



## **PARTICIPATORY SYSTEM FOR SUCCESSFUL WATER MANAGEMENT IN THE TOYOGAWA IRRIGATION PROJECT, JAPAN**

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### **ABSTRACT**

In principles, Participatory Irrigation Management (PIM) means the involvement of irrigation users in all aspects at all levels of irrigation management. In practice, all over the world efforts are being made to realize the principles. However, in the execution of PIM, role sharing between farmers and government is a serious problem, and thus a clear method and ideas are needed to improve PIM. In particular, a broad discussion of role sharing is demanded. This paper illustrates how the Japanese way of role sharing in PIM is realized based on the case of the Toyogawa Irrigation Project in central Japan. Organizationally, the project is jointly managed by five entities, including both the public sector and the farmers' organizations. These entities have clearly divided their functional roles in irrigation management, with the ultimate decision power in all aspects of irrigation management given to organized farmers. The power is realized either directly or through the land improvement districts' representative system depending on the levels of the irrigation system. The public entity provides coordination support to create a transparent forum of discussion together with scientific information for farmers' understanding and decision-making. The participatory institutional line-up

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of Toyogawa Irrigation Project enables the upland areas that suffered periodically from water deficits to develop itself into Japan's major producers with a high productivity and remarkable crop diversification.

## 1. INTRODUCTION

A widely accepted, fundamental principle of participatory irrigation management (PIM) is that it should involve irrigation users in all aspects and at all levels of irrigation management (INPIM). However, in the execution of PIM, role sharing between farmers and government is a serious problem, and thus a clear method and ideas are needed to improve PIM. In particular, a broad discussion of role sharing is demanded.

Under the system of Land Improvement Districts (LIDs), which are farmers' autonomous irrigation associations with total responsibility for irrigation system management, Japanese water management is known as a successful form of PIM. In almost all Japanese irrigation projects, every irrigation facility is transferred to a related LID after construction or rehabilitation is complete. The LID collects its membership fee from farmers to cover all management costs. However, Japan also has some successful PIM cases, in modern large-scale irrigation projects, where farmers and a government agency (or the public sector) share in water management roles.

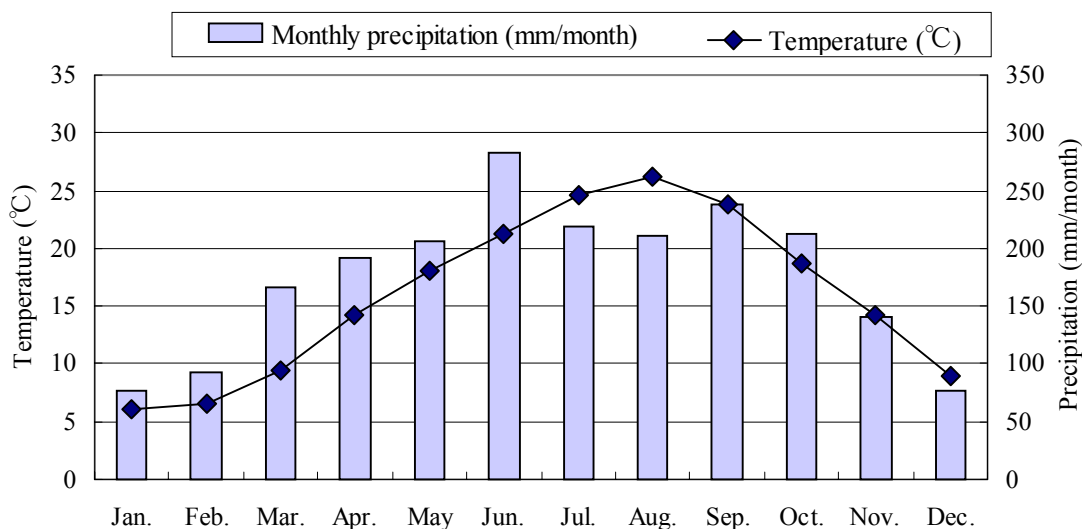
The purpose of this paper is to introduce and analyze the role sharing of farmers and government in water management in the Toyogawa irrigation project, which is the irrigation sector of the Toyogawa Water Resources Developing Project in Japan.

