadequate accumulation of precipitation and low irrigation water. In Israel, for example, constructed large-scale water conveyance and irrigation systems but faces severe shortages of water resources and the quantity of water demanded still exceeds the volume that can be supplied. An additional example is the state of California in the United States, which, due to the lack of adequate precipitation, must import significant quantities of water from other regions.

b. Pumping of underground water

In arid regions lacking rainfall and surface streams, underground water has long been used as agricultural water. With the invention of the turbine pump in the 1920s, it became comparatively simple to pump groundwater, and the use of water from underground aquifers to maintain stable water use unaffected by rainfall increasing. A similar situation where precipitation is minimal, the flow of water replenishing underground aquifers is minimal. As the use of groundwater pumping irrigation spreads, examples can be found in arid regions around the world where the volume of pumped water exceeds the quantity of water replenishing an underground aquifer. This has also resulted in situations where the continuation of irrigation agriculture itself has become difficult, because of the increase in pumping costs caused by the drop in the underground water table.

(4) Irrigation in humid regions

1. Characteristics of paddy field farming

a. Merits of paddy field farming

By taking advantage of rice plants’ physiological characteristics, which protect the plant from damage even when soaked in comparatively large volumes of water necessary for growth, rice plants are grown in paddy fields under inundated conditions in humid regions around the world, particularly in the region referred to as the Asian monsoon region, including eastern and southeastern Asia. These regions have very high annual precipitation and, typically large areas of deep tephra. This means that efforts to prevent soil erosion due to rainfall are indispensable for sustainable farm production. The terrace farmland surrounded by levees such as paddy fields is extremely useful for preventing soil erosion. Moreover, in the low-lying plains along rivers, rice plants grown under flooded paddy conditions also play a valuable role in combating the inundations and flooding that often occur in wet climates. As described earlier, paddy field rice farming possesses numerous advantages for farm management, including simplification of tilling activities, control of thickly growing weeds, practical use of the nutrients borne by the irrigation water and elimination of salts from the soil. It enables sustainable productive capacity without causing soil exhaustion from continuous cropping, and is a form of sustainable agriculture that provides stable and high yields. This clearly shows that the history of several hundred to several thousand years of uninterrupted paddy field rice farming in many regions of Asia is, linked to the widespread formation of societies of high population density.

b. Paddy field rice farming and water circulation

Moreover, in the Asian monsoon region, rice fields covering the water for agricultural use and temporary torrential rains is circulated into underground water or rivers after being stored in paddy fields. Together with allowing repeated use of the water again downstream and increasing the efficiency of water resource use for the catchment area as a whole, this arrangement supports sound water circulation within the catchment area. Furthermore, paddy fields can be referred to as “green catchment basins”. In other words, paddy irrigation channels form a network that includes rivers, they provide a space where a rich diversity of plant and animal life can live and grow. In Japan, for example, in the Survey of Paddy Field Living Organisms conducted in fiscal 2003 through the cooperation of the Ministry of Agriculture, Forestry and Fisheries and the Environment, 72 varieties of freshwater fish were confirmed to be living in local paddy fields, channels and other such structures, including threatened species such as medaka (killifish).

c. Community-based management

Paddy field irrigation in the Asian monsoon region provides examples where irrigation facilities are being excellently managed by farmer’s communities, such as those in Suakon on the island of Bali in Indonesia, Muñaf in northern Thailand or the land improvement districts in Japan. In addition to matters concerning the coordination of agricultural water supply periods or the management of irrigation facilities, such communities are often also associated with local religious affairs and have a large influence on the construction of local society.

2. Current conditions and problems of paddy field rice farming

Exploiting the production efficiency of paddy fields in the Asia monsoon region, the introduction of irrigation runs strong in Asia, where the population density is high and the population increase is also large. Because of this, Asian countries have pursued the construction of large-scale irrigation facilities based on government initiatives and continual international cooperation, mainly since World War II, focusing on areas such as south and southeast Asia, northeast Africa and some parts of South America. In the Asia monsoon region, 22 varieties of paddy fields have been identified, including local paddy fields, marsh fields and other such structures, including threatened species such as medaka (killifish).

