Efficiency in Japan's Agricultural Water-Use -Consideration of Economic Measures-

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Introduction

Agenda 21 of the Rio Declaration on Environment and Development put the subject matter of water crisis on the global agenda. Since then, a plethora of conferences have taken place debating the topic of water resources in the international community. Also in Japan, the third World Water Forum convened in March 2003, which discussed the growing concern over global water resources.

One of the main topics at this conference was the introduction of economic principles into water management. It is said that the way water was managed up until now, priced low giving hardly a reason for efficient use to the user, is becoming a problem for sustainable use. By treating water as an economic good, principles are put into play that may have positive effects on water-use. At this Forum, there was hot debate concerning the introduction of such economic principles to the management of agricultural water, which amounts to a large proportion of total water used world-wide. However, can economic principles be applied to the way agricultural water is managed in Japan? Currently in Japan, water management is left up to the community putting the LDI (Land Improvement District)[1] in charge. Nevertheless, there are no economic principles in such type of management. In this paper, we consider the introduction of economic measures to improve the efficiency of agricultural water-use in Japan

[1] Refer to ANNEX

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Chapter 1 Climate Change and Water

In this chapter, the present condition of water resources in the global community and in Japan will be explained. Next, the effects of climate change on the water resources will be discussed followed by the social changes that are likely to occur in Japan.

1-1 Global Warming and its affect on Water Resources

1 -1 -1 The present condition of the water resources in the world

(1) Water-Resources

Of the 1,385,984 thousand km^3 of water existing on Earth, only 0.8% of this water or 10,635 thousand km^3 is fresh water. Moreover, 0.8% of this fresh water is groundwater, leaving only 0.01% of the water or 105 thousand km^3 of water as fresh water that is easily accessible to human beings.

(2) Water Use

The amount of the water being used globally reflects the increase of population and the rapid improvement of living standards. During the 45 year period from 1950 to 1995, the quantity of water used increased 2.6 times. In 1995, the agriculture sector used 70% of total consumption, which has always had the lion's share of water. Industry and urban use was 20% and 10% respectively.