## 2. STUDY AREA

The Toyogawa Water Resource Development Project, which was established in 1968, is one of the most successful modern water resources development projects in Japan. It is a multi-purpose project for the management of water for agricultural, industrial, and domestic use. In the agricultural sector, this project covers 18,000 ha of farmland (paddy: 6,500 ha, upland: 11,500 ha), extending over six cities and four towns in the central Japanese prefectures of Aichi and Shizuoka. This command area includes traditional paddy irrigation areas. This paper focuses on the new irrigation areas encompassing 16,000 ha (paddy: 5,000 ha, upland: 11,000 ha) in Aichi Prefecture. We call the study area "the Toyogawa area" hereafter.

**Figure 1** shows the monthly precipitation and temperature in this area. The average temperature is 16.0° C and the average annual rainfall is about 2,100 mm/year. However,

dry spells in the region sometimes extend to one month. Therefore, it is impossible for farmers to realize stable agricultural production without irrigation. The project has brought not only increased productivity but also remarkable crop diversification over the upland fields of the area (Sato 1999). Irrigation has also promoted controlled and scheduled production, which agricultural markets in large cities prefer.



**Figure 1.** Monthly precipitation and temperature at the Toyogawa Irrigation Project

**Figure 2** outlines the project's water resources system. The major water source is the Toyo River (total catchment area: 724 km<sup>2</sup>), and supplemental water comes from the adjacent Tenryu River basin (total catchment area: 5,090 km<sup>2</sup>). The irrigation system consists of the Ure reservoir (catchment area: 26 km<sup>2</sup>, live storage: 28 MCM) and the Ohshima reservoir (catchment area: 18 km<sup>2</sup>, live storage: 11 MCM) in the upstream of the Toyo River; the Ohno diversion dam (catchment area: 130 km<sup>2</sup>), seven regulating reservoirs (total live storage: 12 MCM), and a canal network, which includes 2 main canals, 163 lateral canals, 296 common-use farm ponds (FPs), and 2,700 km of distributaries. The irrigation water in the main and lateral canal system area is distributed by gravity, but it is applied mostly by sprinkling systems, which consist of FPs, pumps, and distribution pipelines.

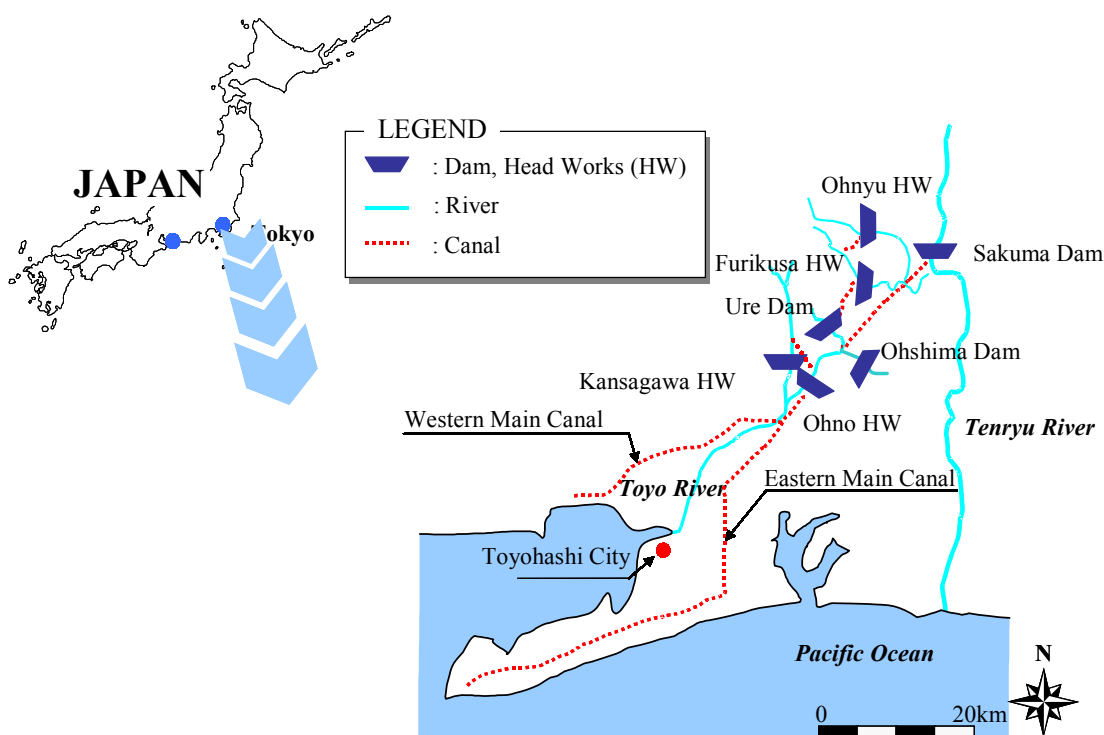


Figure 2. Outline of the water resources system of the Toyogawa Irrigation Project

