



## **PROGRESS OF IRRIGATION AND DRAINAGE PROJECTS IN THE NISHITSUGARU REGION AND ROLES OF THE FARMERS ORGANIZATION, NISHITSUGARU LAND IMPROVEMENT DISTRICT**

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### **1- CHARACTERISTICS OF IRRIGATION MANAGEMENT IN JAPAN**

- 1-1- Land improvement districts: In Japan, maintenance of irrigation and drainage systems and water management are implemented by Land Improvement Districts (hereinafter LIDs) organized by beneficiary farmers.

The major roles of LIDs are, besides these, to conduct necessary procedures through consensus-building with farmers for the construction of facilities to realize rational water management, with technological and financial support from the national government, prefectures and municipalities.

- 1-2- Principle of beneficiaries' burdens: LIDs are managed by directors elected by the beneficiary farmers, and the necessary expenses for managing LIDs are, in principle, covered by dues borne by the beneficiary farmers.

The beneficiaries also share reasonable construction costs and maintenance expenses for facilities with financial support from the organs mentioned above. The projects are, thus, implemented on the principle of beneficiaries' burdens. This ensures the farmers' initiative and makes it more likely that appropriate facilities will be constructed and operated.

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1-3- Land Improvement Law:

The construction of facilities and their operation and maintenance, executed under the initiative of LIDs, are based on the Land Improvement Law enacted in 1949.

The Land Improvement Law includes provisions concerning hardware programs that aim to promote the construction of such facilities, and also software programs to operate and maintain them. Here, it is stipulated that the facilities should be managed by LIDs organized by their beneficiary farmers.

1-4- Participatory irrigation management: LIDs organized on the basis of the Land Improvement Law can ensure their financial resources for the operation of LIDs through mandatory authority under the law. Namely, all beneficiary farmers in a specific region must be members of a LID, to which they must pay their dues and burdens.

This manner in which LIDs conduct their activities is designed with a view to participatory irrigation management in the Japanese style.

1-5- Public interest functions and facility management policies: In recent years, irrigation and drainage requires a high level of management technologies, due to an increase in the scale and modernization of facilities. Moreover, urban areas are expanding into rural regions, while the inflow of domestic wastewater and dumping of garbage into canals are also problems. Such changes have sharply raised management costs for LIDs.

On the other hand, owing to declining agricultural incomes caused by falling prices of farm products under the influence of free trade and so on, it is now becoming more difficult to collect or increase dues, thus weakening the financial foundation of LIDs and their management system.

Irrigation and drainage facilities not only play important roles in agricultural production, but also provide public interest functions such as purification of the environment, removal of a region's excess water and conservation of national land. Therefore, how to share the management costs is one of the challenging problems to be solved. In response to this movement, regional residents and corporations are starting such supporting activities as campaigns to beautify the environment or purify water quality, etc. The national and prefectural

governments are strengthening public control and assistance, and providing guidance for maintenance and operation technologies, but based on management by LIDs themselves.

In these ways, a new facility management policy is operating with the participation and financial support of governmental organs.