1 -1 -2 Global Warming and its Effects

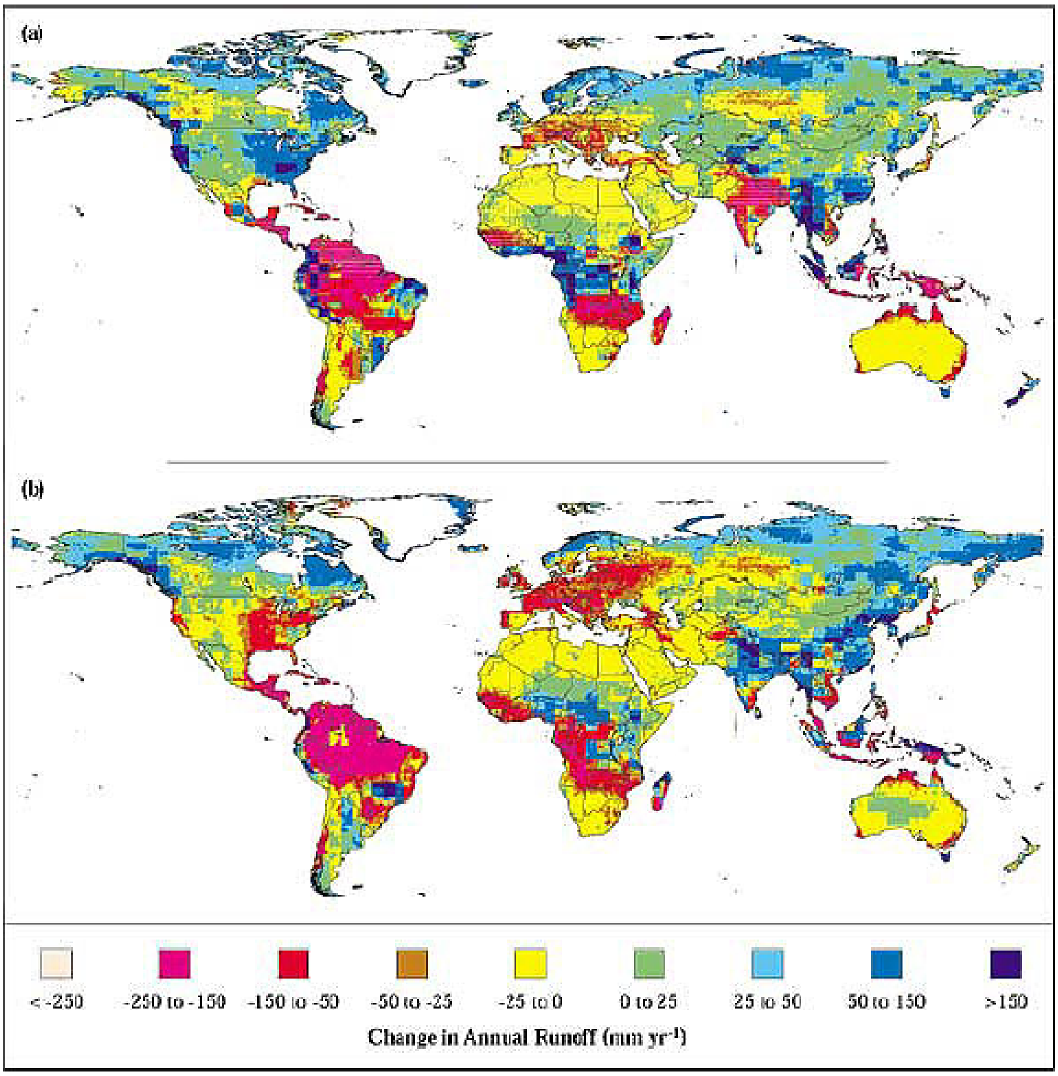
(1) Climate Change

According to IPCC (2001), during the past 1000 years average climate had been stable until the 19th century. Entering the 20th century, however, the climate rapidly increased due most in part to human activity. The increase of average global ground temperatures in the past 100 years is reported to be about 0.6℃. This increase is predicted to continue throughout the 21st century, making temperatures much warmer than the current situation.

(2) Effects on Water Resources

It is reported that the average evaporation and precipitation will also be affected. Table 1-1 shows the predicted change in surface water as a consequence of global warming.

Chart 1 -1 Effects on Surface Water Due to Climate Change, prediction for 2050[2]
(a): HadCM2[3] (b): HadCM3[4]



According to this simulation, average global evaporation and average precipitation will increase in the 21st century in many scenarios. Moreover, precipitation will likely increase in the higher latitudes of the northern hemisphere and in the southern hemisphere, while the continents of lower latitudes will experience both increases and decreases of precipitation. In this way, there is a great possibility that fluctuation of precipitation will grow.

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[2] IPCC (2001)
[3] HadCM2 means coupled atmosphere-ocean general circulation model (AOGCM) that was developed by the Hadley center in 1997.
[4] HadCM3 means coupled atmosphere-ocean general circulation model (AOGCM) that was developed by the Hadley center in 2000.

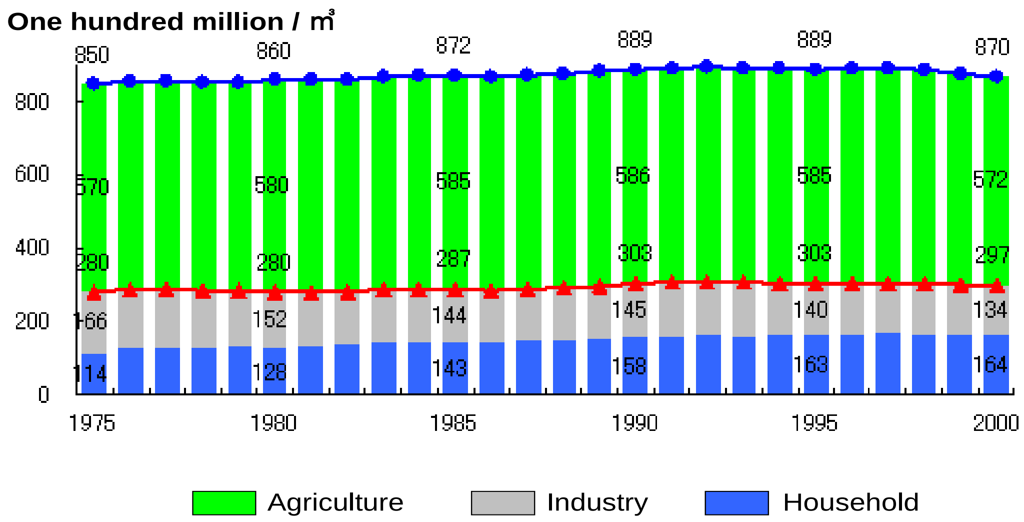
1 -2 Effects of Global Warming on Japan's water recourses

Climate change and its effects on water resources are global and Japan is no exception. Here, a close look at the situation in Japan concerning abnormal weather due to changes in precipitation is given a closer look.