### 3. ORGANIZATION FOR WATER MANAGEMENT

#### 3.1. ORGANIZATIONS

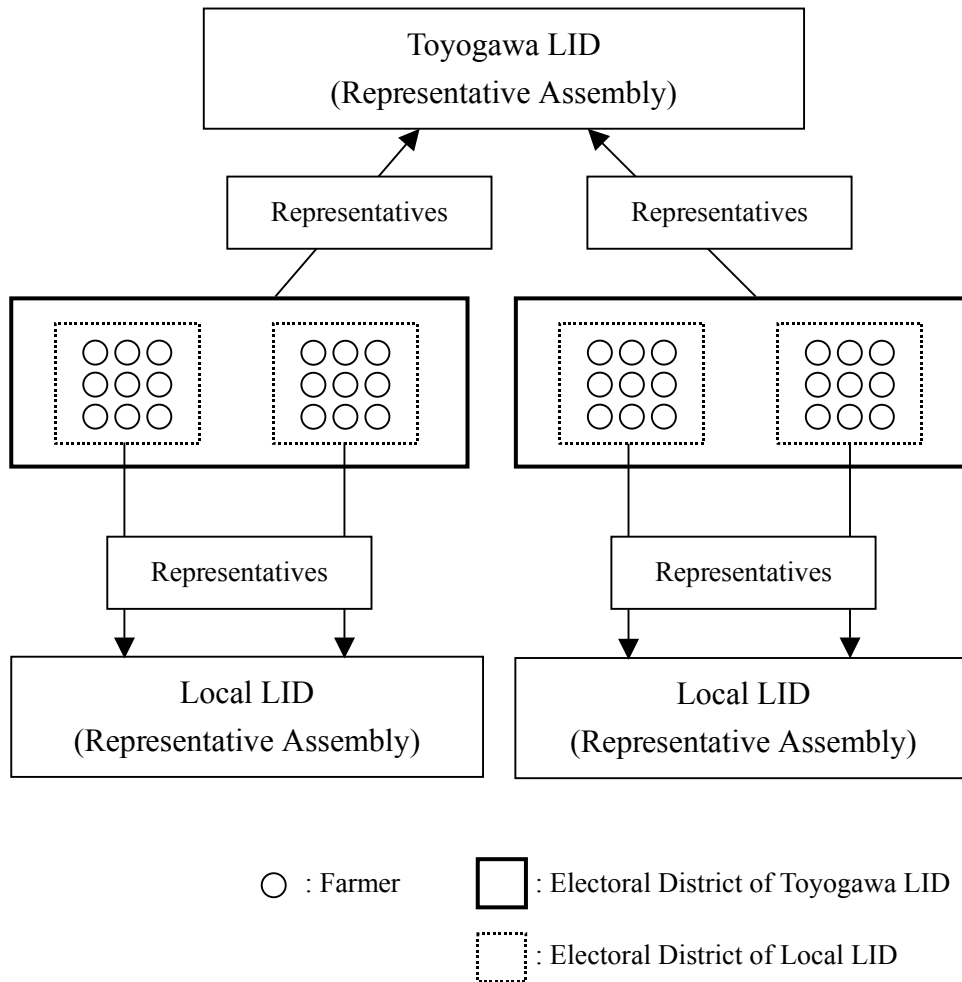
Five kinds of organizations are involved in the Toyogawa Irrigation Project (Kozuki 2000): (1) the Japan Water Agency (JWA)<sup>1</sup>, a public entity that managed the construction project; (2) Toyogawa LID, an autonomous irrigation association of farmers that is established for this project<sup>2</sup>, having tree branch offices; (3) local LIDs, which are established based on administrative boundaries of cities or towns and which function as local water user associations; (4) Management Districts (MDs), which are established by beneficiary farmers of each FP, practically corresponding to a traditional local community of *Mura*; (5) Management Groups (MGs), which are established by three to six farmers as rotational irrigation units in an MD.

Toyogawa LID and local LIDs are farmers' autonomous irrigation associations. As they are LIDs, they employ a representative system following the articles of the Land Improvement Act (1949). The representative assembly is the highest legislative organ in

1- JWA was originally called the Water Resources Development Public Corporation.

