PRINCIPLES AND METHODS FOR PARTICIPATORY IRRIGATION MANAGEMENT AND ROLE SHARING BETWEEN GOVERNMENT AND FARMERS

Dr. Masayoshi Satoh[1], Satoshi Kono[2], Tassanee Ounvichit[3]

ABSTRACT

This paper theoretically discusses the principles and methods for Participatory Irrigation Management (PIM), including the goals of irrigation management and obtaining farmers' cooperation in implementing water management systems. In addition, the principles for role sharing between governments and farmers are discussed. First, the Law of Diminishing Return is used to explain the relationship between the efficiency of an irrigation project and equal water distribution. The law explains that a governmental project has two independent goals of highest economical return and equity in irrigation management, both of which can be simultaneously realized under specific and limited conditions. Second, background is given on how to obtain the cooperation of farmers to show that cooperation is possible because of the competitive relationship of local farmers, not in spite of it. Third, the water distribution process is divided into four sub-processes of decision making, operation, monitoring and feedback. Traditional role sharing between the government and farmers' organizations is called "spatial role sharing" because lower levels of the canal system are handed over to farmers, while the main levels of the system are still totally managed by the government. Instead of the traditional method, "functional role sharing" is recommended, in which the government

1- Professor, Graduate [S]chool of Life and Environmental Sciences, University of Tsukuba, Ten-nodai 1-1-1, Tsukuba, Ibaraki, 305-8572 Japan, Phone: +81-29-853-4648,
E-mail: massa@sakura.cc.tsukuba.ac.jp
2- Graduate [S]chool of Life and Environmental Sciences, University of Tsukuba, Ten-nodai 1-1-1, Tsukuba, Ibaraki, 305-8572 Japan, Phone: +81-29-853-4899, E-mail: shitosanoko@hotmail.com
3- Policy Analysis Group, Planning Division, Royal Irrigation Department, 811 Samsen Road, Bangkok, 10300 Thailand, Fax: +66-2-669-5014, E-mail: ounvichit@yahoo.com

and farmers share functions based on the four sub-processes, according to each irrigation facility at the main, lateral or on-farm level.

1. INTRODUCTION

The world's irrigation area was 94 million ha in 1950, and tripled to 276 million ha in 2000 (Figure 1). This is a result of irrigation development, and can be viewed as a great achievement towards the more stable and increased production of food, and to contributing to the food supply for an increased population. This increase in the irrigation area is seen not only in developing countries but in industrialized ones. However, efficiency and sustainability in irrigation management are a challenge, especially in developing countries. Most of the irrigated areas in 1950 were traditional irrigation systems sustainably managed in a traditional way with farmers participating when necessary (Surarerks 1986, Ounvichit 2006). The present problems of irrigation management are mainly related to modern irrigation projects that have been developed after World War II, most of which are in Asia, Africa and Latin America, where many small scale farmers have to share an irrigation canal.

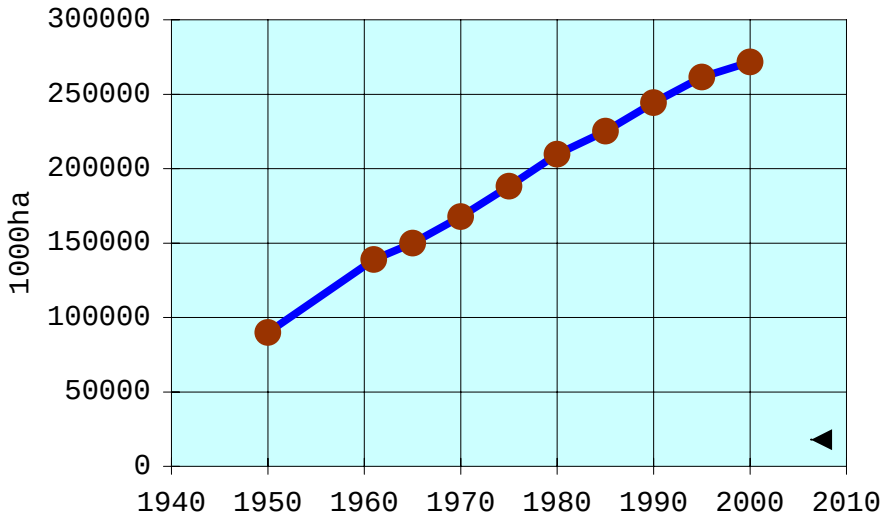

Figure 1 World irrigation area tripled during the latter half of the 20th Century (Source: FOASTAT, Brown 1999)

These irrigation projects have been initiated, planned, constructed and managed mostly by governments, but many experts now believe that irrigation systems should be turned over to local farmers to be managed by the water users themselves. Governments and international organizations around the world are attempting to implement this

"Participatory Irrigation Management" (PIM). However, it is widely recognized that the establishment of a water user's group, an essential element of PIM, and its stable management are very difficult (Vermillion 1997, Groenfeldt and Svendsen 2000).