1 -2 -1 Water resources in Japan

Japan has about 4,200 hundred million m^3 on average of water resources, while consuming approximately 870 hundred million m^3 a year[5]. As chart 1-2 shows 65% or 572 hundred million m^3 goes to the agricultural sector, 15% to the industrial sector, and 20% to the household sector.

Chart 1 -2 Amount of the water used in Japan[6]



source: Ministry of Land, Infrastructure and Transportation

1 -2 -2 Present Situation of Global Warming and its Effects

(1) Temperature

According to the Meteorological Agency (2002), ground temperature increase is said to be about 1℃ for every 100 years. This is due to the higher concentration of greenhouse gasses emitted by human activity. Much of the increase has occurred

[5] Based on Water Withdrawal in 2000
[6] Ministry of Land, Infrastructure and Transport homepage

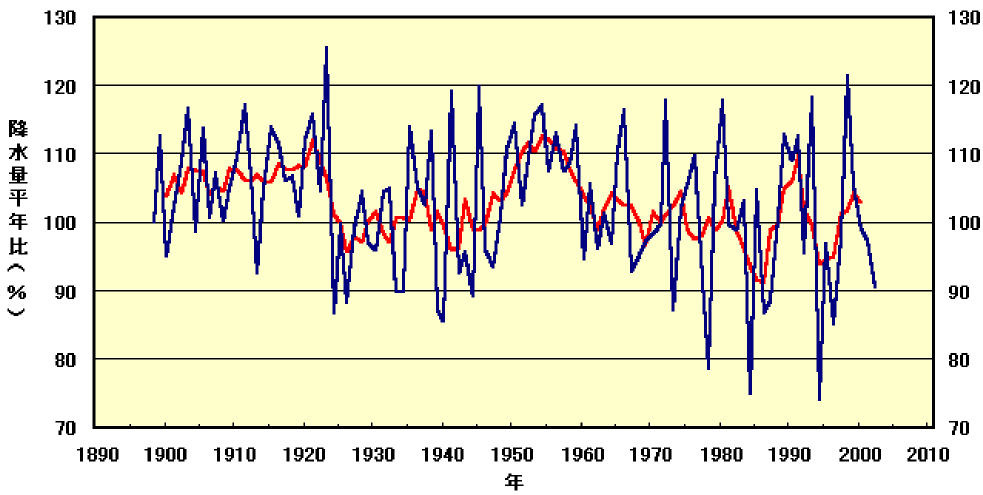
towards the end of the 1980's and temperatures reached record highs during the latter 1990's.

(2) Change of Precipitation and Abnormal Weather

Chart 1-3 shows the change in precipitation illustrating a decrease in the long-term. Also, the width of fluctuation has been growing, which can especially be seen starting in the 1970's.

This change in the amount of precipitation suggests frequent abnormal weather in the future. Abnormal weather includes concentrated heavy rainfall and drought, which in fact have been observed in recent years in Japan.

Chart 1 -3 Changing Precipitation in Japan[7] (1898 -2002)



A blue line shows that the average of the ratio to normal year precipitation in reference at 51 spots
A red line is a normal year ratio.5 A year moving average is shown.

1 -2 -3 Concern for Sustainable Water Use

The state of global warming and its effects on Japan has been mentioned above. To summarize, climate is rising 1 ℃ for every 100 years, a rate higher than the global average of 0.6℃. Precipitation is gradually decreasing, while fluctuation is widening. This is becoming apparent from the abnormal weather in recent years which is likely to become a greater concern in the near future as the situation becomes more serious. As a result of these effects, water supply is predicted to decrease while demand will increase due to higher temperatures and climatic aberrations. The paper written in 2002 by

[7] Japan Meteorological Agency(2002)

seniors of the Yamaguchi seminar discussed ways for adaptation to such change, which is summarized in box 1.

1 -2 -4 the technique about a concern dissolution

As mentioned earlier, agricultural water uses as much as 65% of total consumption I Japan. For this reason, greater efficiency in this sector could promote sustainable water use. Currently, water is managed by the farmer community in which *bansui* and *hanpuku-riyou*[8] methods are the main ways to lower levels of water use. However, we examine economic measures as another method to induce efficient water use.