2- When the Toyogawa Irrigation Project started, the farmers' organization for water management of the whole project was an integrated body of local LIDs, which was later reorganized as the Toyogawa LID.

an LID. Representatives are elected from electoral districts by local farmers, each of whom has an equal vote. Every farmer in this project belongs to both types of LIDs (**Figure 3**).



**Figure 3.** The relationships between farmers to Toyogawa LID and Local LIDs

### 3.2. DEMARCATION IN FACILITY MANAGEMENT

These organizations demarcate their roles in water management according to the level of a facility, from main to on-farm. JWA manages the main parts of an irrigation facility: water resource systems (reservoirs, diversion dams, regulating reservoirs) and main canals. It is responsible for delivering water to lateral canals.

The Toyogawa LID manages lateral canals and sends water to FPs. Toyogawa LID staff patrol FPs to check on stored water daily, and they readjust allocation of water to lateral canals as needed.

Local LIDs, MDs, and MGs manage FPs and on-farm facilities in a group. MG leaders in a MD adjust water demand each other. The MD representative designated by local LID has a capacity to operate valves to send water from FPs. Only MD representatives have this authority; other farmers are not allowed to adjust water distribution. Local LIDs compile requests from MDs and request water from the Toyogawa LID according to necessity.

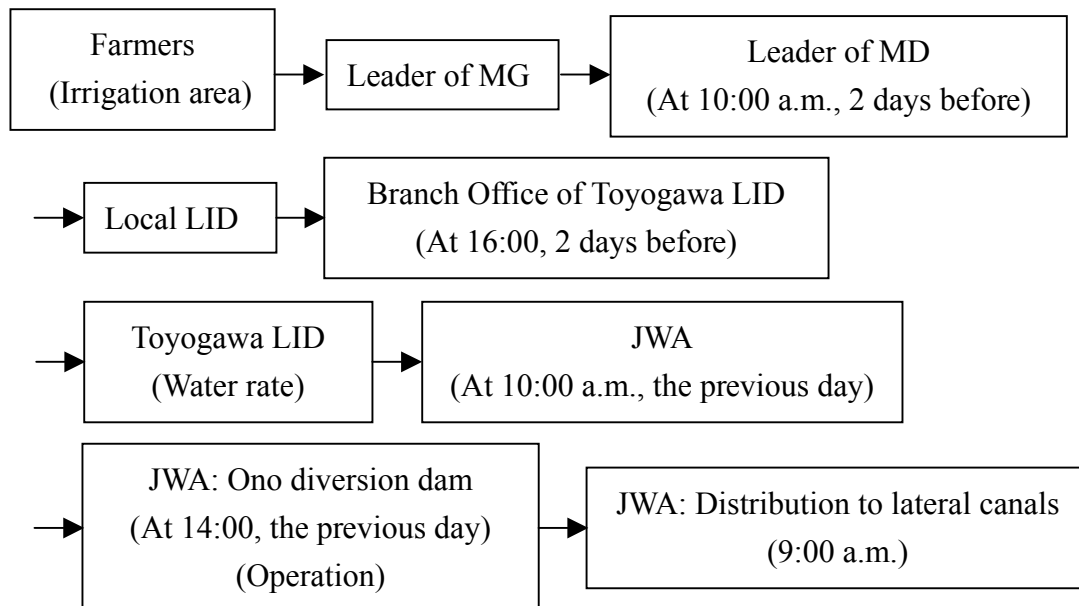
### 3.3. MANAGEMENT COST

All costs for water management in the Toyogawa Irrigation Project, including the JWA, the Toyogawa LID, and the local LIDs, are covered by the beneficiary farmers. The Toyogawa LID helps JWA collect money from farmers. The membership fees are based on acreage as well as on the land use of paddy or upland fields.

## 4. WATER ALLOCATION PLANNING

### 4.1. IMPROVEMENT PROCESS

Originally, the water distribution method that was applied to the project is shown in **Figure 4**. The water demand was calculated fully based on the declared daily irrigation area by farmers. The total area of irrigation was conveyed through the LID's hierarchical system, converted to a flow rate, and forwarded to the JWA.



**Figure 4.** The original water allocation method and distribution process

This system was applied to promote the development of irrigated upland agriculture in this area; it supplied enough water to satisfy farmers' needs. It also realized crop diversification in extensive way. However, it required two whole days to send water to lateral canals after farmers' requests. Under uncertain weather conditions, it is difficult for farmers to precisely decide the area to be irrigated two days in advance. Therefore, to avoid risk, farmers requested more water than they thought they would actually need. This resulted in high water demand and low irrigation efficiency. It caused frequent water shortage problems even though the water demands of other sectors had not yet developed to the designed levels (Satoh 1973).

