

## Water Management by Farmers in Japan

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### Introduction

Water Management in Japan has been implemented by farmers through water users' organization called Land Improvement District ("Tochi-kairyō-ku" in Japanese), which is organized by farmers themselves mobilizing their colleagues in an area on the basis of the Land Improvement Law.

Land Improvement Districts manage their own irrigation /drainage systems, and operate and maintain facilities of their systems with financial resources which come from irrigation fee, in line with traditional rural communities, governments and so on. Land Improvement Districts also implement an irrigation and /or drainage project(s) to improve /develop farmland conditions in their areas, obtaining government assistance. Current water management systems in Japan were formed in climate conditions featured by Asia monsoon weather and paddy agriculture in the country with dense population, and in historical process of paddy development for expansion of food production for a long time in the past.

Here, water management by farmers in Japan will be briefly introduced. A legal system on water management and Land Improvement District is presented following background of water management. Then, water management by Land Improvement District is presented before challenges.

### 1. Background

#### 1-1 Outline of Climate Conditions and Agriculture in Japan

##### 1) Climate Conditions

Japan is an island country which consists of 4 major islands and other thousands islands ranging in an arc from the northeast to the southwest on the east of the Eurasia continent. Its length is about 3,000 km whose southern and northern end is at about 20 and 45 degrees of the north latitude respectively. Its total area is 378 thousands km<sup>2</sup>, of which about 74% is mountainous area, and 11% and 15% are mountainous terrace and lowland

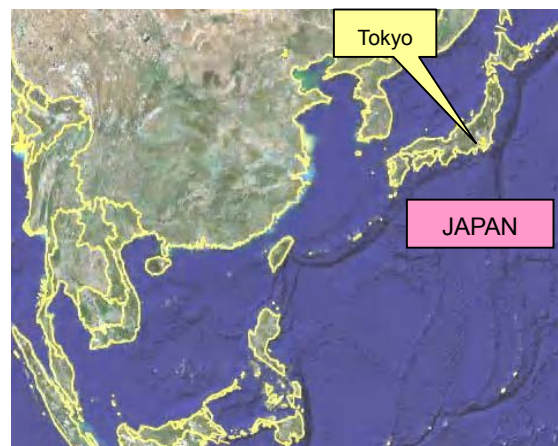


Fig. 1. Location of Japan

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area at downstream of rivers respectively, which both form small flats. Then 66 %, 13 % and 5 % of the total areas are used for forestry, agriculture and residence respectively (2004).

The population is 127 million people (2006) of which about 50% are living in the lowland areas such as Tokyo, Nagoya and Osaka metropolitan areas. So, the national lands are highly and densely used as known from that the population density in habitable areas are 1,559 people /km<sup>2</sup> (1995).

Japan lies in the temperate climate zone except some areas such as southern islands and northern area. Weather conditions are featured by monsoon and oceanic climate, showing typical four seasons with large differences in annual air temperature. And there is larger annual precipitation, compared to the other mid-latitude areas in the world, brought by rain, especially, in summer season and snow in winter season. This hot and humid weather with much precipitation provide very suitable conditions with paddy rice production.

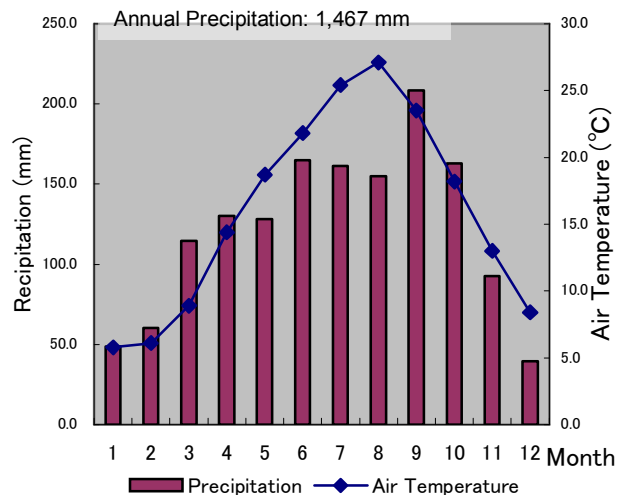


Fig. 2. Weather in Tokyo, Japan (1971-2000)

## 2) Outline of Agriculture

There are arable lands of 4.7 million ha; of which 2.5 million ha are paddy fields and the remains are up-land fields including orchard. The number of farm households and farmers are 2.9 million units with 8.4 million members and 3.2 million people respectively, however large part of them are also earning a living from other jobs (2006). One household manages farmlands of 1.3 ha on an average excluding Hokkaido prefecture and gains total incomes of JPY 5 million /year, of which only JPY 1.2 million come from agriculture (2005). One of features of Japanese agricultural management is a small scale farming by family as known above.