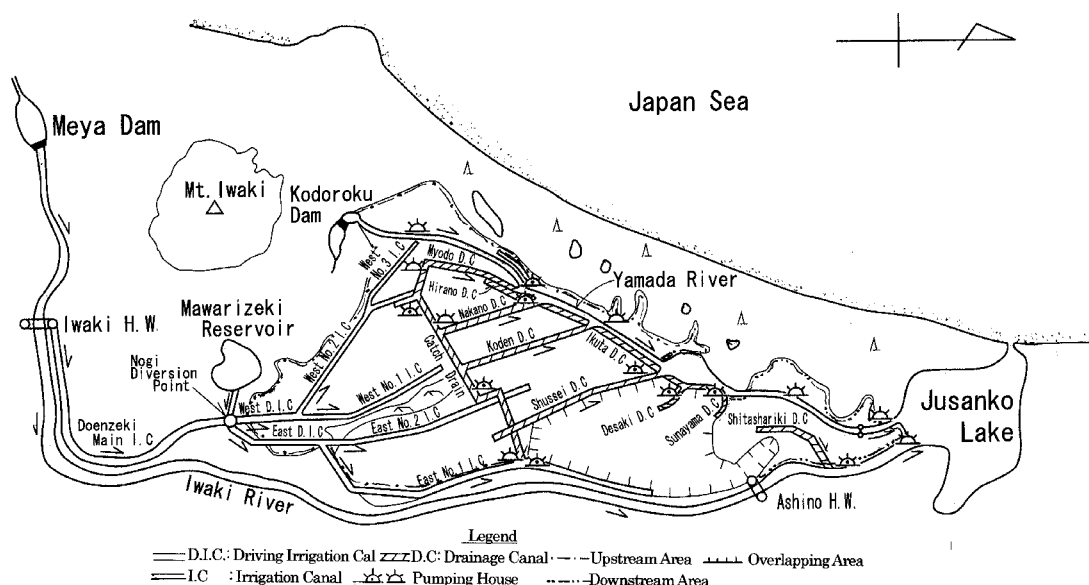


Fig 1. Outline of the Irrigation and Drainage System in the Nishitsugaru Region

Table 1. Progress of the Irrigation and Drainage Projects in the Nishitsugaru Region

Project	Year	1940	1950	1960	1970	1980	1990	2000	Remarks
N. Nishitsugaru	1944-1969	████████████████████							Upstream
N. Nishitsugaru 2nd	1968-1981				████████████████████				Upstream
P. Nishitsugaru	1969-1988				████████████████████				Upstream
N. Iwakigawa L.B	1996						████████████████████		Upstream
P. Iwakigawa L.B	1996						████████████████████		Upstream
N. Jusanko	1948-1968		████████████████████						Downstream
N. TaugaruHokubu	1982-1998					████████████████████			Downstream
P. TaugaruHokubu	1985-2006						████████████████████		Downstream
P. Land Consolidation	1970-1994				████████████████████	████████████████████			Entire Area
Iwakigawa HW	1958-1961			████████					Upstream

Legend N: National Project ██████, P: Prefectural Project ██████ Prefectural Land Consolidation Project ═════

## **2. PROJECTS IN THE NISHITSUGARU REGION**

### **2.1 State Of The Region And Improvement Of Facilities**

#### **2.1.1 State Of The Region**

The Nishitsugaru region is located in northwestern Aomori Prefecture at the northern tip of Honshu Island, Japan. It is a paddy field zone occupying approximately 10,000 hectares on a low flat alluvial fan. Located along the lowest reaches of the Iwaki River, which supplies water for the Iwaki Plain, it has a long history of drought, flood disasters and water disputes.

The peat soil that typifies this region, along with poor drainage, used to form extremely soft ground that caused serious difficulties for farmers' cultivation. As a result, there was considerable demand for the improvement of irrigation and drainage facilities among farmers in this region. The LID, in response to this, played a central role in forming a consensus among beneficiary farmers concerning project plans, sharing part of the project costs and management method of facilities after completing as necessary legal procedures. These missions have been adopted on an individual basis for every national project, prefectural project and others, respectively, and have promoted the development of regional facilities over many years.

#### **2.1.2 Improvement Of Core Facilities**

The Nishitsugaru National Project to construct core irrigation and drainage facilities in the upstream area and the Jusanko National Project in the downstream area began before the war. However, following the enactment of the Land Improvement Law in 1949, the projects shifted into a higher gear with the renewal of project plans and the establishment of local supporting systems, and were thus completed in 1968.

#### **2.1.3 Improvement Of Main Irrigation And Drainage Facilities**

Following the construction of core facilities, and in response to strong demand from farmers, the Nishitsugaru National Project phase 2 was started in 1967, succeeded by the Nishitsugaru Prefectural Project in the upstream area. The projects aim to construct various pump stations, and to rearrange and improve disordered canals with a view to strengthening drainage systems and setting up water reuse systems, and were completed in 1988.