[8] Refer to ANNEX

Box 1 Methods of Adaptation

Securing water resources for future use is an important concept when alleviate unsustainable water use due to fluctuation of water supply and demand. In order to do this, there are two possible viewpoints: demand-side management and supply-side management. Supply-side management treats water like an infinitely renewable resource by constructing projects that ensure withdrawal of water. On the other hand, demand-side management tries to control water use at the user level to reduce withdrawal.

Supply-side management centers around building big costly dams. Nevertheless, in recent years environmental awareness and opposition against expensive public-works has made supply-side demand difficult. This is why demand-side management has gained wide acceptance and achieved recognition to be a possible way in realizing the sustainable use of water resources.

Reduction potential of Water Withdrawal

	percentage of water withdrawal for each sector	present measures for efficient water use	reduction potential of water withdrawal
Household	20%	·promoting water saving and water for miscellaneous use	Yes
Industry	15%	·promotion of using recycled water	No
Agriculture	65%	·historical methods ·renewal agricultural irrigation	Yes

About household and industry, the former has the possibility of reduction potential of water withdrawal with the present condition, on the other hand, the latter attaints the efficient use of water by this time, so it is thought that there is no room of reduction not much. Agriculture has the room of reduction potential of water withdrawal. So it uses 65 % of all amount of the water, if it is attained to induce the efficiency of agricultural water use, it will contribute to stabilization of water management in Japanese future greatly.

Chapter 2 Agricultural Water as an Economic Good

In a chapter 1, the fluctuation of water demand and supply as a result of climate change was explained. Problems that may occur because of this unstable situation of water resources should seriously be considered globally as well as in Japan. To alleviate the possibility of water shortages, efficient use of agricultural water has the potential to play a major role in the reduction of water withdrawal. In recent years, the introduction of economic principles in the management of agricultural water has become a hot topic at international conferences held around the world. Can such economic principles be applied to the system in Japan as well? In order to examine this, we take a look at what it means to treat water as an economic good in the next section.

2 -1 International Recognition

Principle 4 of the Dublin Statement put the concept of water as an economic good on the international agenda. This principle was adopted at the International Conference on Water and the Environment (ICWE) in Dublin, Ireland in 1992 reads, *"…water has an economic value in all its competing uses and should be recognized as an economic good"*. Water experts at the conference realized that past failure to recognize the economic value of water had led to wasteful and environmentally damaging uses of water resource. Managing water as an economic good was seen as an important way of achieving efficient and equitable use. Also, this would encourage conservation and protection of the resources.

In more recent years, the World Water Forum has convened and presented the World Water Vision, in which the concept of "full cost pricing"[9] for water management is introduced. Making users of water pay for the full cost of water would make them realize the true expense, promoting efficient water use.

Especially, making farmers pay for the true cost of the water they use, which accounts for a large proportion of total consumption, is critical. It is important to treat water resource like any other limited resource, such as land or oil, in this current society where the water use may in fact become unsustainable. In the next section, possible economic measures for the agricultural sector, pricing and trading, will be discussed.

[9] Refer to 2-2-2

2 -2 Appropriate Water Price (Pricing)

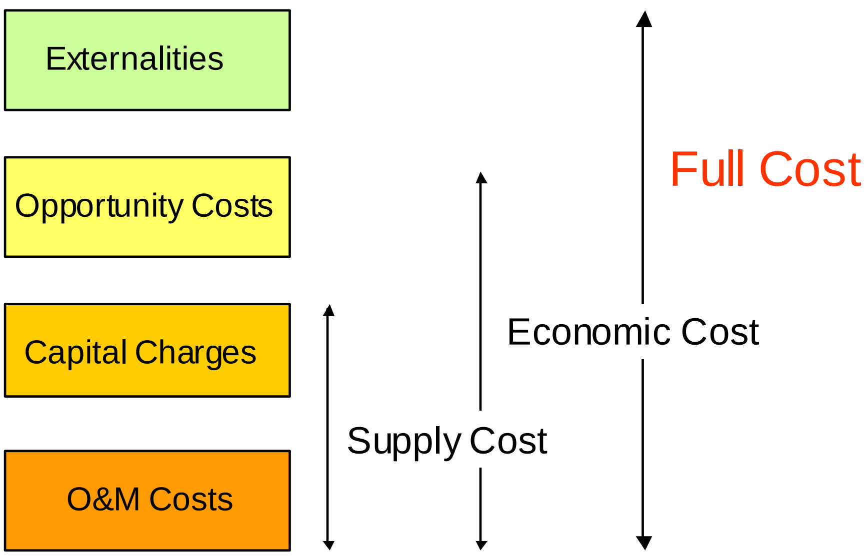
2 -2 -1 Pricing

The price of water varies greatly among users, while the agricultural sector is generally charged the least out of the sectors. Changing the current price structure to better reflect actual prices is called pricing. Pricing agricultural water has become a topic of hot debate only in recent years, so there is no definition as to what the appropriate price actually is.

