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Rural Environment, Self-Governance of Local Common-Pool Resources and Development Planning in Japan

by

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1 Introduction

We can identify two major rural environments: the infrastructural rural environment and the non-infrastructural rural environment. The former refers to rural natural resources such as irrigation (including dams, canals, reservoirs), farmland, forestry, and fisheries, and the later to externalities or incidents such as pollution of irrigation water because of industrial wastes or excess use of chemical pesticides, crop damage because of acid rain, rural population pressure on farmland and urban population pressure on rural farmland. In this paper while we are mainly concerned with Japan's infrastructural rural environment with special reference to self-governance issues of common irrigation system as a common-pool resource (CPR), we will briefly illustrate some important aspects of non-infrastructural one.

Most of the rural infrastructural rural environments refer to local common-pool resources. Issues concerning how the CPRs will be managed and who will manage them have been critically debated over the past several decades. Scholars such as Gordon (1954), Demsetz (1967), Olson (1965), Hardin (1968), Hardin and Baden (1977), and Smith (1981) have advocated either a state solution or a market solution (i.e., privatization). One of the seminal works, *The Logic of Collective Action* (Olson 1965), recommends that external coercion (the state solution) is necessary to make rational, self-interested individuals achieve their common interest in a group. The primary implication of a state solution or a market solution is to work out Hardin's (1968) "tragedy of the commons," which says CPRs users, in the absence of an external coercive force, overexploit their resources due to individual interests taking priority over common interests in an interdependent situation. Therefore, CPRs are doomed to degradation characterized by Pareto-inferior, Nash-Equilibrium states. Scholars such as Ostrom (1990), Gardner *et al* (1990), Fenny *et al* (1990), McKean (1992), Schlager *et al* (1994), Bromley & Michael (1989), and Ellickson (1994) have advanced some different views to patronize the CPRs users' institutional solution as an alternative. They have performed a number of case studies and referred to several thousands of empirical case studies (see Hess 1996 for a comprehensive bibliography) to establish that users' self-

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governance of local CPRs is also possible in many instances, under endogenous institutional arrangements that the users design by themselves. Some of the proponents of the institutional solution argue that when the CPRs management is either privatized or controlled by the state, internal institutions that the users traditionally have or can craft are adversely affected, finally leading to the users' overappropriation of the resources. Consequently, "the tragedy of the commons" may also occur with both the market and state solutions due to "market failure" or to "state failure."

While Ostrom *et al* (1999, 281) argued, "the tragedies of the commons are real, but not inevitable," Fenny *et al* (1990; 86) commented, "Hardin's model is insightful but incomplete." The increasingly influential book, *Governing the Commons* (Ostrom 1990), has strongly challenged the "metaphorical" uses of Hardin's "tragedy of the commons" and Olson's (1965) *Logic of Collective Action* models. This book argues that self-governance of CPRs can address users' collective action problems well. Although proponents of self-governance believe that self-governance is not a "panacea," they argue that case studies throughout the world reveal that self-governance can also address those problems that concern Hardin's tragedy of the commons, as well as Olson's logic of collective action, and protects resources from possible degradation.

In our random and limited observation, the most of the studies that concern self-governance policy are based on developing countries; only a limited number of studies have been conducted on highly developed countries. Our present study[1] is an attempt to delineate the self-governance issues of CPRs in Japan, which enjoys the second largest economy in the world and which has a number of self-governed CPRs that substantially contribute to rural development planning. The main reason we have incorporated the concept of self-governance into the subject of rural development planning is that local institutions (the mainstay of self-governance) and local CPRs management are interrelated and interdependent. Therefore, a thorough understanding of such a relationship can contribute to CPRs management as a part of rural development planning. We discuss the self-governance strategies — particularly from institutional point of view — of irrigation CPRs in Japan while briefly outlining those of fisheries and forestry CPRs. The study is expected to be useful to those national policymakers and donor agencies who are engaged in the rural development planning — for example, local CPRs management, rural environment conservation, and community-based conservation of biological resources — of other Asian countries that have experienced state failure as well as market failure or that are considering to adopt self-governance strategies for rural development. By "self-governance" we simply mean the users' self-management of their CPRs based largely on their endogenous institutions that they craft themselves with or without the presence of external entities that do not exercise coercion or impose exogenous

[1] A part of this study was presented in different conferences: Sarker and Itoh 1999a; Sarker and Itoh 1999b; and Sarker and Itoh 1999c.

institutions unless the users may collectively accept, not because of coercion but of agreement.