In the downstream area, the Tsugaru Hokubu National Project and the prefectural project began in 1982, mainly focusing on drainage improvement, and were completed in 2006.

The prefectural projects that followed on from the national project are to construct facilities for a beneficiary area of less than 500 hectares.

#### 2.1.4 land consolidation project and irrigation and drainage networks

Meanwhile, since field conditions are extremely poor in both soil and format in this region, some small groups of farmers and individuals had previously rearranged paddy fields and executed soil dressing as well as underground drainage works.

Given this background, there was a growing movement for farmers to improve paddy fields completely using land consolidation works. In 1969, the Prefectural Land Consolidation Project was started as the largest in scale among such projects in Japan. The intention was to consolidate narrow and irregularly-shaped paddy fields, to make them wider and more orderly with the provision of terminal irrigation and drainage canals. Since the land consolidation works and works to improve canals were conducted simultaneously throughout the entire region, the arrangement of main canals was boldly transformed. By 1994, canals and paddy fields were systematically reorganized to overcome poor topographical, geological and climatic conditions over an area of 9,700 hectares.

#### 2.1.5 Deterioration Countermeasures And Improvement Works

Responding to the accelerated deterioration of facilities due to harsh natural conditions, as well as demands for facilities to achieve more effective use of agricultural land and to conserve the environment, irrigation and drainage projects at both national and prefectural level began in 1996, covering approximately 10,000 hectares of the entire region. These, Iwaki River Left Bank projects, have been reconstructing or upgrading facilities with a view to promoting sustainable irrigated agriculture and stable farm operation.

#### 2.1.6 Related Facilities Constructed In Conjunction With The Irrigation And Drainage Projects

#### a. Meya Dam

The Meya Dam, a multi-purpose dam with capacity of 3.3 million , constructed in 1960, is managed by Aomori Prefecture. A new Tsugaru Dam is now under construction by the Ministry of Land, Infrastructure and Transport due to the deterioration of the Meya Dam.

#### b. Iwaki River Integrated Headworks

The headworks take a maximum 18 /sec of irrigation water from the Iwaki River into the main canal, and are managed by a Union of Land Improvement Districts consisting of five land improvement districts. The Iwaki River Left Bank National Project is scheduled to reconstruct these headworks in the near future.

### 2.2 Activities Of The Nishitsugaru Land Improvement District

To carry out an irrigation and drainage project in Japan, it is necessary to organize an LID covering the whole area where the project is implemented, in order to operate and maintain the facilities which will be constructed by the project.

In the Nishitsugaru region, the Nishitsugaru LID plays this role. By setting the structure of operation and maintenance in absorbing and combining small and medium-size older LIDs in the region, the LID has been promoting such projects while coordinating existing customs and rights which had arisen in the course of history, and obtaining more than 90% agreement from farmers for each project based on the Land Improvement Law (the agreement of two-third or more is required by the Law).

#### 2.2.1 Organization And Roles Of The Lid

##### 2.2.1.1 Organization Of The Nishitsugaru Lid

There are 10,300 hectares of beneficiary area, covering Tsugaru City, Goshogawara City and Tsuruta Town. The organization consisted of 6,127 members as of 2006, including 13 directors, 4 auditors and 95 representatives.

The secretariat has 40 employees under the Chairman of the Board of Directors.