For the success of PIM, it is critical to extract the common principles underlying successful irrigation management by analyzing experiences in traditional irrigation systems and to apply them to new and problem systems. These analyses should be carried out very carefully, because so many aspects of a country affect irrigation management. We know that a successful method in one region does not always guarantee success in other regions in other countries.

Japan achieved a rapid increase in irrigation areas from the 17th to 18th centuries that led to water conflicts similar to the conflicts the world is facing now. Consequently, Japan has a long history of water conflicts and resolution, and has developed its own style of managing irrigation projects. It employs a Land Improvement District (LID) system for irrigation projects, in which farmers manage their irrigation systems in an autonomous way, determining water distribution, operating the canal system, and collecting membership fees covering the entire cost of management. Thus, Japan is regarded as a country whose experiences in irrigation management deserve analysis and generalization.

This paper aims, based on the authors' experiences in Southeast Asian countries as well as in Japan, to discuss common principles for success in PIM, and to thereby present ideas that should be introduced into PIM implementation.

2. PROBLEMS OF WATER MANAGEMENT IN MONSOON ASIAN COUNTRIES

One of the special characteristics of the water management situation in East and Southeast Asian countries, including Japan, is that a large number of small scale farmers are the beneficiary of a project. Moreover, a farmer owns several plots dispersed over an area. The terminal ditches delivering water to these small plots are so small and earthen that it is impossible to measure the water used by individual farmers. Under these conditions, a water management company may not be able to run a business delivering water to each plot according to farmers' needs, unlike in the water supply sector or in large scale farming systems. The farmers inevitably have to be both users and managers of the water at the lowest level.

An important discussion point is expressed in the slogan, "From government to farmers." The incentive of farmers for a good water management is stronger than that of government bureaucracies (Groenfeldt and Svendsen 2000). Should the ultimate goal of PIM therefore be to transfer everything to farmers? Although government officers are now the official managers of irrigation systems in most countries and are achieving very low performance, transferring everything to the farmers may not be the best ultimate goal.

A real problem is that the illegal interference and no maintenance activity of farmers with irrigation facilities are leading to uneven water distribution and rapid deterioration of the facilities. What is needed is not the simple participation of farmers, but an adequately controlled participation of farmers. If this is undertaken, who would control farmers' participation? For what goal would someone undertake to control the farmers' participation?

The most fundamental and even practical problem may be that most government engineers, officers of international organizations, farmers and other stakeholders have no commonly shared understanding of the goals of water management, or of why, and in what form, farmers should participate. The idea from the World Bank, "The concept of PIM refers to management by irrigation users at all levels of the system and in all aspects of management." and "the PIM approach starts with the assumption that the irrigation users themselves are best suited to manage their own water." (INPIM) is widely accepted. This can work as a general guideline in promoting PIM. However, there have been very few discussions on the practical goals and methods needed to achieve this involvement. We need a clear image for the course of action.

3. DIFFERENT GOALS OF WATER MANAGEMENT IMPROVEMENT FOR GOVERNMENTS AND FARMERS

Investments in irrigation development are done mostly by governments (both central and local). In particular, farmers are not requested to cover the main construction costs, with some exemptions like Japan that requests monetary contributions from farmers, for main facilities as well as for on-farm ones. In this investment, the government mainly looks for the highest economical return from irrigation development. The broader targets of a government, such as poverty alleviation and increased social stability will, of course, accompany the project (Asian Development Bank, Hussein et al. 2002). But the first and most fundamental target of water management is still to harvest the largest

amount of food with the given amount of available water.

However, you have the farmers, each of whom will endeavor to make the maximum profit from the water flowing in front of them. The ability of farmers to obtain more profit is in itself a favorable thing, but not all of the farmers' goals can be realized at the same time under the limited availability of water. Farmers have to share the water. In the management of irrigation projects, farmers have a basic and rational demand, which is that they want to know the reason why a certain amount of water has been given to them at this moment, and they also want to be able to decide the amount and time of receiving water by themselves if they can. Seen in this light, we can surely say that farmers have a basic incentive for participating in irrigation management.