For example, in Thailand, the Cheo Lan reservoir system in Thailand is the largest of its kind in the world, with a storage capacity of 11,000 million m³. In addition, in the Philippines, the Bulacan irrigation system provides about 1,000,000 m³ per day to replenish underground water, and this underground water will spread to the surface downstream, to be used for daily necessities and other purposes by about 900,000 residents of the city. In regions where there are many rivers with steep gradients, the abundant water resources provided by the rainy season precipitation or other sources are frequently allowed to discharge ineffectually into the sea. Therefore, in order to maintain resources effectively, methods to maximize the aboveground holding time are required.

In the Asia monsoon region, paddy fields and irrigation systems such as channels, constructed and maintained with the investment of enormous amounts of money and labor, fulfill the important role of extending the aboveground holding time. Water taken from rivers for agricultural use and temporary torrential rains is circulated into underground water or rivers after being stored in paddy fields. Together with allowing repeated use of the water again downstream and increasing the efficiency of water resource use for the catchment area as a whole, this arrangement supports sound water circulation within the catchment area. Furthermore, paddy fields can be referred to as “green catchment basins”. In other words, paddy irrigation channels form a network that includes rivers, they provide a space where a rich diversity of plant and animal life can live and grow. In Japan, for example, in the Survey of Paddy Field Living Organisms conducted in fiscal 2003 through the cooperation of the Ministry of Agriculture, Forestry and Fisheries and the Environment, 72 varieties of freshwater fish were confirmed to be living in local paddy fields, channels and other such structures, including threatened species such as medaka (killifish).

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3. Water resources and water for agricultural use in Japan

(1) Water resource use

Japan lies in the humid region, a part of the world with frequent heavy rains. A average annual precipitation (about 3,700 mm) is about twice the global average. It has been estimated, moreover, that the average annual amount of evapotranspiration is about 600 mm. As a result, the quantity of potential water resources per unit area is comparatively large. However, because of unique local conditions such as Japan’s steep topography and the short length of its rivers, and because rainfall is concentrated in the typhoon season, rainfall tends to be discharged quickly and ineffectively into the sea. These conditions make effective use of Japan’s water resources an important issue.

(2) Agricultural water use

Formation of sound water circulation systems

Therefore, in order for Japan to effectively use precipitation for paddy field rice farming, efforts have been undertaken to extend the length of time during which precipitation can be stored through 1) channeling water from rivers into irrigation facilities to store in reservoirs (reservoirs) and 3) measures to control water retention by the soil (afforestation of mountainous areas).

In conjunction with the development of farmland such as paddy fields, uninterrupted efforts have been carried out to create facilities for using agricultural water, such as intake weirs, irrigation and drainage channels and reservoirs. As a result, the current total length of major irrigation and drainage channels in Japan is more than 40,000 km. Furthermore, when small- and medium-size irrigation channels and drains are included, the total length is roughly 400,000 km, equivalent to ten times the earth’s circumference. These irrigation and drainage channels for agricultural use cross the land like human arteries and veins. Along with supporting Japan’s farm production, they help the water held in paddy fields to be repeatedly used in other paddy fields further downstream, thereby improving water resource efficiency as a complete catchment basin and contributing to the formation of a sound water circulation system.

Status of irrigation facilities management

Some of Japan’s irrigation facilities such as the irrigation and drainage channels for agricultural use are facilities of a highly public nature that are operated by the central or local governments, but management for the maintenance of Japan’s irrigation facilities is provided by land improvement districts composed of farmers using agricultural water (farmers). For example, approximately 80% of the 40,000 km of irrigation and drainage channels mentioned above is managed by land improvement districts. Individual farmers pay the land improvement district a prescribed levy to operate the irrigation facilities, and in some cases also provide occasional labor. This kind of farmer-participation-type irrigation management (PMI) has made possible a smooth supply of water for agricultural purposes.

In addition, there are also examples in which the water conservation percentages accepted by farmers during water shortages are higher than the percentages for water usage for daily domestic necessities or industrial purposes based on a “spirit of compromise.” Farmers also strive to conserve water by providing extensive labor and shoring the economic burden by means such as releasing water in turns, inspecting water channels and using the same water repeatedly.