##### 2.2.1.2 Roles Of The Nishitsugaru Lid

The LID's main activities are to promote various projects through consensus-building regarding necessary facility construction, and maintaining

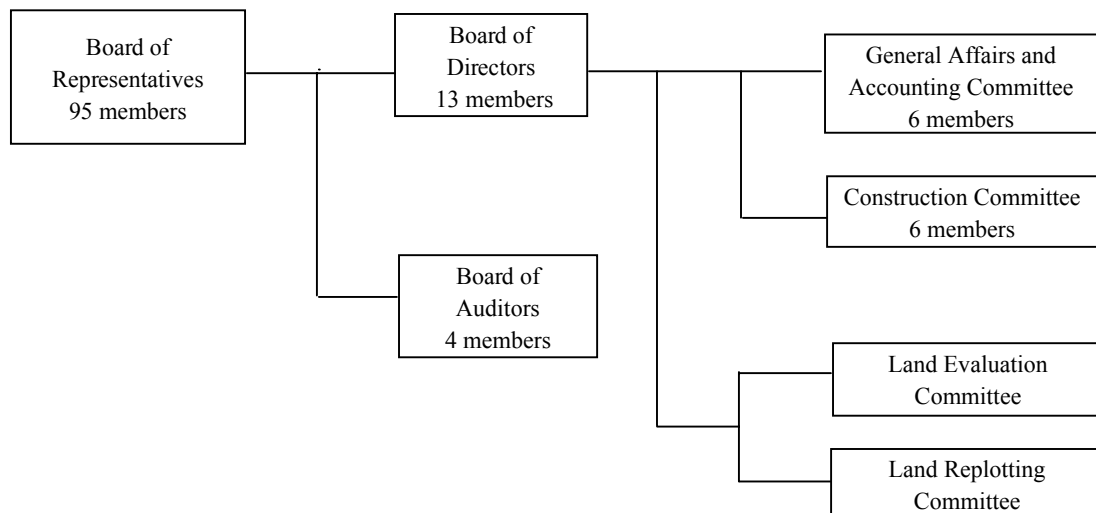
facilities, water management including fair water distribution and appropriate drainage, and collecting the cost from the beneficiaries of each project, as well as dues consisting of running expenses and maintenance expenses of the LID.

### 2.2.1.3 Structure Of The Lid

Decision-making by the LID is based on democratic principles, in order to reflect the beneficiary farmers' wishes by referring to a Representatives' Assembly (consisting of 95 Representatives selected by elections in each district).

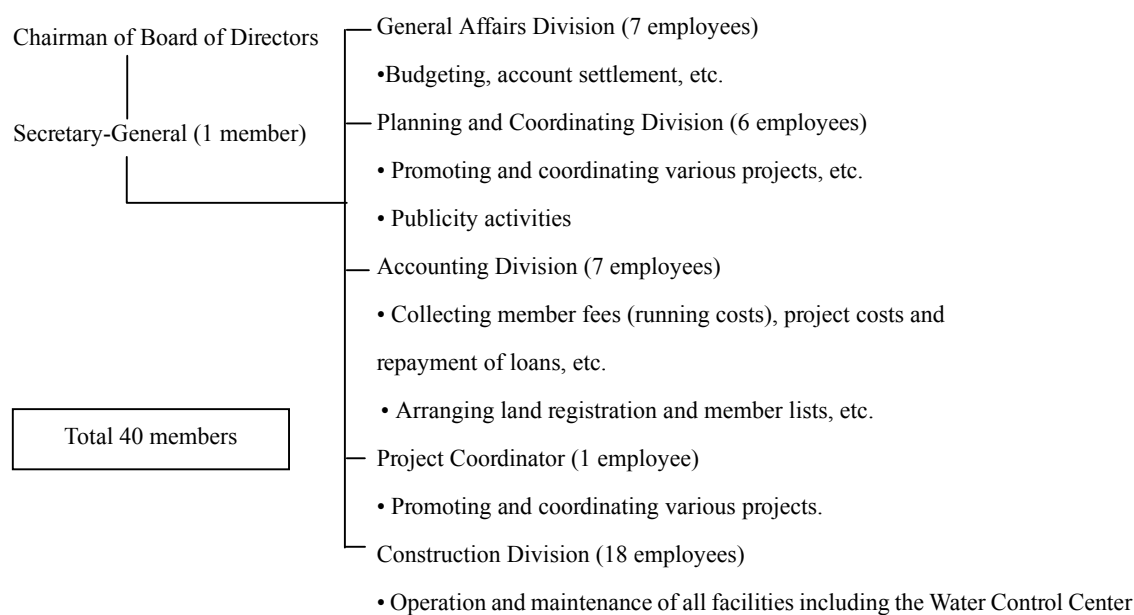
The LID is managed as follows:

- 1- The Directors and other executives manage the LID
- 2- By passing resolutions under the General Assembly or Representatives' Assembly
- 3- In accordance with articles and rules required for the operation of the LID
- 4- Based on the constituent members



**Fig 2.**Organizational structure of the Nishitsugaru LID

### 2.2.2 STRUCTURE AND ROLES OF THE SECRETARIAT



**Fig 3.** Structure and roles of the Secretariat

### 2.2.3 Election Of Representatives

Since the Nishitsugaru LID has more than 6,000 members, the decision-making body is the Representatives' Assembly rather than the General Assembly.

A total of 95 Representatives are elected from 11 election blocks by the LID members.

### 2.2.4 Election of Directors

A total of 13 Directors are elected from 11 election blocks by the Representatives.

### 2.2.5 Publicity activities

Publicity is one of the important activities for gaining members' understanding and managing projects smoothly when implemented by the LID in cooperation with them.

Publicity activities by the LID are as follows:

- Publication of bulletins: Publishing the "Tsugaru Bulletin" twice a year (April and



January)

- Postcards: Sending announcements about important events and matters (such as the start date of water supply) to the Representatives, municipalities and branch offices of national and prefectural governments concerned, other farmers associations, etc.
- Broadcast by local radio system: Broadcasting issues to concerned villages within the beneficiary region.
- Posting notices: Rotational irrigation plans for drought countermeasures are posted at the diversion and intake point, respectively, notifying dates of irrigation and non-irrigation, and are broadcast at the same time to the villages concerned via the local radio system.

## 2.2.6 Maintenance of facilities and water management

### 2.2.6.1 Maintenance of facilities

#### a. Delivery of facilities

Facilities completed by the national and prefectural governments are delivered to the user, the LID, and maintained by it.

With delivery, two documents (“Management Manual” and “Management Regulations”) are provided for regulating the management, maintenance and operation of the facilities, and the LID is supposed to manage the facilities under the terms of these two documents.

#### b. Training for operating engineers

With the increase in size and sophistication of irrigation and drainage facilities, operating engineers are required to have expertise on high-level technologies and gain the necessary qualifications stipulated in the Management Manual mentioned above. Therefore, the national government is expanding systems to train operating engineers prior to the completion of national projects, in order to promote mastery of operating technologies and make progress with operating systems.

The Nishitsugaru LID has been utilizing these systems and upgrading the technical ability of the engineers in charge.

### 2.2.6.2 Irrigation systems and facilities in the Nishitsugaru region

a. The major irrigation water for the Nishitsugaru region diverges from the Iwaki River at the Integrated Head Works about 25 km upstream of the region, and is conveyed to the Nogi Diversion Point through the Doenzeki irrigation canal (primary main irrigation canal).

b. Below the Nogi Diversion Point in the region, there are five main canals after two driving main canals, all constructed by the national project, which serve water to terminal beneficiary fields of 500 ha (secondary main irrigation canals).

c. Below the five main canals, beneficiary areas ranging from 500 to 100 ha are irrigated by the main canals constructed by the prefectural project (tertiary main irrigation canals).

d. Irrigation water from the main canal is led to about 12 ha of field blocks through lateral irrigation canals, divided into irrigation ditches and distributed to field lots individually. The lateral irrigation canals and irrigation ditches were constructed by the Prefectural Land Consolidation Project (field canals).

e. This irrigation system provides various supplementary water resources, as follows.