However, an important point to note is that the efficient and sustainable use of an irrigation project is out of the direct purpose of individual farmers' performance. An irrigation organization of farmers with such backgrounds is not easy to manage in accordance with the goals of the government. Our observations of irrigation projects in Asia and Africa has led us to conclude that the maximum benefit to the government or society is not realized if irrigation management is transferred to farmers or farmers' organization with no intervention from the government (Ishii et al. 2005, Sato and Satoh 2006). Therefore, farmers should not be allowed or expected to manage the project themselves. We should again confirm the final goal of water management improvement for the project or the society, and the methods for realizing the goals of PIM should be continuously sought.

4. TARGET OF WATER DISTRIBUTION

Let the major target of water management be to gain the maximum yield under the given irrigation conditions. Then we need to know what water distribution will gain the maximum under a given amount of water. Here, the authors introduce the Law of Diminishing Returns, which is widely used in economics. This law may be applicable to the irrigation of farmland (Figure 2). It suggests that the first one unit of water applied to rain-fed farmland has large benefits, but that the marginal benefits decrease as the water application increases, though the total benefit continues increasing. It means the relation curve for irrigation and yield is convex upward. The marginal benefit will eventually reach zero when the total benefits have been reaped. By applying this law, we understand that the maximum benefit of irrigation is realized when the available water is allocated equally among individual plots in the project area.

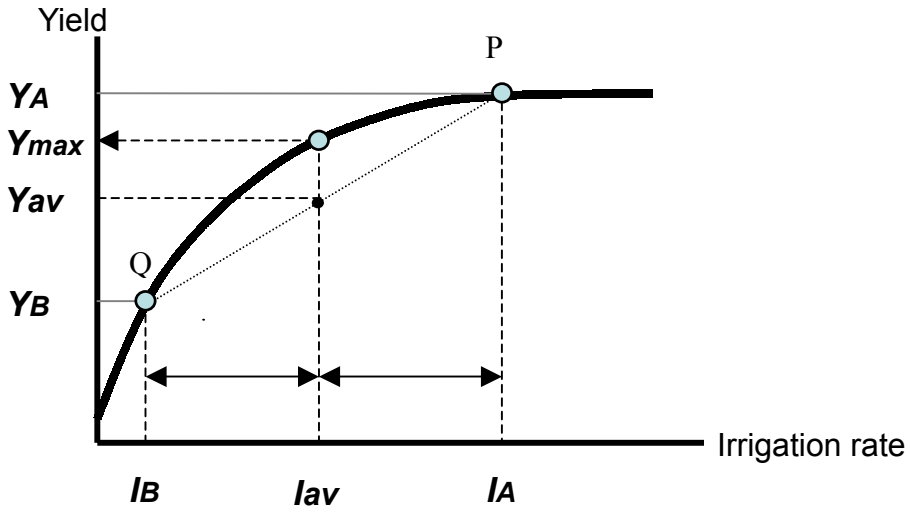

Figure 2. Law of diminishing returns for irrigation management.

A model for an irrigation project consisting of two regions, A and B, having the same areas of irrigated land is introduced as shown in Figure 3. Assume that all conditions except water are the same in both areas and that there is no water conveying loss. Let the available water W be not enough for the whole project, and distributed to regions A and B by W_A and W_B ($W_A > W_B$), respectively. The irrigation intensities in Regions A and B, I_A, I_B are obtained by W_A and W_B divided by each area, respectively. The average irrigation intensity for the whole area I_{AV} is given as $(I_A + I_B)/2$. When this relation is applied to the Law of Diminishing Returns, we know the yield in Region A Y_A is larger than that in Region B Y_B, as shown in Figure 2. The average yield for the whole region Y_{AV} is given as $(Y_A + Y_B)/2$, on the middle point between P and Q. The average yield, of course, represents the total yield in the project area.

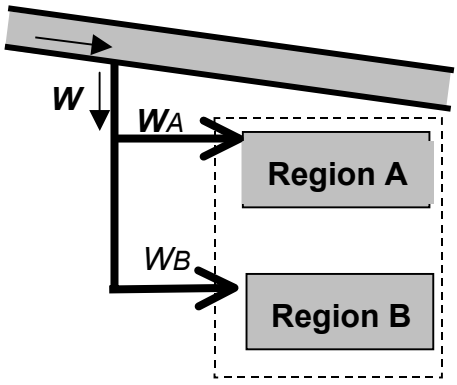

Figure 3. Water distribution model: Available water is distributed to two

regions, A and B, with the same areas of cultivated land.