(3) Issues related to water for agricultural use

Harmony with the environment

Situated in a humid region, the paddy fields and irrigation facilities in Japan provide habitats and nesting grounds for various creatures and support the rich ecosystems in rural agricultural areas as a water-side environment. In addition, they also play a larger role from the standpoint of water quality, scenery, and helping to create positive attitudes towards water resources. However, as illustrated by examples such as the maké, a typical well-known fish designated as an endangered species, in recent years the importance of harmony with the environment has become even more critical.

Appropriate management of irrigation facilities

Although 70% of the costs required to manage irrigation facilities are borne by the land improvement districts, which are the main management entities for such facilities, these costs tend to increase for reasons that are beyond the control of the farmers. For this reason, attempts are being made to use water more efficiently by irrigating felds in optimal patterns, and by using appropriate irrigation techniques such as drip irrigation, or the recycling of treated sewerage to agricultural use. A preferable approach, for example, will be to promote the development and introduction of new irrigation techniques, such as precision irrigation combined with prevention of soil salinization through techniques such as micro irrigation or drip irrigation, or the recycling of treated sewage to agricultural use in response to widespread water stress.

Obsolescence of irrigation facilities

In 2002, irrigation facilities such as dams and water channels for agricultural use that have been built to provide water for agricultural use in such as paddy fields were worth approximately 35 trillion yen on a replacement cost basis. These facilities contribute not only to agricultural production, but also to other important aspects of society such as catchment basin water circulation and the preservation of local ecosystems. The number of irrigation facilities approaching the age at which they will have to be replaced is increasing in the future. In order to pass these facilities down to the next generation, efficient maintenance and renewal has become an important issue.

External economic effects accompanying appropriate management of irrigation facilities

As agricultural trade of agricultural products has grown, discussions on the way used to grow agricultural products have increased. On the other hand, in Japan, in order to effectively utilize precipitation despite the conditions of steep topographic features and short river lengths, a network of irrigation and drainage channels reaching some 400,000 km in length has been built. This network supports sound water circulation as the “arteries and veins” of the national land, and creates many economic external effects that are not evaluated by the market. It is also predicted that in the future, water will increasingly be directly and indirectly traded as a good for production and services in the market. We believe that in order to maintain and improve sound water circulation in Japan, it is necessary to promote research on water as a public good. The external economic effects of properly using water for agriculture, and the large amounts of labor and capital invested to maintain the health of water channels, must also be properly evaluated.

4. Directions for optimum water use in the future

(1) Promoting awareness of water for agricultural use

Recognition of the need

Given that the world’s population is projected to continue growing in the future and that demand for food will gradually increase, the question of how to increase farm production has become an issue. On the other hand, the world’s cultivated acreage has recently leveled off, and so improvement in land productivity through innovation has become increasingly important for global agricultural production. It is therefore necessary to recognize again that securing water for agricultural use to meet the increase in food demand will become more important in the future.

Recognition of regional characteristics

Agriculture is carried out by taking advantage of local resources such as soil and water, and is an industry intimately linked to and inseparable from the natural environment. This means that water for agricultural use also displays various aspects determined by the local region from every aspect, including the amount of water available for raising crops, irrigation methods, the kinds or scale of irrigation facilities such as drainage and irrigation channels or reservoirs, and methods of water supply management. Moreover, in each region of the world, the water circulation that supports water resources varies from arid regions to humid regions, as represented by rainfall and example, and the water for agricultural use that comprises part of water circulation is greatly affected by the water circulation of each region, so the conditions for using agricultural water will vary. Thus we should recognize that the water for agricultural use has significant regional characteristics in terms of supply and demand.

(2) Optimum use of water for agriculture around the world

The need for discussion based on regional characteristics of water for agricultural use

Together with the increase in the world’s population and social and economic development, the world’s demand for water continues to increase. Fresh water is available in easily used forms on the earth’s surface such as lake and river water, however, is extremely limited, which demands that we use these limited water resources in a sustainable manner as we continue to maintain sound water circulation. Yet despite the fact that water is a critical factor in the water circulation cycle, and is an indispensable factor in producing food, arguments are also being made that because 70% of the world’s total volume of fresh water is consumed by agriculture, this sector should reduce its water requirement so that more water can be diverted to other uses.