- The Mawarizeki reservoir and the Kodoroku Dam are major supplementary water resources.

- Five pumping stations constructed along catch drains located at 3 m in elevation are to reuse drained water.

- Bi-purpose pumping stations for irrigation and drainage are installed below 3 m in elevation.

- The area along the left bank of the Yamada River is irrigated by pumping water from drainage canals.

- A group of small or medium-size reservoirs is scattered in the surrounding area.

### 2.2.6.3 Divisions of management between the LID and farmers

Water management and maintenance of facilities are categorized between the LID and the farmers under the principle that major facilities are managed by the LID

and on-farm level facilities are left to the beneficiary farmers. Concerning irrigation and drainage canals, the LID undertakes management up to tertiary canals constructed by prefectural projects, while the farmers undertake lateral irrigation and drainage canals and ditches on fields constructed by the Prefectural Land Consolidation Project. Besides these, farmers take care of distributing water, operating gates and maintaining canals at on-farm level, with rules decided by themselves in each unit area.

#### 2.2.6.4 Water management by the LID

a. A centralized management system is implemented at the Irrigation Control Center placed in the center of the region.

b. Water levels and discharge at major points throughout the region are monitored from the Center, and the discharge is adjusted by controlling intake gates through a central-remote manual operation system. Pumping stations are also operated by same system, which controls operating pumps, and the shutting and adjusting of valves from the Center.

c. Water management system

Five employees are stationed at the Irrigation Control Center to monitor and control the system on graphic display terminals, and also they patrol the entire region when necessary.

Two employees are assigned to the East and West Main Canal systems, one to operate each of the intake gates installed at the main canals (secondary and tertiary).

The 26 operators assigned at the pumping stations manage water and facilities and undertake garbage disposal.

#### 2.2.6.5 Rotational irrigation during droughts

a. Start and duration of rotational irrigation

Rotational irrigation starts when the discharge is lowered to less than approximately 6.0

m<sup>3</sup>/sec compared to a normal design discharge of 10.9 /sec at the Nogi Diversion Point (located at the entrance to the region), and continues until the discharge recovers.

Because of the recent tendency whereby for the main stream, the Iwaki River, reduces its discharge. Supposedly due to abnormal weather conditions or expanding deforestation, rotational irrigation is unavoidably implemented for one to two months every year.

#### b. Rotational irrigation method

- To divide water flow using the planed discharge ratio between the West Driving Main Canal and the East Driving Main Canal at the Nogi Diversion Point.
- Three-day rotational irrigation is performed below the Driving Canals. In the case of the west canals, the entire water discharge is introduced into the West No.1 Canal for the first three days, and then on the fourth day, similarly, the entire water discharge is introduced into the West No.2 Canal. Such rotations are repeated every three days.
- The same system is operated on the East Driving Canal side.
- Irrigation water based on rotational irrigation in this region, in principle, is delivered in turn from fields further away from the main canal.
- Accordingly, irrigation water is available for a guaranteed supply even to terminal fields.
- Land consolidation works, providing irrigation ditches along every field lot, have made rapid water distribution possible to the area requiring water.

#### 2.2.7 Maintenance of facilities

##### 2.2.7.1 Facilities managed by the Nishitsugaru LID

**Table 2** Facilities managed by the Nishitsugaru LID

Facilities	Irrigation Canals		Drainage Canals		Pumping Stations	Gates	Remarks
	Route	Length (m)	Route	Length (m)	Places	Places	
Totals	51	141,429	53	137,956	68	53	

### 2.2.7.2 Maintenance by the LID

The LID maintains facilities in the region based on maintenance plans provided by each facility. However, because there are an extremely large number of facilities, the LID tries to carry out systematic and scheduled maintenance and repairs by adopting subsidized projects from the government in order to prevent deterioration and reduce farmers' burdens.

#### a. Pumping stations and equipment

Daily inspection and maintenance are carried out by 26 operators under the guidance of two center employees. Periodical inspection, maintenance and repairs are entrusted to specialized companies.