A main crop produced in Japan is paddy rice. It is planted, usually once a year, in paddy fields with 1.7 million ha and produces husked rice with 8.9 million ton (2002). Areas to plant paddy rice as well as its production have decreased for past tens years due to a taste diversification and a consumption falling. Large part of the remains of paddy fields are used for planting other crops such as bean, vegetable etc., while abandonment areas of cultivation have been increasing.



Fig.3. Rice Planting Work by Machine

Rice production accounts 23% of total agricultural production equivalent to JPY 8,500 billion, and vegetable production, fruit production and animal husbandry account 24%, 8% and 30% of the total respectively (2005).

As for improvement of farmland, most of entire paddy fields have been covered with irrigation systems and 59 % of total paddy areas have been consolidated into standard lots with areas over 0.3 ha /lot and both canals for irrigation and drainage. And 20 % of total areas of up-land fields have been covered with irrigation systems. (2005)

### 1-2 Historical Overview of Irrigation Development and Birth of Land Improvement District

Irrigation in Japan had been developed along with past expansion of paddy. It is said that a farming was introduced with paddy rice production, instead of fishing and coursing, in about 300 years B.C., and irrigation was developed through using tools of iron imported around the same time as paddy rice and gradually brought ancient states with mobilizing individuals (around 4<sup>th</sup> Century A.D). After that, village communities with strengthened independence established an autonomous system called as “Sou” organization (14<sup>th</sup> C), which managed on-farm irrigation facilities. And liege lords extensively developed new paddy fields and huge irrigation facilities in a term from “Sen-goku” period and “Edo” period (15<sup>th</sup> - 19<sup>th</sup> C).

New national government that superseded warrior rule in 1868 established a legal system relating to irrigation and farmlands to promote irrigation development and land consolidation, and to also organize farmers’ associations who manage irrigation system or implement land consolidation. And irrigation and drainage project became to be implemented by prefectural governments with the nation’s subsidy in 1921; however, before 1921, these projects, except providing former warriors with works, were implemented under private investment of landlord etc.

After the World War II (1945), land reclamation and /or irrigation projects were requested to urgently implement nationwide in order to supply food and reconstruct the country. In this situation, the Land Improvement Law was enacted in 1949 to promote these projects in association with a lot of land-owing farmers brought by the agrarian reform. And the Law provided Land Improvement District to implement these projects and managements of constructed facilities, while regulating that the nation was requested to provide the entire project with subsidy and to implement national projects. Here, Land Improvement District was born instead of previous cooperatives for land consolidation and for water management, and farmers got to play main role for land improvement projects including irrigation instead of previous landlords. The Ministry of Agriculture, Forestry and Fisheries (MAFF) have administrated the Law since its establishment.

## 2. Legal System on Water Management and Land Improvement District

### 2-1 Legal System on Irrigation and Drainage Management /Project

The Land Improvement Law (LIL) aims to improve and develop agricultural production base. LIL regulates 7 specific project components that are i) to newly construct, manage, disestablish or change land improvement facilities such as irrigation and drainage canals, farm roads, ii) to consolidate farm lands, iii) to reclaim farmlands, and so on. Based on LIL, a project to implement the above is defined as Land Improvement Project (LIP) and facilities constructed by LIP is also defined as Land Improvement Facility.

LIPs include several specific projects such as irrigation and drainage project, water management project, farm road project, land reclamation project, land consolidation project and so on, according to the above components. LIPs are also classified into 4 categories by executive body under LIL; namely project operated by i) land improvement district, ii) national or prefectural government, iii) cooperative and iv) municipal government. Land improvement districts apply LIPs to the national government and /or a prefectural governments when the projects satisfy conditions for a national /prefectural government-operated project.

Several basic requirements /procedures are regulated in LIL to start and implement LIP.