If we consider a little more even water distribution, I_A will shift to the left on the horizontal axis and I_B will shift to the right by the same distance. As a result the average yield Y_{AV} increases while W (I_{AV}) stays constant. According to this process, if all available water becomes evenly distributed over Regions A and B, the water application rate for all water users is I_{AV}, which brings the average yield for the whole region to the maximum at Y_{MAX}. Now we know that an irrigation project can realize the maximum yield when the available water is distributed evenly over the service area, or beneficiary farmers.

The maximum yield is just what the government is seeking from the viewpoint of the national economy. The economic benefit happily coincides with the social need for equity. This discussion may be sufficient to show that the major target of water management should be equal water allocation, though it is abstracting some minor conditions such as the scale of the project, crop stage, soil conditions, and so on.

Two supplemental discussions should be given. First, in the discussion above the yield of Region A is reduced to get the maximum benefit of the whole region. This implies that local benefits and the national benefit conflict with each other in water management. We have to suppress the benefits of some local groups for the sake of the whole. Second, if we consider a different situation, that there is a water conveyance loss, equal water distribution will not guarantee the national maximum benefit from the economical point of view. Such a situation can easily be found during the dry season in the Asian monsoon region, especially in areas where the canals are made of earth. In this case we need to sacrifice the maximum benefit for the whole society to keep the goal of the equal water distribution over the areas. The same discussion is available for the case of poverty alleviation if the water distribution for realizing the maximum economical benefit must be changed for the poverty alleviation purpose. This means that the goals of water management to bring about economical benefit and other social benefits of equity and poverty alleviation conflict with each other. We should know that it is necessary to choose one of these goals as the priority goal in some conditions of actual water management.

5. IS FARMERS' COOPERATION POSSIBLE?

Even when a government facility is managed by the government, in correspondence with the government's goals, experience has shown that the government cannot and

should not manage everything (Groenfeldt and Svendsen 2000). Governments cannot manage every facility by themselves because of budget constraints, and cannot prevent farmers from performing illegal actions on the facilities the government is trying to control. Governments need farmers to achieve the government's target. Here, we should remember that the individual farmer's target in water management is different from the government's target. If the government lets farmers manage facilities without any conditions set down or rules governing this management, the government cannot achieve its target. How can the government realize a management transfer while achieving its target?

To realize the target, farmers need to be organized and behave according to specific rules for the transferred facility. However, in the process of water allocation under limited water availability, more water to a farmer or a group of farmers means less water to others. There are strong conflicts among farmers in every region at the main, lateral, and on-farm levels (Shinzawa 1955). Therefore, we face a more fundamental question of whether or not establishing farmers' groups and gaining their cooperation are possible in principle.

The authors' idea is that despite the conflict, or rather because of it, farmers may opt to establish their own water user group and organization, because farmers can hope to realize common benefits only by establishing their own water user group to claim their right to have water. This idea has two prerequisites: First farmers need to be informed and understand the reality of conflicting structures in water management, and second, there must be an institutional system in which farmers' decisions in their group can be reflected or realized in water management at the higher canal level. If not supplied with such conditions, farmers cannot take action or formulate plans, and they then feel desperate and lose their motivation to improve their situation. Therefore, the first goal in farmer education and capacity development is to prepare such conditions and explain them to the farmers.

Based on this idea, the suggested action for governments to promote the sustainable establishment of water user groups is to prepare a table at which different water user groups can claim their rights and talk to each other, as well as a system in which whatever they decide is realized in an actual water management process.

A group of water users composed of farmers cannot operate by themselves, because if they do so, conflicts among themselves can destroy the group. A water users' group needs, for its continuous existence, a common outside interest for which they have to

cooperate. Understanding the need for a common outside interest leads to a conclusion that we should not expect a successful establishment of water users' groups (WUGs) as a condition for the subsequent establishment of an integrated water users' group (IWUG) (Gautam 1997). Rather, the simultaneous establishment of WUGs and IWUG is necessary for success. This idea has been applied to JICA projects in Thailand and Egypt (Onimaru et al. 2003).