2 -2 -2 Costs that should be collected

If water resources are to be treated as economic goods by applying economic principles, water prices should include the all costs needed in supplying that water. In reality, however, it is near impossible to price water in this way. In the following section, the costs that should be collected through pricing along the lines of the User Pays Principle declared by the OECD will be explained. Chart 2-1 shows the three concepts when pricing water, which are the supply costs, the economic costs and the full costs.

Chart 2 -1 Components of Full Costs[10]



Supply cost consists of operation and maintenance costs (O&M costs) and

[10] Rogers et al (1998). It creates on a basis.

capital costs. O&M costs are the running costs of the supply system, which go to labor, repairing facilities, distribution, treatment plants and expenses for managing the storage of water. Capital costs include the depreciation charges and interest costs of water supply facilities such as reservoirs, treatment plants and distribution systems. The economic cost, as can be seen in the table, is the sum of the supply cost stated previously and the opportunity costs. Opportunity costs realize the fact that a user consuming water is depriving another user of the water. Opportunity costs must be taken into account only when the marginal productivity of the person(s) using water is lower than the person(s) being deprived of that water. In other words, if the user being deprived of the water has a higher value for the water, then there are opportunity costs occurring in the society as a whole as a result of misallocation.

Finally, the concept of full cost adds environmental externalities to the economic cost stated earlier. This can either be a negative or a positive factor on the price. For example, if by using water for agriculture has negative affects on the ecosystem such as salinity of soil or contamination due to pesticides etc., then the externalities should be internalized pushing the price of water up. On the other hand, positive externalities may occur, such as the recharging of groundwater aquifer, should also be incurred in which case the price would be lowered. It should be clarified, however, that environmental externalities are often difficult to valuate in economic terms.

From the viewpoint of UPP (User Pays Principle), the user should be charged for the full cost of water. Nevertheless, due to difficulty in estimating the externalities and also because of subsidies to water, not many countries are able to charge the user of agricultural water the full costs. In fact, economic costs are barely covered by the charges currently in place. It is reported that farmers pay anywhere between 60%-100% of the O&M costs, while paying only a fragment of the capital costs involved in the supplying of water[11].

Yet, it must be noted that in recent years, as a means to create efficiency in water use and also to alleviate financial burdens of the government, many countries are leaning towards charging the user for water use or increasing the current price structure. O&M costs are beginning to be recovered at the minimum in the international community. Also, from the perspective of collecting fees, privatization of waterworks is another topic of debate. Transferring management of water resources from the government to the private sector could bring efficiency into play, since privately run firms would charge the user more appropriately than the government.

[11] Kenji Yoshinaga (2000)

As it was mentioned briefly above, subsidies and environmental externalities make it difficult to recover the full cost of water from the user. Here, a closer look is taken at these two barriers.

2 -2 -3 Subsidies

The price of agricultural water has been kept low in many countries by subsidization to this sector, in order to promote viable farming systems, alleviate poverty and ensure food security. For this reason, the price of agricultural water is far from what it actually should be. In other words, the price does not properly reflect the components of the costs mentioned in section 2-2-2. Compared to when there are no subsidies in place, production costs for the farmers are low, leading to over-production of crops. This in turn leads to further demand of water. Moreover, generally speaking, marginal productivity of crops decreases as production increases, meaning more water is needed to grow another extra unit. When water consumption is made possible by subsidies and this use of water is causing externalities such as water pollution, then the subsidy is can be labeled as being environmentally damaging. Subsidies need to be eliminated or reduced, if water is to be priced appropriately.

2 -2 -4 Evaluation of Environmental Externalities

The evaluation of environmental externalities is difficult, since socio-economic factors and price of water range from country to country. Hence, charging farmers the full cost becomes a difficult as well. Although in recent years, much research is being done to establish a method for the evaluation of the environment and the effects on it mostly due to human activity, there seems to be no method that satisfies all the entities involved with the decision making process of pricing water.