- i) Qualification to join a LIP; People (farmers) to join LIP should be farmland owners or tillers in a proposed project area. (Except land reclamation project)
- ii) Application; More than 15 people with the qualification should apply to a government(s) with agreements below. (There are several options for application)
- iii) Agreement with the project implementation; Applicants should get agreements of more than 2/3 of qualified people in a proposed project area before applying, officially announcing a general description on a project scheme and measures to manage constructed facilities.

Reasons for necessity of the agreement are that; i) the project influences their property such as farmland in the area, ii) they are obligated to bear cost for the project implementation and system management.

As for a construction cost sharing for LIP, LIL regulates to gather expenses for construction depending on a benefit, while the national government is regulated to pay a certain part of the cost for nation-operated LIP. Detailed regulations for the cost sharing are actually entrusted to ministerial ordinances on government subsidy and prefectural bylaws. On the other hand, the Land Improvement District (LID) basically carries out system management with own burden after completion.

It can be said that the most characteristic feature of LIP, even water management, is a farmer-oriented project as shown in the project application by farmers, the farmers' agreement

with the project, the system management by farmers after completion, and farmers' burden of cost for construction and system management. Moreover, it can not be forgot that it is a project of entire rural communities, as shown in that the two-third's agreement with the project enforces all of the qualified people (beneficially) to join the project and pay the cost burden, regardless of their agreements or disagreements, however it is actually operated to get the agreement over 90% and LIL provides the people with measures for a motion of objection.

## 2-2 Land Improvement District

### 1) Establishment of Land Improvement District

Land Improvement District (LID) is a nonprofit corporation that is established on the basis of LIL. More than 15 people with the qualification mentioned before in a certain area apply to a prefectural government and establish a LID with an approval of the government in order to implement a LIP. Before applying, applicants are requested to make the following procedures;

- i) To get an agreement of more than 2/3 of qualified people in the area, officially announcing a general description on the project, outline of LID's articles and other necessary matters, and
- ii) To decide a plan of LIP, a LID's articles and other necessary matters.

A command area of LID is usually corresponded with an area of its irrigation and drainage system that is planed along with physical conditions such as topography, so its area lies within a municipality or covers several municipalities<sup>2</sup>. There are 5,853 LIDs with about 4.0 million members and 2.8 million ha of command areas nationwide in 2006. Table 1 shows that command areas of each LID range from tens ha to tens thousand ha.

**Table 1: Number of LID by Size of Command Areas and by Number of Member**

Command Area (ha)	Number of LID	Ratio	Number of Member	Number of LID	Ratio
less than 50	1,661	28.4%	less than 200	2,517	43.0%
50 - 100	1,016	17.4%	200 - 300	760	13.0%
100 - 300	1,425	24.3%	300 - 1,000	1,619	27.7%
300 - 500	535	9.1%	1,000 - 5,000	855	14.6%
500 - 1,000	564	9.6%	5,000 - 10,000	74	1.3%
1,000 - 2,000	334	5.7%	more than 10,000	28	0.5%
2,000 - 3,000	129	2.2%	Total	5,853	100.0%
3,000 - 5,000	121	2.1%			
5,000 - 10,000	52	0.9%			
more than 10,000	16	0.3%			
Total	5,853	100.0%			

Source: MAFF (2006)

<sup>2</sup> Japanese local administration system has 1,827 municipalities (805 cities, 827 towns and 195 villages) under 47 prefectures. (2007)

LIDs have organized a prefectural federation of land improvement association (PFLIA) by each prefecture and a national federation of land improvement association (NFLIA) nationwide with approval of governments. PFLIAs and NFLIA play act to support activities of their members with membership fee.

## 2) Organization and Operation of Land Improvement District

Member of LID is the qualified people (farmers) in a project area as mentioned before. LID's legislative organ is a general assembly composed of all members or a representative assembly composed of people elected from members when total number of members is more than 200 people. As well, representatives speak for members in each electoral district that is usually set in units of traditional rural community called as "Mura", "Shuraku" etc.