Water for agricultural use around the world is quite diverse however. For example, considering the sustainable use of underground aquifers, there are examples in arid regions where pumping of agricultural water for irrigation has depleted groundwater resources. In contrast, agricultural water used to irrigate paddy fields in humid regions frequently serves to replenish underground aquifers. As this illustrates, the characteristics of irrigation on which any discussion is based will differ depending on the region.

Accordingly, when discussing the world’s agricultural use, such discussion should be adequately based on regional characteristics.

Desirable water use for agriculture in arid regions

Agricultural production provides multifunctional roles such as land conservation, recharge of water resources and conservation of the natural environment. These functions are demonstrated mainly by irrigated paddy field. In the future, we need to maintain and form sound water circulation, it is necessary to appropriately demonstrate such functions.

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Mutual cooperation by farmers who play a central role

In traditional irrigation, organizations centered on farmers independently handled matters such as the efficient, impartial distribution of water resources, and came to play a key role in the maintenance and formation of sustainable water use and sound water circulation. But, with the large-scale irrigation facilities developed after World War II, examples also can be cited in which adequate functions are not evident, frequently in such cases, irrigation facilities are managed under government direction, and management efforts have become erratic as demands on government finances have grown. In such cases, programs to resolve such issues through a transition to participatory irrigation management (PMI) involving local farmers have become a global trend. Moreover, in local communities, individuals capable of recognizing water-related issues - such as the volume of water required for food production and drinking water or the influence and effect that water use exerts on the natural environment - are their most important problem are precisely those individuals who use water, the farmers who manage and use agricultural water are expected to play a central and active role. Therefore, it is necessary to maintain and form sustainable water use and sound water circulation, all people who are concerned about and affected by water use, including farmers, should recognize the role that each individual can play and work independently to fulfill his or her own role.
of opportunities such as the world water forums to develop mutual cooperation, by pursuing their common experiences with irrigation management, and contribute to solutions to global water issues.

(3) Optimum use of water for agriculture in Japan

The road to solving problems begins from concern about water for agricultural use

On a calorie basis, Japan’s food self-sufficiency rate is about 40%, and Japan is dependent on imports for many food items. If we relate Japan’s current condition to focus on the agricultural water used when such imported agricultural products are grown, one could say that through its imported agricultural products (Japan issuing the agricultural water in regions outside) Japan to enjoy an abundant diversity of food. While it is believed the producing areas for imported agricultural products are diversified among various regions, it is also possible that agricultural products produced in various regions, where water resources are not abundant, are included among these imports.

To help solve the water-related issues facing the world, each citizen must first develop a concern regarding issues such as the need for water for agricultural use and its regional characteristics, and the relationship between the world’s water for agricultural use and lifestyle. Next, to develop this understanding, we should recognize that achieving sustainable utilization of water for agricultural use is important both for the earth and for Japan. For this purpose, efforts to disseminate information on topics such as population, food products, and water and agricultural land conditions, and activities such as education or study for every age group from children to senior citizens, in various locales including local communities and the home, will also be effective.

Securing appropriate water for agricultural use, sustainable use, and sound water circulation

Originally, individuals in rural villages of Japan engaged chiefly in agriculture and lived in close touch with nature, going about their lives as they maintained the national land. Agriculture was the central activity of a society based on recycling, where man and nature lived together, and people used various resources such as rice plant straw and “night soil” by re-circulating them. Water for agricultural use also played a key role, and was deeply intertwined with traditional Japanese culture and way of thought. As time passed, numerous production resources were invested into the resource circulation of rural communities from the outside, as farmers sought greater economic efficiency in agricultural production. Even today, however, as part of regional water circulation, water for agricultural uses combined with the natural water circulation helps not only agricultural production but also demonstrates the multifunctional role of agriculture.

In order to provide stable food supplies in the future and appropriately demonstrate the multifunctional role of agriculture in Japan, it is important to appropriately ensure water for agricultural use. In addition, to construct a society where people and nature coexist and agricultural production and the natural environment are in harmony, the preferred approach will be to utilize water for agricultural use in a sustainable manner, based on the recycling-type society experience that has been practiced in rural communities, and to form and maintain sound water circulation in which the utilization of water for agricultural use and locally available water circulation patterns are integrated.