#### b. Heavy machinery owned by the LID

For removal of sediment in irrigation and drainage canals: 3 backhoes

For removal of weeds and algae from drainage canals: 1 algae boat

#### c. Canal sediment removal plan

The removal of sediment is scheduled once every three years for each canal, taking account of the state of the canals. In addition to such machinery use, workers are hired in case of need.

#### d. Disposal of garbage

Disposal of garbage piled in the main irrigation canals, six siphons and 28 unmanned pumping stations is carried out by garbage disposal contractors.

#### e. Melting snow measures

Since melting snow causes submerged damage to urban areas and villages in the region during the spring thaw, accumulated snow in the drainage canals during winter should be removed to let water flow in the canals. Snow is removed and canals cleared by seven leased machines and two self-owned ones.

### 2.2.7.3 Maintenance by beneficiary farmers

The beneficiary farmers negotiate and decide how to share the maintenance works for lateral canals and ditches (both irrigation and drainage) per water use unit.

Works to be executed are mainly removing mud from canals, weeding along canals and repairing flume joints, among others. Farmers execute such works collectively from April to May before transplanting, and after that, in September, they dig drainage canals to drain water quickly. Other works are carried out when necessary. In case some works need heavy machinery, the LID undertakes temporary recovery works, and at a later point a subsidized project will start, including the restoration works mentioned above together with others.

#### 2.2.7.4 Collection of dues and burdens

Expenses that the LID collects from its beneficiary farmers are dues, consisting of running expenses and operation and maintenance expenses, and burdens of project costs shared by farmers. Dues include personnel expenses and others for the operation of office works, as well as operation and maintenance expenses for irrigation and drainage facilities belonging to the LID. The burdens of individual projects are collected from each farmer who benefits from each project, based on the payment conditions stipulated for the project or loan repayment conditions.

The collection ratios are over 99% for both LID dues and shared project costs, although it takes several years to obtain claims for one year, reflecting the economic conditions facing farmers recently.

#### 2.2.7.5 Details of dues

- a. Running expenses: Expenses for personnel, Representatives' Assembly, elections of Representatives and Directors, office works, etc.
- b. Operation and maintenance expenses: Expenses for operators of pumping stations and heavy machinery, electricity, gasoline and other fuel for pumping stations and laborers for maintenance works, etc.

### 2.3 Measures to lower the burden on beneficiary farmers

#### 2.3.1 Measures for project costs

In Aomori prefecture, the national government and the prefecture subsidize approximately 90% of project costs for national irrigation and drainage project. In the case of prefectural projects, farmers' shares are 25% for irrigation facilities and 15% for drainage facilities. In land consolidation projects operated by the prefecture, the farmers share 27.5% of the costs.

The municipalities concerned, in addition, subsidized 50 % of farmers' shares for the Tsugaru Hokubu National Project, and are subsidizing the farmer's entire burden for the Iwaki River Left Bank National Project. This is in consideration of the harsh situation of farm management, and the fact that the objective facilities, major facilities in the region, have a high level of public interest.

### 2.3.2 Measures for dues

There are various measures provided for the LID for the safe and sustainable management of facilities with high public interest functions.

The Nishitsugaru LID is striving to take advantage of these measures to lower the burden on farmers.

#### 2.3.2.1 Subsidy for periodic maintenance and repairing works

Works for pumping stations, dredging canals and others are subsidized.

#### 2.3.2.2 Governmental management of important facilities

The biggest five pumping stations are controlled under the prefecture for appropriate operation and economic assistance.

#### 2.3.2.3 Restoration works by the prefecture

The prefecture implements urgent restoration works for main facilities.

#### 2.3.2.4 Subsidy for management expenses of main facilities

Management an expense, personnel, fuel and others costs of main facilities constructed by the national projects are subsidized.