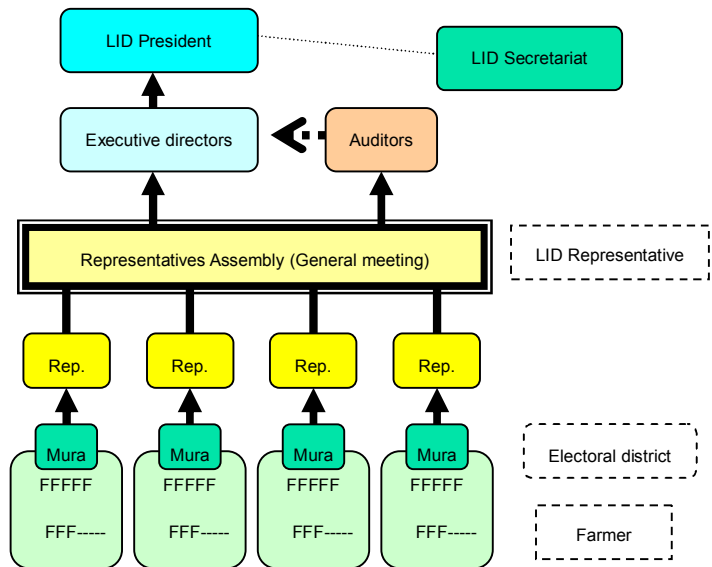


Fig. 4 Organization of Land Improvement District

The assembly elects directors (more than 5) and auditors (more than 2) from the members at its general meeting, and the directors organize a board of directors to enforce its business following articles and decisions of the assembly. The board usually organizes an internal committee(s) for discussing about a specific matter(s) such as finance, water delivery, and has secretariats whose staffs are employed by LID and realize its business following directions of the board; however there are many LIDs that have no full-time employee. (Refer to Fig. 4, 5)

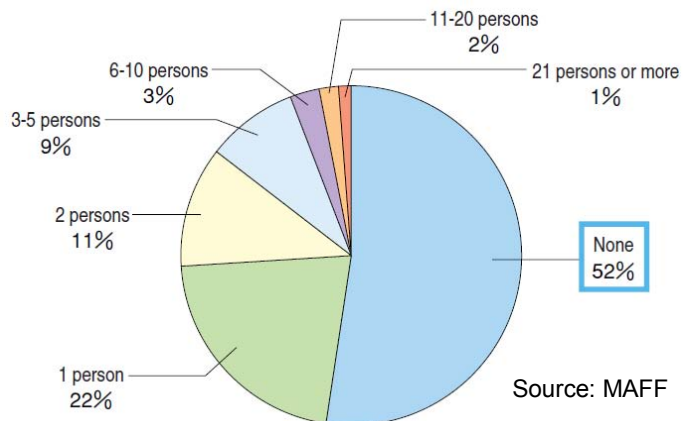


Fig. 5 Number of Full-time Employee in each LID

The board calls a general meeting of the assembly at least once a year to discuss and adopt /decide i) changing LID's articles and regulations, ii) bond floatation and debt loan, iii) budget for income and expense, iv) imposition (e.g. irrigation fee), v) business report and settlement of balance, and so on as well as setting or changing a LIP plan(s). And a decision of proceedings is made with an agreement of major part of the attendances, except changing LID's articles, setting or changing a LIP plan(s), and dissolving or uniting their LID.

LIDs impose to their members and collect money, pompously labor or goods to allot to an expense for their business following the articles. When imposing, LID considers benefit from the LIP based on objective indexes such as beneficially areas, water flows and so on.

Decisions /adoption of general meeting, and efforts and /or movements of LID are usually informed to all members from representatives at gathering of traditional rural community or through a regular publication /news letter prepared by the board.



Fig. 6 Gathering of community

### 3) Business

Business of LID is to implement LIP(s) including water management. For implementing the business, LIDs carry out activities about project formulation, construction work, operation and maintenance of their facilities, coordination about interest for such as water use, imposition, accounting etc., with technical advice /assistances from LIDs' federations and /or governments.

As for water management, the board plans delivery schedule, operation and maintenance of the facilities, collection of irrigation fee etc., keeping communication with members and related outside organizations. And the board puts those plans into practice in cooperation with them.

## 3 Water Management by Land Improvement District

### 3-1 Cooperation with Governments and Rural Communities

Networks of agricultural water supply and drainage channels, formed around rural areas throughout the long course of history, now extend to a total length of some 400 thousand km, of which 40 thousand km are main canals. This "arterial network of national land" has watered Japan's richly green rural environment and has also supported the convenience and stability of urban life, while it has provided with basic conditions for agricultural production.