2 -2 -5 Pricing Structures

There are several charging structures such as area-pricing, volumetric pricing and two-part tariff pricing. As the components of costs charged vary among countries, the pricing structures differ as well. Table 2-2 shows several of these as examples.

Table 2-2 Pricing Mechanisms[12]

Area-pricing	Charge for water used per unit of irrigated area
Volumetric Pricing	Charges based on consumed volumes or time
Two-part tariff pricing	Volumetric pricing + fixed annual charge
Volumetric-pricing with a bonus	Volumetric pricing + reward if consumption is below a certain volume (or penalty for over-use)

The objective of each pricing mechanism differs. For example, by area-pricing, charges collected are stable compared to volumetric pricing. By using the volumetric pricing, farmers become aware that the more water they use, the more they must pay. This would give an incentive to the farmer to use water more efficiently.

2 -3 Tradable Water Rights (Trading)

2 -3 -1 Trading

Besides pricing, trading can also be considered as an economic measure that induces efficiency to the user. By giving out and assigning rights that can be traded, a market may be established, in which those rights are treated as economic goods. Several examples are the system of the much debated emissions trading subsequent to the Kyoto Protocol, fishery rights, and water rights. Several forms of such type of market are already in place in other countries.

2 -3 -2 Establishing a Water Market

In this section, the mechanism in which a water market works will be discussed. A water right gives the holder of the it the right to abstract and consume a certain amount of water from a river. Assigning water rights to those in demand would create a water market, if those rights are tradable. When a market is established, the farmer with a higher marginal productivity would buy water rights from the farmer with a lower marginal productivity until the point where their marginal productivities equal one another. In other words, the farmer with the higher marginal productivity would have more value in the water than the other, rendering the price of the water right to be more than what the farmer with the lower marginal productivity values the same water. In this case, it would be better for both entities to trade water rights. Also, if water rights can be sold in the market, users would have motivation to reduce their

[12] OECD (1999a)

own use in order to sell the rest off in the market to other users.

Water rights can be assigned to farmers based on actual records of historical use or given out by auction. In either case, theoretically the price of water would be the same; however, there would be a transfer of income when water rights are decided according to auction. On the other hand, giving out water rights based on historical use concerns vested political interests.

2 -3 -3 The Preconditions for the Establishment of a Water Market

For a water market to be carried out successfully there are several preconditions that must be satisfied[13]. They are (1) clarified water rights, (2) infrastructure for the transportation of traded water, (3) evaluation of environmental externalities, (4) information transparency between the buyer and seller, (5) prospect of future water resource from precipitation.

The first criterion, clarified water rights, requires the allocation of water rights by either grandfathering or auctioning. Grandfathering is based on historical water use and assigns water rights without charge to the person in demand. On the other hand, auctioning water rights causes transfers of income between the river administrator and the buyer of the water right.

The second precondition requires infrastructure for the transportation of water being traded from one entity to another. This includes facilities for water storage and pipes that are needed to draw water from the river.

The third criterion is evaluating environmental externalities. This is necessary as stated in earlier chapters to reflect the true cost of water use. When trading takes place and the user changes, the effects on the environmental due to the use of water may change as well. In this case, third parties may be affected indirectly, however must be taken into consideration.

The fourth precondition, the transparency of information between the buyer and seller of water rights is essential. This is especially important when all sectors are participating in the market, since the water quality in demand is far from homogeneous between the sectors (agriculture, industry and household). Information asymmetry needs to be resolved in order for the market to work without failure.

Finally, the last precondition assesses the fact that there is an uncertainty in future precipitation. This becomes a problem because the amount of water resource that may be traded in the market will be uncertain as well, which may cause fluctuation of water prices leading to disruption in the market.

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[13] Kenji Yoshinaga (2000)

Chapter 3 Applying Economic Measures in Japan

In chapter 2, the two economic measures of pricing and trading were described. In this chapter, the possibility of applying these measures in Japan will be discussed.

3 -1 Reforms of Water Price

If water is to be handled as an economic good, pricing water so that it reflects the full cost and charging the user based on volumetric pricing is ideal. When the pricing is structured in this way, farmers will no that the more they use the more they will have to pay. They will make an effort to use less water so that their bills will be lower, which will in turn result in the efficient use of water. In the international community, it has become a common notion that water in the agricultural sector, especially irrigation, should introduce economic measures to promote efficient water use since water in this sector is often thought as being wasted.