#### 2.3.2.5 Governmental support for activities with NPOs and regional residents

A new project is scheduled to start in 2007. Joint activities with NPOs and regional residents for improvement and conservation of farmland, water and environment are supported technically and financially by the governments.

### 2.4 Main effects achieved in the Nishitsugaru region

Over a period of years, the LID has been making effort with beneficiary farmers to promote the improvement of irrigation and drainage facilities, as well as their

operation and maintenance.

Such activities have been brought remarkable effects into the region as follows;

There used to be more than twenty farmers' groups, which were in conflict, with each other due to disputes over drawing irrigation water, disposing excess water, and so on. However, thanks to the improvement of a great deal of facilities and as well as united water management by the LID, these problems have been solved and all such conflicts in the region have disappeared.

The improvement of canals and pumping stations expanding from main facilities to terminal field lots, and water management through monitoring and operating at the Irrigation Control Center, have made it possible to achieve rotational irrigation throughout the region, and have thus greatly relieved farmers from the past history of troubled irrigation practices and drought damages.

Such improvement of facilities, as well as water management and implementing melting snow disposal, have markedly reduced flood and melting snow damage.

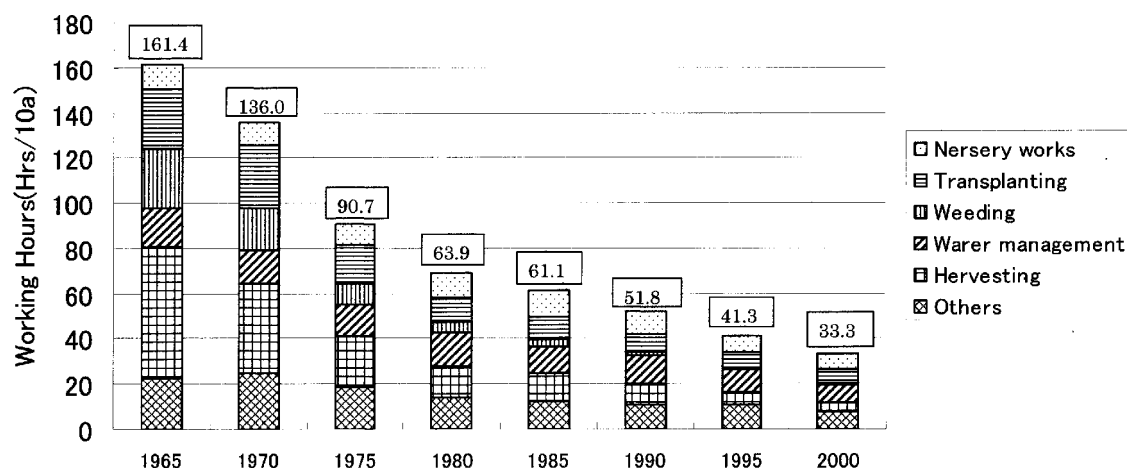
In towns and villages in the region, safe and sanitary living environments have been created thanks to the integration and improvement of a great deal of old canals with reliable water management.

The improved canals, land consolidation works and appropriate water management have transformed ill-drained paddy fields, once a serious problem for the farmers, into well-drained fields where heavy farm machinery operation and upland cropping are possible. Working hours for rice cultivation have decreased drastically to less than a quarter of those compared with forty years ago, and the farmers have been relieved from heavy farm works, and obtained highly productive agricultural fields.



**Table 3** Change in Unit Working Hours for Rice Cultivation in Aomori

(a prefecture with approximately 85,000 hectares of paddy fields including the Nishitsugaru region)



## 2.5 Conclusion

This paper aims to refer in detail to the activities that farmers and their organization, the Nishitsugaru Land Improvement District, have executed in the region as an example of participatory irrigation management. The effects have been brought by the participatory irrigation management that the farmers have implemented based on their own initiative. Nevertheless, looking at the progress of improvement, appropriate participation and support by the national government, the prefecture and municipalities, etc., are considered essential to the LID.

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