#### 1) Cooperation with Governments

There are three means in institutional system to operate and maintain not only those canals but also reservoirs, weirs, pumping stations etc. to supply agricultural water; namely they are i) management by MAFF, ii) management by local government (prefecture and municipality) and iii) management by LID.

After completion of national /prefectural government-operated LIPs, MAFF, for example, operates and maintains only selected main facilities according to special conditions such as technical difficulty of operation and maintenance, largeness of public interest of facilities, while MAFF hands over or entrust other facilities to local governments (prefectures or municipalities) and LIDs to operate and maintain them. So, LIDs operate and maintain about 80 % of main canals with length of 40 thousand km that were constructed by the national or prefectural

governments. Table 2 shows that more than 60 % of facilities /canals constructed by the national government are being operated and maintained by LIDs. As for facilities /canals constructed by LIDs, of course, LIDs themselves usually manage those facilities, sometimes receiving financial assistance of local governments. Meanwhile, governments usually implement each management with their own finance as well as resources from irrigation fees when they manage.

Management Entity	Major Water Use Facilities		Irrigation Canals and Drainage Canals	
	No. of Facilities	Ratio	Length (km)	Ratio
National	20	1.3%	94	0.5%
Prefecture	247	15.6%	576	2.9%
Municipality	265	16.7%	6,939	35.1%
LID	1,042	65.8%	12,133	61.3%
Other	10	0.6%	52	0.3%
Total	1,584	100.0%	19,794	100.0%
(Source: MAFF)				

This situation shows that there are sometimes several management bodies (national, prefectural or municipal governments, and LIDs) in an irrigation and drainage system; however LIDs are constantly involved into it. So, in these cases, operation and maintenance works in irrigation and drainage systems are implemented in cooperation among concerned organizations including LIDs through close communication.

### 2) Cooperation with Rural Communities

Irrigation and drainage facilities, especially at on-farm level, are usually operated and maintained by LIDs, subunits of LIDs, farmers as well as traditional rural communities, in cooperation with each other.

Traditional rural community called “Mura” etc. usually has social and productive functions originated with “Sou” organization, which was organized hundreds years ago to operate orderly and maintain collectively irrigation and drainage facilities for paddy fields where many farmers cultivated. “Mura” performs as a mutual assistance organ of inhabitants and an informal sub-unit of the smallest administrative authority, for example, as it carries administrative decisions. And it operates and maintains facilities for not only irrigation and drainage but also transportation and other communal facilities in its territory. Those works are called “E-sarai” (canal cleaning) and “Michi-bushin” (road maintenance) etc. In recent years, however, above functions are weakening due to decreasing of number of farmer or progressive of co-habitant in rural areas.

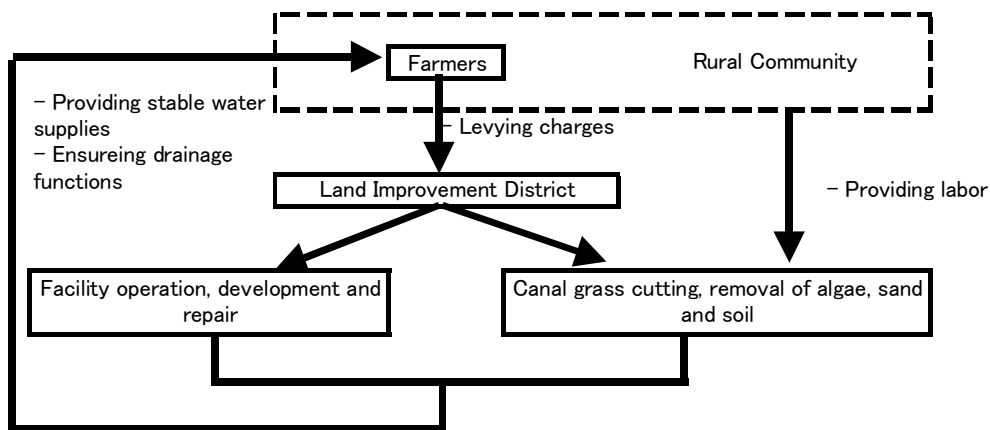


Fig 7. Canal cleaning by members of rural community



The communities voluntarily carry out maintenance works (cleaning and minor repair etc.) of irrigation and drainage canals passing its territory and a part of tertiary canals that are owned and managed by LIDs. Farmers with membership make operation and maintenance works such as gate operation and cleaning of terminal canals beside their farm lots. And LIDs communicate and coordinate with the communities and the farmers to carry out those works consistently, and sometimes provides the communities with a financial contribution.