So, what are the barriers when applying such economic measures in Japan? First and foremost, when if a volumetric pricing system is to be used, facilities that enable the metering of water volumes is essential. In many countries, meters and not installed in which case, area- pricing system is utilized. This is the current situation of Japan as well. Hence, if volumetric pricing is to be implemented, metering facilities need to be put into place. However, the costs of initial installation and monitoring water use later on are often expensive, sometimes outweighing the benefits of applying volumetric pricing. In a study[14] done by Tsar and Dinar if the implementation costs of water metering exceed 10% of the charges that will be collected through volumetric pricing, then it is better to stay with area-pricing. As this study shows, cost-benefit analysis should be done in order to compare the costs and benefits from introducing volumetric pricing, before actually changing the current pricing system.

Another important point that needs to be considered is that the environmental externalities stemming from agricultural in Japan, is quite different and complex than in that of other countries. The irrigation in Japan plays many roles apart from the production of crops[15]. For example, the benefits experienced in society such as shaping landscape, diminishing erosion and protecting downstream areas from flood.

[14] OECD (1999a)
[15] See also ANNEX

3 -2 Establishment of a water market

To review what has been said in section 2-3-3, the preconditions that need to be met when establishing a water market are as follows:

(1) Clarified water rights
(2) Infrastructure for the transportation of traded water
(3) Evaluation of environmental externalities
(4) Information transparency between the buyer and seller
(5) Prospect of future water resource from precipitation.

Each of these preconditions will be discussed in order to assess whether it is possible to establish a water market in Japan. (1), (2), (3) and (4) are barriers that exist within the social system and practices of Japan. Especially concerning (1), much debate is necessary since there are many stake-holders who are involved with defining and clarifying water rights. Nevertheless, it is not impossible to meet such conditions in Japan, as long as enough time and money are not problems. This is discussed next.

(1) Clarified water rights: Currently, rights written down in the River Law concerning agricultural water are historical water rights and water use rights.

(2) Infrastructure for the transportation of traded water: Cost-benefit analysis need to be examined before actually constructing or upgrading facilities that enable trades to take place. Obviously, the costs incurred for improving facilities must not outweigh the benefits of trading water rights.

(3) Evaluation of environmental externalities: As it has been mentioned in chapter 2, research and development of methods to evaluate the environment are well underway. These methods must be transparent and reliable so that they are acceptable to the stake-holders. This would make the internalization of externalities possible.

(4) Information transparency between the buyers and sellers: Information asymmetry often leads to market failure. Nevertheless, there are examples of ways to overcome such a barrier. In California, information is computerized, enabling the smooth trading in the market place. Also, transaction costs are reduced by having such an electronic database.

The most problematic precondition that may be a barrier is the fifth one, having an accurate prospect of future water resource so that fluctuating prices do not create chaos in the market. The elimination of fluctuating prices is most likely a problem for Japan, which lies in the heart of the Asian monsoonal region. Precipitation varies greatly throughout the year, which means that the quantity of tradable water rights would differ from time to time as well. Agricultural water is for the most part, drawn from rivers so precipitation has a direct impact on available water. In California, where the water market has brought about considerable benefits, most of the rainfall is in the spring time. This water is stored for the summer season, when water is in demand for the production of crops. Hence, the amount of available water resource is known at the point when each farm plans their production for the summer to come. If the farm is short of water, buying water rights from the water becomes an option. On the other hand, the situation in Japan is different. Since the rainy season and the cultivating season overlaps, it is difficult to predict how much water is available at the time when the production of crops is planned.

Conclusion

It is not that we are criticizing the current community management (LID) for wasteful use of water resources. In fact, it is Japan's geographical, historical and cultural factors that have lead to such style of management and parts of this system should be recognized as promoting the efficient use of water resources. Nevertheless, as water resources continue to deplete and future availability in becoming more uncertain due to such reasons as climate change, more aggressive actions need to be taken to promote efficient use. In this paper, we considered the introduction of economic measures as the means to do so.

ANNEX Japan's Agricultural Water Management

This ANNEX, will describe the present situation of Japan's agricultural water management. Rice field irrigation, which occupies a great portion of water for agricultural use, will be focused upon and its management system and new measures are explained.

1 Japanese rice field irrigation

1-1 Japan's climate and rice field irrigation

Japan is endowed with a lot of rain. The annual average precipitation is about 1,700mm, which is about twice the global annual average precipitation. As the feature of climate and country, river flux changes in the immediate term and the outflow to the sea is early because of many torrent rivers. In addition, there are many floods.