The water allocation and distribution system was improved to avoid this complicated procedure and the problems it induced. In the new system, the first four steps in the previous system are skipped and Toyogawa LID branch offices take the first step to request water as on behalf of farmers.

JWA, the prefectural government, and Toyogawa LID discussed the water allocation plan when an improvement project started in 1980. As a result, a pattern of a standard demand rate (SDR) for each lateral canal was developed based on the water distribution record during 1978 to 1980 (consecutive water shortage years). This record was regarded to reflect the actual water demand in each lateral canal. Since then, the SDR has been used as the water allocation basis.

Crops and cropping patterns have been changing in different ways over the area, and a discrepancy developed between actual water demand and the SDR. Therefore, SDR was reviewed during a discussion of measures against water shortages in 2002. A new SDR was made for every ten-day period based on farming area and crops. The revised SDR better matches to farmers' actual demand now.

As mentioned above, the water allocation plan has been changing. However, it should be noted that the plan is discussed and decided principally based on farmers' demand, with farmers participating through the LID system.

#### **4.2. PRESENT PROCEDURE FOR ANNUAL WATER DISTRIBUTION PLAN**

The representatives of local LIDs gather in the Toyogawa LID branch office every year to discuss and adjust the annual water demand. Toyogawa LID compiles these demands and submits them to JWA. JWA and Toyogawa LID then discuss the annual water allocation plan in consideration of applied demand and SDR. Upon approval by the

president of the Toyogawa LID as well as by other water sectors, the annual water allocation plan is finalized. Thus, JWA doesn't decide the plan in a top-down manner.

Toyogawa LID employs a representative system and the directors are elected in a representative assembly, which selects the president. Therefore, the president's approval in the final stage of the process can be regarded as approval by all farmers in the hierarchical representative system.

## **5. MEASURES AGAINST WATER SHORTAGE**

The Toyogawa project area has been experiencing water shortages rather often: 28 times in the past 38 years. JWA has established the Water Saving Committee (WSC) to discuss and decide measures against water shortage. The main discussion in the committee is to what extent water saving ratios should be applied to the different water sectors and when their application should be started or changed (intensified or loosened).

The WSC consists of 14 people. Two of them are the staff of JWA, and others are representatives of related organizations: Seven people are from four related LIDs, and the remaining five are from two prefectural governments representing the water supply sector, the industrial water sector, and some other farmers in Shizuoka Prefecture. Thus the representatives cover all beneficiaries in the project. WSC is chaired by one of the staff members of JWA. The secretariat of JWA compiles records of river discharge, water storage in the reservoirs, expected future water demand, meteorological forecasting, etc., and presents all the data necessary for discussion to the committee. The secretariat also proposes measures against shortages to the WSC if required.

In case a water conservation operation is performed, especially when the ratio is very high, the local LIDs supplement the water supply by operating wells that have been developed for emergencies. The distribution of the wells is not uniform over the command area; some lateral systems include many wells, while others contain few or no wells. Therefore, a local LID will adjust the water allocation to lateral canals from the Toyogawa irrigation system so that all members of the local LID receive an equitable amount of water. This shows that local LIDs have developed a sense of unity among them. The lower-level farmers' organizations, MD and MG, have the same quality.



## **6. DISCUSSION**

There is an idea that water management can be better understood if it is divided into four processes: Decision, Operation, Monitoring, and Feedback (Sato, 2003). Based on this idea, the role sharing between JWA and farmers in the Toyogawa project is discussed.

### **(1) DECISION PROCESS**

When deciding matters related to water management plans such as SDR, annual water distribution, or measures against water shortages, JWA convenes a meeting or begins a process in which all interested organizations are invited to participate. In this meeting, interested organizations discuss, adjust, and decide, while JWA provides scientific and technical knowledge and guides the meeting to rational and fair discussion. Thus the roles of JWA are coordinator, adviser, and chair, while water users act as decision-makers. The most important thing is that not only interested organizations have decision power but JWA (the government) assists them to enable them to decide rationally. This system can be called functional role sharing (FRS).

In addition, Toyogawa LID and local LIDs are farmers' autonomous irrigation associations. As they are representative systems, every important matter is discussed and decided in a representative assembly. Representatives compile local farmers' intentions and demands, so every farmer can participate in decision-making through the representative system. In other words, every farmer has decision power through the hierarchical system.