System of operation and maintenance works for Irrigation and drainage facilities at on-farm is generally shown as Fig. 8.



**Fig. 8 General Maintenance and Management System by Land Improvement District**

### 3) Contributions of Concerned Organizations for Water Management

Water management is being implemented by several concerned organizations under cooperation among them, as mentioned above. And financial contributions of each sector are shown in Table 3. This table shows that LIDs and farmers etc. in rural areas contribute 70 % of total management costs for operation and maintenance.

**Table 3 Management costs for agricultural water facilities**

(Unit: 100 million JPY)

Cost burden category	Management Body		Labor	Total	
	Central & local government	Land Improvement District		Amount	Ratio
Central & local government	450	225		675	30.2%
Land Improvement District	17	805	740	1,562	69.8%
Total	467	1,030	740	2,237	100.0%

Source: MAFF

### 3-2 Practical Water Management by Land Improvement District

LID's boards draft plans for water intake /delivery, and operation and maintenance of facilities, and decide them every year after necessary discussions and coordination with their sub units, farmers, and related organizations mentioned before. Then LIDs carry out those plans in line with related organizations such as governments, rural communities. When charging or taking river water, LIDs prepare plan and use water following a water right authorized to occupy exclusively on the basis of the River Law under the Ministry of Land, Infrastructure and Transport.

### 1) Operation and Maintenance Works

Operation and maintenance works of the facilities are made by LIDs, being paid attention for troubles, accidents and natural disaster, and following the plans and management regulations or manuals prepared by LIDs themselves and provided by related authorities. LIDs monitor water delivery, and patrol and check the facility conditions with cooperation of operators and farmers to carry out effective and adequate maintenance works. A maintenance work such as cleaning, grass cutting of canals is usually carried out through labor service of farmers and inhabitants in rural communities. LIDs also make efforts to remind inhabitants to keep clean and protect the facilities through distributing publications and /or standing signboards beside the facilities. It can be said that these farmers' contributions strengthen their own sense of responsibility or ownership for facility management.

LIDs keep and maintain a main register about beneficiary farm lands and irrigation and drainage facilities managed by LIDs as a basic data book to operate water management.

### 2) Water Delivery

LIDs' main responsibility is to timely deliver necessary amount of water to membership farmers through operating and maintaining irrigation facilities.

LID boards prepare and inform to membership farmers of a water distribution plan before irrigation season. The plan is prepared on the basis of the plan of irrigation project and includes beginning and ending day of water delivery, intake water amount of each irrigation period and so on. During irrigation season, LIDs revise and inform of the plan according to conditions such as weather.

During irrigation season, LIDs operate the facilities following the plan and check the water delivery patrolling and /or measuring water flow. When they find some troubles through their check and /or information from farmers, they coordinate and /or correct them. When frictions /conflicts on water use arise among the farmers, LID boards mediate them and coordinate water use as needed, however resolution finding is sometimes very difficult.

Japan occasionally experiences abnormal droughts with continuous period 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, temperature 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 LIDs, and devote much time and money on forms of water conservation, including rotation, repeated use and rigorous inspection of water channels. LIDs also negotiate and coordinate with other water users along a river to take irrigation water from limited flow, and sometimes give domestic users an advantage depending on situations.

### 3-3 Official Support for Operation and Maintenance Works of Land Improvement District

There are three schemes in official support system for operation and maintenance works of LIDs; namely they are support for i) maintenance and repair of facilities /machines, ii) technique /skill improvement of technical staffs and iii) improvement of management system. These schemes are carried out depending on ministerial regulations /ordinances.

As for support for maintenance and repair of facilities /machines, MAFF provides LIDs with subsidy to appropriate for a part of expense for repair or maintenance works of facilities /machines, so that those facilities /machines work functionally and safely. And MAFF also subsidizes a part of expense for promoting LIDs' efforts on environmental conservation and public safety. As for improving technique /skills of LIDs' staffs, MAFF provides with training, seminar or practical guidance on operation and maintenance. In addition, MAFF prepares and provides regulations and standard guideline /manuals on operation and maintenance.