Before critically discussing infrastructural rural environments that include those local CPRs such as common irrigation system, we will briefly narrate non-infrastructural environmental problems as well as government investment for rural development planning in Japan. The reason we have specially addressed the Japan's irrigation CPR is that the irrigation management system is quite unique in its self-management strategies that many other Asian countries may largely refer to.

2 Non-infrastructural Rural Environmental Problems

It is generally recognized that most of the countries of the Asia-Pacific region are encountering critical infrastructural and non-infrastructural environmental problems in rural areas, depending on their economic development or geographical location or climatic condition. Both poverty and affluence are recognized as contributors to environmental problems and the exhaustion of natural resources (Rao, 1998). In low-income countries such as Bangladesh, India, and Pakistan, environmental problems arise because of devastating floods, rural population pressure on farmland, deforestation, soil erosion and so on. Medium- and high-income countries such as Thailand, the Philippines, Malaysia, and South Korea, have rural environmental problems because of the excessive use of chemical fertilizers and pesticides, and their irrigation water becomes polluted by industrial effluents. In Japan, which has the second largest economy in the world and the largest one in the Asia-Pacific region, severe environmental problems turn up in rural areas. However, Japan has taken to address these problems, such as flood control through the improvement of dams and irrigation and drainage systems and pollution reduction by limiting the discharge of industrial or animal wastes.

We can consider two broad sources of non-infrastructural rural environmental problems in the Asia-Pacific region. The first one is external, pertaining to non-agricultural activities. One example is polluted irrigation water due to industrial wastes that contaminate the land in rural areas. In a developed country, another external source of rural problems is the encroachment of the urban population on farmland because of the rapid expansion of urbanization. The second source of non-infrastructural rural environmental problems is internal, referring particularly to agricultural activities. An example is polluted irrigation water due to the excess use of chemical fertilizers and pesticides, which destroy the agricultural ecosystem. Another example, in a densely populated developing country such as Bangladesh, the rural population growth puts internal pressure on farmland. There are also other good examples. The creation of river dams usually prevents the flow of sand and stones from the upper stream area to the lower, causing erosion problems in the lower stream area and, consequently stronger river currents in the lower stream area that may affect the ecology there. The reduction of agricultural lands and an increase in concrete canal or channels linings may threaten the ecosystem in rural area. In Japan, as a highly

developed country, the environmental problems arise from a number of external and internal sources.

In Japan, while the history of external-source-based rural environmental problems consists of isolated incidents over a long period, the history of internal-source-based environmental problems includes many incidents over a shorter period. As industrialization expanded during the Meiji period (1868-1912), environment pollution originating from external sources began to appear, contaminating the rural environment. The first such environment pollution incident is known as the Ashio Kodoku Jiken (Ashio Copper Mine Incident), which took place in Tochigi Prefecture. The Ashio Copper Mine, established in 1877, caused acidic pollutants to contaminate nearby rivers. In the 1890s, regular floods contaminated over 50,000 fertile acres (20,250 ha) in the north Kanto Plain (*Japan: An Illustrated Encyclopedia* 1993, 67). As copper seriously damaged rice growth, the local farmers launched successful protests against mining companies' operations.

The second environmental pollution incident originating from external sources is known as the cadmium contamination of the Jinzu River due to liquid waste from the Kamioka mine in Gifu Prefecture. While excavation of the mine began in the 1590s, mining operations soared in the middle of the Meiji period, and wastes contained cadmium from the mine plant. In Toyama Prefecture, where the Jinzu River was used to irrigate rural areas, zinc and copper damaged the rice. Those rural people who continuously ate the contaminated rice suffered from the Itai-Itai (ouch-ouch) disease, which made their bones fragile and easily fractured and ultimately caused death. In the Jinzu river basin, more than 1,500 ha of paddy fields had the soil contaminated by cadmium (Misawa 1999, 136).