Expectations towards land improvement districts

Japan’s irrigation system is often described as “arteries and veins” that have enriched the country through long years of use. Moreover, viewed from a global perspective, the majority of Japan’s irrigation facilities have been maintained and operated extremely well by the land improvement districts, made up of local farmers, indeed, roughly 80% of the 40,000 km of major irrigation and drainage channels is managed by land improvement districts. Since the high economic growth period, however, as the gap in profitability between agriculture and other industries has widened, and the aging of farm households and the shortage of individuals to take over existing agricultural holdings is becoming more severe, the farm population has shrunk, and farmers have taken up other jobs in other industries. There are misgivings concerning issues such as the management required to address irrigation facility obsolescence, even though land improvement districts are working to fulfill this role. In order to achieve sound water circulation that combining local natural water circulation with appropriate and sustainable water circulation for agricultural use, both agricultural production by farmers and their associations, and sustainable management of agricultural water mainly by the land improvement districts, must be continued.

As part of this effort, it is important that the land improvement districts overcome the issues they face today, and continue to fulfill their role in the management of water for agricultural use and irrigation facilities.

Towards the formation of sound water circulation; efforts by land improvement districts and all local individuals

Water for agricultural use, which accounts for a large share of total water use, is combined with natural water circulation in a region, and is an important element for the maintenance and formation of sound natural water circulation. Nevertheless, it is also important that water use be sustainable in all forms of use. Therefore, for water circulation from the time when rain falls on the land until it flows to the sea, the best approach is for every individual who uses water to recognize the role fulfilled by land improvement districts or the issue addressed by land improvement districts, such as increase of waste processing and installing safety facilities, as part of the ongoing urbanization and mixed residential use of rural communities, and to cooperate in overcoming all issues.

Moreover, land improvement districts must also not merely continue to fulfill their present role, such as management of irrigation facilities, but should aggressively strive to gain the understanding and cooperation of all of the people in their area with regard to the district’s role and issues.

Land improvement district efforts as a model approach

We believe that this type of land improvement district effort will provide a case model for the maintenance and formation of sound water circulation in every part of the world. We also believe that efforts by farmers organizations in Japan, such as the land improvement districts, to continue providing information on examples of their various undertakings and support mutual cooperation with farmers around the world, will be an effective contribution by Japan to help solve water-related issues which have become global in scope.

Conclusions

Water is a resource that places limits on our existence as it circulates around the earth. Together with nurturing diverse living things, including human beings, water is indispensable for the farm production that supplies our food. Therefore, the quantity of water for agricultural use, which is indispensable for agricultural production, is also expected to continue increasing in the future as the world’s population continues to grow. To achieve sustainable development in the future and to eradicate poverty, human beings must maintain sound water circulation patterns in each region of the world, but must secure the water necessary for food security and rural development, and use water in a sustainable manner based on the characteristics of each part of the globe.

We believe that sound water circulation means that the entire water circulation process in a region, combining the original natural water circulation with the artificial water circulation needed for agricultural production and daily human needs according to the characteristics of each region, can be sustained in a superior mode both qualitatively and quantitatively. Naturally, this demands that sound water circulation also be harmonious with local ecosystems and other aspects of the natural environment.

Despite the fact that water for agricultural use displays local characteristics, such use accounts for a large portion of global water demand and makes a vital contribution to the maintenance and formation of sound water circulation. A good example is paddy field irrigation in humid regions, which demonstrates the multifunctional role of agriculture such as groundwater recharge, when water for agricultural use is utilized appropriately.

Because the multifunctional role of agriculture is displayed through agricultural production, the manifestation of these functions depends upon agricultural production carried out by farmers and their organizations or the management of water for agricultural use. In other words, farmers’ independent activities contribute to the maintenance and formation of sound water circulation.

We hope that in every region, each individual concerned about regional water issues will strive to appropriately understand and evaluate the effects of their own independent farmer activities, pursue cooperative relationships, and work towards the maintenance and formation of sound water circulation by fulfilling their respective roles.

In every part of the world, we look forward to the creation of sound water circulation societies by promoting proper development of the social infrastructure such as irrigation facilities, the technology for managing these facilities or water for agricultural use, social systems such as regional agreements and common practices that make such facilities perform adequately. This requires the independent participation of every individual who is involved with water, including farmers.