Fig. 9 Practical guidance to LID's staff

Support as mentioned above is usually provided under cooperation among MAFF, prefectural governments and the national /prefectural federations of land improvement associations. And technical support such as training is given LIDs' staffs by engineers /technical staffs of MAFF, prefectural governments or prefectural federations of land improvement associations.

Whereas MAFF provides LIDs with financial and technical support, MAFF supervises and gives LIDs an administrative guidance on their organizational managements.

## 4 Challenges about Water Management

### 4-1 Current Situations about Water Management

Paddy field irrigation and irrigation system 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 ageing 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.

## 1) Changing Rural Community

In association with economic growth and change of industrial structure after around 1970, many people of farm households moved from rural to urban area and urbanizations progressed in rural areas, particularly near big cities. Those movements in rural area have brought the following situations; i) excessively declining of population in rural area, ii) aging and lack of successors of farmers, iii) increasing of non-farm households in rural areas, namely progress of co-habitant, then iv) weakening functions of traditional rural communities as mentioned before. And these situations have consequently brought difficulties in water management as well as in operation of LIDs. So, it is required to restructure a system for appropriately maintaining irrigation and drainage facilities together with other rural resources (e.g. farm land, agricultural water) according to the changes.

## 2) 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 results in the habitation and growth of many species. In recent years, however, increasing importance has been placed on harmony with the environment.

## 3) Appropriate Management of Irrigation Facilities

Maintenance costs for irrigation and drainage facilities, however LIDs shoulder a major part of the cost, are in an increasing trend, owing to the need to process waste, install safety facilities, and other factors accompanying the urbanization and progressive co-habitant of rural areas. Further more, 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 irrigation water. So, LIDs are required to manage irrigation facilities while responding to these changing circumstances.

## 4) Increasing Obsolescence of Irrigation Facilities

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 JPY 25 trillion, based on reconstruction cost 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 needed to be protected and renewed efficiently.

### 4-2 Current Efforts for the Challenges

#### 1) Policy for preserving farmland, agricultural water and environment

Depending on changes of rural communities and increases of public account for rural environment, it is required to appropriately preserve rural resources such as farmlands,

agricultural water and to improve rural environment, and it is also required that agricultural production shifts to emphasize an environment conservation due to raising public interest on environment issues. Then, the policy for preserving farmland, agricultural water and environment has been just started by MAFF.

As a measure of the policy, working groups consist of not only farmers /farmers' groups but also non-farmers /non-agricultural groups such as residences' associations, young men's associations in a rural area, are established and carry out works for maintaining and preserving regional resources including irrigation facilities and natural environments, following a plan which is prepared by themselves and regulates target areas and resources /facilities and activities. The national and local governments assist to promote their collective activities through providing institutional guidance, technical advices and financial supports. It can be said that maintenance of irrigation facilities has systematically faced cooperation with regional communities through partnership with nonagricultural sectors.

### 2) Measures for extending operating life of irrigation facilities

In an investment for the land improvement projects, around 50 % of total expenses are allocated to renovation or renewal works of irrigation and drainage facilities. It is important that those renovation or renewal works for present huge stock mentioned before should be properly and effectively implemented in the future. And it is essential that end-of-life facilities should be timely renewed and maintenance works should be carried out carefully to extend those operating life.

Following above ideas, preventive maintenance method in which appropriate countermeasure is given based on results of diagnostic function check was put an importance and just introduced into water management from aspect of decreasing life-cycle cost in recent year. In this measures, diagnostic function checks are carried out more carefully, sometimes with high technology such as unmanned survey instruments, nondestructive testing devices, in order to find defects /failures of facilities earlier. According to the results, appropriate countermeasures are given to maintain /repair defects /failures before those deadly expanding.

## 5 Conclusions

Water management system in Japan has been formed in a historical development process of paddy rice irrigation and in agricultural circumstances of small-scale farming. And water management has been generally being implemented, as one category of land improvement projects, through Land Improvement Districts consisted of farmers on the basis of Land Improvement Law.

LIDs operate and maintain irrigation and drainage facilities to deliver irrigation water timely and effectively in cooperation with related administrative authorities, traditional rural communities and farmers under financial and labor contributions, closely communicating with all of them. It can be

said that water management in Japan is carried out through “3C” (Cooperation, Contribution and Communication) centered on LIDs, being supported by engineering /technique on water management.

New policies on water management have started to improve its system according to present situations.

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