Under such conditions, rice field irrigation in the agricultural sector efficiently uses water resources in the abundant rainy seasons. There are many advantages, such as supply of the manure ingredient by water for irrigation, control of weeds growth and stable productive capacity.

1 -2 Multiple functions of rice field irrigation

Rice field irrigation has multiple functions that are important features. Multiple functions mean functions other than crop production by rice field irrigation. In case of heavy rains, rice fields are effective in the storing of rain water, and it is useful in the prevention of soil corrosion in the inclination ground or the flood in the low flat ground. Moreover, it is reported for example[16] that groundwater from the rice field is used as household water or water for industrial use on the downstream of a river.

Economic evaluation of the multiple functions of the rice field irrigation has been done. Chart (a) shows the multiple functions with money evaluation.

Chart (a) Money evaluation of the multiple functions[17]

[16] The *Tedori* River in Ishikawa Prefecture and the *Shirakawa* basin system in Kumamoto Prefecture
[17] Science Council of Japan(2001)

Type of function	Evaluation technique	Amount estimated
Flood prevention	Substituting method	34,988 hundred million yen
Stable River flow	Substituting method	14,633 hundred million yen
Groundwater occurrence	Direct method	537 hundred million yen
Soil corrosion prevention	Substituting method	3,318 hundred million yen
Landslide prevention	Direct method	4,782 hundred million yen
Organic waste processing	Substituting method	123 hundred million yen
Climate relief	Direct method	87 hundred million yen
Health care, relaxation	Travel cost method	23,758 hundred million yen

2 Japanese Agricultural Water Management

2 -1 Land improvement district (LID)

A land improvement district is irrigation management that divides irrigated land based on a basin system. It is the management organization constituted by farmers which is the user of water for agricultural use, and is considered to be the core object of land improvement projects. In the present, there are 6,559 areas in Japan, and farmland amounts to about 3 million ha[18] in all. 70% of irrigation institutions in Japan are managed by the land improvement district[19].

2 -2 The role of LID

The land improvement district control and manage the irrigation institution of a specific area. The farmhouse pays a fee for the services provided by the LID and also provides labor, such as cleaning of a waterway, for reservation of the stable supply of agricultural water. The fee varies between ~~by~~ land improvement districts or areas. Its price is between 1300yen to 1600yen per 10a[20]. The rate of occupying the assessment from the farmhouse in the incomes is various among the land improvement districts. The incomes, such as the assessment and a subsidy or subsidy from the government, are applied to management of an irrigation institution.

In the case of a shortage of water, the supply and distribution of agricultural water are achieved by *bansui* (an appropriate distribution way) and *hanpuku-riyou* (repetitious use).

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[18] It is occupied 60% of the planted area of Japan.

[19] Ministry of Agriculture, Forestry, and Fisheries of Japan (2003b)

[20] The land improvement district homepage of an every place region

2 -3 Land improvement district A new measure

Japanese irrigation is praised by world experts of the water use because it takes advantages of the history and characteristic of a farm village area[21]. However, there are some problems, such as change of the social situation and superannuation of an irrigation institution.

Because of a reduction of irrigated area and the farmhouse number and urbanization in a farm village area, the union power and management consciousness of a farmhouse that had an important role in LID are decreasing. With the turn, the role of agricultural water which people ask for is also changing. In addition to the role for agricultural activity, the function of urban ~~city~~-use, such as water quality purification and processing of waste, is increasing.

An aging irrigation institution is also serious problem. It is expected that the number of institutions which should be renewed will increase ~~increases~~ from 2002 to 2010. Japan should manage them appropriately in order to succeed to the next generation.

With these issues at hand, new measures should be promoted. They are "21 Century land improvement district creation movement" that Japan LID organizations have been working on from 2001 and the integration and improvement of LID by Japanese government to integrate maintenance of a small-scale LID. The track record is shown at Chart (b). It turns out that the number of LID has decreased by combination of LIDs every year.

Chart (b) Change of the number of LID[22]

Year	1995	1996	1997	1998	1999	2000	2001	2002
The number of LID	7,681	7,573	7,414	7,297	7,137	7,004	6,783	6,559

LID has some important roles such as agricultural development, a stable supply of food and agricultural country environmental preservation through the management of farmland and irrigation institutions. Therefore, the projects to strengthen and activate LID are very important. The Japanese government is planning to economize agricultural water management by these measures.

[21] OECD (1999a)
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