The role-sharing between JWA and the interested water users' organizations in WSC, which is a discussion table for decision-making, is clear. The roles of JWA are: (1) to convene the WSC (coordinator), (2) to provide scientific and technical knowledge for rational discussion and decision-making (adviser), and (3) to chair the meeting to finalize plans (chairperson). On the other hand, the role of farmers' Delegate is to discuss, adjust, and practically decide. Considering the composition of the participants, it is clear that water users hold the deciding power in WSC.

### **(2) OPERATION PROCESS**

JWA, Toyogawa LID, local LIDs, MDs, and MGs form a hierarchical system

corresponding to facility levels, and operate in an environment of spatial role-sharing (SRS). In this environment a directly interested organization is not allowed to operate by itself, but a higher organization operates instead. In this way, it is easy to distribute water in a fair and neutral way. For example, the water allocation to each lateral canal is decided by beneficiary farmers, but the operation is done by JWA staff. Water distribution in lateral canals is operated by the staff in a regional office by the staff of Toyogawa LID.

It is difficult for farmers to operate modern large-scale irrigation facilities, since special knowledge and skills are needed. On the other hand, staff members of JWA cannot manage every facility at the on-farm level by themselves because of limited resources. Therefore, role sharing in the facility operation of a large-scale irrigation project is inevitable. Methods to maintain fairness in operation have been crucial for maintaining farmers' satisfaction with the project.

### **(3) MONITORING PROCESS**

JWA disseminates information on the state of water resources by several means, such as its website or by providing information directly to related organizations. A bulletin periodically distributed to every member farmer can also support farmers' understanding of the state and functions of facilities. Everybody can see the state of water distribution at FP or at a spillway.

The staff of the Toyogawa LID branch office is responsible for distributing water down to FP, but they also go and observe water conditions in the field and adjust water distribution accordingly. In a formal procedure, a local LID and MD are supposed to inform the Toyogawa LID branch office about what they observe. However, they tend not to inform the Toyogawa LID branch office if there is more than enough water, while reporting urgently when water is short. In this way they watch each other, and suspicions of unfair or irrational operation are swept away. The staff of JWA, of course, watches farmers to prevent selfish actions at the lateral gates and other facilities. Since water distribution is well monitored, any selfish action would be easily revealed.

In addition, as every farmer has participated in the decision process for water allocation, not directly but through a delegate, any selfish behavior would be blamed not only by other group members but also by his colleagues.

#### **(4) FEEDBACK PROCESS**

As mentioned above, monitoring and feedback processes occur simultaneously for the water distribution within a lateral canal system. Water between laterals can be adjusted as a result of discussion at a local LID. If a serious water shortage occurs, the growth stages of the affected crops are considered, and the priority would be placed on critical crops, thus avoiding serious damage and higher profits in that district.

On the other hand, it is not easy to adjust water allocation among local LIDs, especially during times of serious water shortage. Differences in cropping schedules have already been considered in making the SDR. However, the WSC is always watching the state of water resources, so its can properly change the water saving ratio according to the continuation of a drought.

### **7. CONCLUSIONS**

The Toyogawa Irrigation Project is one of the most successful in Japan. It has achieved not only increased production but also extensive crop diversification over the beneficiary area of the upland irrigation. It is based on the principles of stable irrigation management and the full participation of farmers.

The project is managed by the Japan Water Agency (JWA). However, the farmers have developed the Toyogawa LID for the project as well as local LIDs for every region of the project area, which hierarchically includes Management Districts (MDs) and Management Groups (MGs). These five organizations share water management roles based not only on the levels of canals but also on the steps of the water management process: Decision, Operation, Monitoring, and Feedback.

Special attention should go to the fact that decision-making power is practically given to farmers at all levels and in all aspects. Water management plans are decided in meetings attended by all delegates from different interest groups, and JWA merely guides and supports the discussion by providing scientific and technical information. On the other hand, water allocation operations are performed by JWA staff to strictly implement what has been decided in the meeting. As a result, JWA can realize equitable water sharing and high irrigation efficiency, which are goals of the government, with minimal effort.

The main points for the successful water management of the Toyogawa Irrigation Project are (1) participation of farmers in the decision process at all levels, (2) farmer

organizations for the project that give every farmer the opportunity to express his opinion, (3) a Functional Role Sharing (FRS) system in which related organizations play their roles in the four functions of water management at each canal level.

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