6. ROLE SHARING BY GOVERNMENT AND FARMERS IN WATER MANAGEMENT

What part of water management should farmers be involved in? As far as the scale of irrigation system is concerned, the management of a small scale irrigation project can be completely transferred to a farmer's organization. Most of the irrigation systems in Japan, even large scale ones, have been completely transferred to farmers' organizations, Land Improvement Districts (LIDs). Provided appropriate conditions are in place, a large scale project with a beneficiary area of more than 10,000 ha can be transferred to a farmer's organization such as an LID. However, a widely accepted idea for large scale irrigation systems is that governments or public sectors should manage the main parts of the systems, and the farmers' groups the on-farm facility. Japan also has examples of this demarcation, which can be called "spatial role sharing" (SRS).

However, a simple application of SRS may not be successful for PIM since many factors are involved in water management. SRS is sometimes seen as a reason for governments to no longer support or intervene with farmers' management of on-farm systems after PIM or water management transfer (WMT) has been introduced. As for the main part of the irrigation system, if every decision on water allocation is made by the government, and if these decisions are not explained, farmers won't know whether they are being treated equitably or not. Moreover, they cannot construct a farming plan if they are not informed of the water resources status of the project. Under such suspicious conditions, farmers are apt to take action for their individual benefit. Governments have no capacity to suppress such activities, which are usually committed during the night. Governments should not expect farmers to behave rationally for the national goal. It is therefore extremely important for governments, as much as is possible, to eliminate those actions which cause farmers to take selfish actions of their own, and also to prevent these actions from being taken in practice. Information dissemination and accountability are of the utmost importance.

Water management (in the broad sense) consists of operation, maintenance and

management (organization and finance), among which operation can be regarded as the core of water management because it is the action that brings the water to farmers. Thus, operation may be called water management (in the narrow sense). The other two kinds of activities have rather supplemental functions that make this water management (in the narrow sense) efficient and sustainable.

An action can be divided into four processes: target setting, execution, evaluation and adjustment. The authors suggest the classification of water management (in the narrow sense) into four processes (Figure 4) to discuss the role sharing of government and farmers:

1) Decision process: Deciding on the water distribution target and plan
2) Operation process: Operating the facilities according to the plan
3) Monitoring process: Monitoring the operation to see whether it is performed as expected
4) Feedback process: Adjusting the operation or decisions based on monitoring

Each process is further explained as follows:

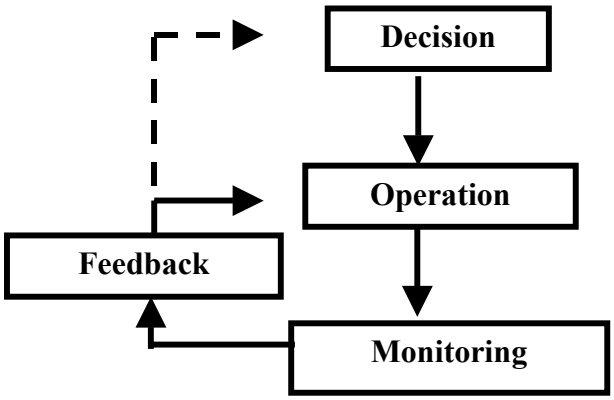

Figure 4 Four processes of water management

First, in the Decision process, how much water should be introduced and distributed to each canal must be decided based on evaluation of the water demand and supply. It makes sense for this process to be primarily covered by the farmers, because the ultimate users of water are farmers and every target is based on their request. Only farmers really understand the necessity of water, and thus they can negotiate and adjust water allocation in case a water shortage occurs. This will increase water use efficiency. However, it is the role of government engineers to give farmers the scientific and technical information on hydrology and hydraulics to enable the farmers to make

rational decisions. The government should also guide and oversee the farmers' discussions so as to guard equity, which realizes the government's goal in water management. To protect the interests of everyone concerned, the decision process for the whole project should be shouldered by both the government and farmers. To make this possible, farmers should form a project level water users' organization to which every regional water user group will send delegates.

Second, government engineers should be primarily responsible for the Operation process. For, the other parties (farmers) should not be involved in operation of water distribution to keep fairness. In addition, special knowledge and skills are needed to operate the main systems. However, government officers and farmers may cooperate in the operation process at the lateral level and below.

Third, the Monitoring process includes watching for unfair or illegal operation, measuring the water delivered to each canal and ditch, and comparison of planned and actual waters as well as watching of the state of crops. Farmers should take an important role in the monitoring process, especially in watching for the illegal operation and destruction of facilities. Farmers would have a strong incentive to play a role in this process as long as they themselves have created the water distribution plan during the decision process. The results of the water distribution process should be monitored and gathered by government officials, and the information made openly available to all farmers.

Fourth, during the Feedback process, water distribution should be adjusted if there is a discrepancy between the initial plan and monitored results. To make this possible, there should be some place where farmers and government officials can get together to discuss any discrepancy. There may be cases in which the water distribution plan itself must be adjusted. Sanctions may be taken against farmers or local groups of farmers who have intentionally operated the irrigation system in an unfair way.

To realize effective water management, we should consider the role sharing of the above four functions between government and farmers for each irrigation facilities at the main, lateral and on-farm levels. This may be called "Functional role sharing" (FRS) against "Spatial role sharing". An example is seen in the Toyogawa Irrigation Project in Japan, where the water distribution plan in the whole system is decided by all organizations benefiting, although operation is the role of the public sector.

7. METHODS FOR PIM

To realize farmers' participation in water management for the whole irrigation system, a water user organization for the system needs to be formed, and must be supported by a hierarchical farmer group system such as WUG, IWUG, and so on. The challenge is how to set up and sustain such organizations.

We often see that depressed farmers in the downstream, who cannot get enough water, do not take positive action to improve their situation. Two factors may be influencing this: One is that the farmers have no expectations about the projects because they have not participated in the initiation, planning, or design. They feel no ownership of the project or irrigation canal. They just may not object to the project as long as the project has no negative impact on their traditional rain-fed farming. The second is that farmers do not understand the reason for their unfavorable situation, and cannot expect government officers to take effective action for them. This is principally because of lack of information disclosure to farmers, which is not recognized necessary by the officers.

To realize the proposed role sharing between government and farmers, the following are of special importance:

1) The government openly declares, after establishing its own goals, that beneficiary farmers have equal rights in the system, and that these equal rights are one of the principles in water management.

2) The government establishes a forum for local hydraulic groups to discuss and decide water management according to the equity principle.

Through the above mentioned roles in and the contribution to water management, farmers can have ownership in their irrigation project. The majority of beneficiary farmers would understand that equitable water distribution is necessary and can be realized by their cooperation.

We should not underestimate the importance of water distribution at an on-farm level. Inequitable water distribution at the on-farm level for a project is equivalent to inequitable water distribution on a large scale. Governments need to pay attention to this. However, it is impossible for central governments to be involved in every water management process. Local governments and communities share a common interest with the central government, that of maximum exploitation from irrigation. The central government can achieve its goal by cooperating with and supporting the local governments.

The participation of farmers in the decision making process is the issue raised in this paper that may attract the most serious discussion. There is a strong traditional attitude

among government officers that they, being highly educated, should hold the power to make decisions. However, if governments do not allow farmers to participate in decision making, then they cannot expect farmers to cooperate in other aspects of the water management. As explained above, governments can achieve their goals more effectively by letting the farmers discuss decisions with them, and by sharing information with the farmers to enable these discussions to be rational.

8. CONCLUSIONS

1) We need a clear image for the practical goals and methods to realize successful participation of farmers in water management. In this regard, it should be confirmed that the first and most fundamental goal of water management for governments is to harvest the largest amount of food with the given amount of available water, and some other social goals of poverty alleviation and equitable water sharing among beneficiary farmers are accompanied.
2) Farmers have a strong incentive for irrigation management transfer (IMT), which is recommended to get higher efficiency of irrigation. However, a simple WMT to farmers with no government intervention would not realize the government goals because individual farmers have different goals.
3) The Law of Diminishing Returns shows that the equal water allocation can realize the maximum yield, which is the major target of governments in water management, under some simplified conditions.
4) Farmers have strong conflicts in water management at every level of irrigation system. However, the principal possibility of farmers' cooperation in water management can be found in these conflicts. Farmers can cooperate only to get a common benefit outside. From this understanding, a simultaneous establishment of water users' group (WUG) and integrated water users' group (IWUG) is recommended.
5) Water management (in the narrow sense) should be divided into four processes of Decision, Operation, Monitoring and Feedback. A traditional role sharing between government and farmers, in which farmers should be responsible for every function relating to the on-farm facility management, should be called "Spatial role sharing" (SRS). However, the "Functional role sharing" (FRS), in which the government and farmers should share the roles considering the function each at the main, lateral and on-farm facilities, should be introduced for the successful participation of farmers.
6) The participation of farmers in the decision process is of special importance, only

through which the government can expect farmers to cooperate in other aspects of the water management. Thus, governments can achieve their goals effectively and surely.

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