Until the 1960s, people thought that environmental problems in rural areas arose due to external sources such as mining and chemical industries that contaminated irrigation water and farmland. *Kodansha Bilingual Encyclopedia of Japan* (1998, 406) and *Japan: An Illustrated Encyclopedia* (1993, 347) pointed out that four major factors contributed to the emergence of water pollution problems from the 1960s to the 1970s. These factors are rapid industrialization, rapid urbanization, the lag in constructing some overhead capital facilities, and a public policy that favored economic growth over public health and a clean environment. Later, it became clear internal sources also contaminate the rural environment. Haraikawa (1998, 88) pointed out some environmental problems whose main sources are internal. He noted that agriculture can adversely affect the environment due to the use of chemical fertilizers and pesticides in intensive agriculture, animal waste disposal and the offensive odors associated with intensive livestock production, and the disruption to natural habitats.

Rural environmental problems, both from internal and external sources, became severe after World War II in Japan. After the war, Japan emphasized industrial expansion without considering environmental problems, which led to the spread of pollution-related diseases among general public (*Japan: An Illustrated Encyclopedia* 1993, 1217). In the 1960s, there was a violent outbreak of Minamata disease, characterized by the

degeneration of nerve cells, among people who ate seafood poisoned by industrial mercury discharge into the Minamata bay in the Kumamoto Prefecture. Victims with symptoms similar to those of Minamata disease appeared in a fishing and farming district in Niigata Prefecture in 1964-65.

Issues concerning non-infrastructural rural environmental problems were not discussed much in Japan in the years following World War II and the government's indifference to environmental problems until the 1960s resulted a series of pollution incidents. Waste water from industrial and domestic areas became the main sources of pollution instead of mine waste. Misawa (1999, 136) described how industrial and domestic water pollution increased rapidly with fast economic growth. In 1970, the agricultural land irrigated using polluted water reached approximately 2000,000 ha, the equivalent of seven percent of the total areas of paddy fields (Misawa 1999, 136).

However, when the pollution incidents intensified and significantly damaged rural areas, the government enacted "The Basic Law for Environmental Pollution Control" in 1967 and significantly strengthened the law in 1970. Areas polluted by effluents from mines and factories decreased due to both the Water Pollution Control Act and the people's increasing concerns about environment pollution. By the end of 1970, National Assembly revised 14 pollution-related laws, with a higher priority to resolution of environmental problems rather than to those economic development measures that adversely affect the environment. The resolution of environmental issues began in the 1970s, especially as the "Environmental Agency" under Prime Minister's office was established in 1971 to conduct Environmental Impact Assessment (EIA) and to take proper preventive measures against environmental degradation.

3 Government Investment, Planning of Rural Development in Japan

Table 2 shows some important statistics of Japan's agriculture. Japan has 37,652 thousand square kilometers of land area of which approximately 11.51 percent is arable and land under permanent crops (in 1996). As is generally known Japan's agriculture is characterized by small-scale farms (1.37 ha/household). Due to high economic growth in urban areas during the postwar period, the economically active population in agriculture is remarkably decreasing over the years. The economically active population in agriculture, 19.6 percent in 1970, decreased to 4.8 percent in 1997, mainly due to rural-to-urban migration, farmers' abandonment of agricultural profession, and an increase in the number of part-time farmers. Japan's government has invested a substantial amount of money and energy in rural development and in planning to retain young farmer-successors and attract new ones to rural areas. Although the government has spent a lot, it has usually given greater priority to users' self-governance when the resources are CPRs.

The Agricultural Structure Improvement Bureau of the Ministry of Agriculture, Forestry and Fisheries (MAFF) is

primarily responsible for establishing a production structure that secures a stable supply of good quality and safe food products to the people and for improving the living environment in rural areas. The bureau carries out an "Agricultural and Rural Development Project" that has the three main objectives (Agricultural Structure Improvement Bureau 1996): (a) improvement of irrigation and drainage facilities, consolidation of farmland, and development of farmland (within the framework of "Development of Agricultural Production Infrastructure");

Table 2 Some Important Statistics of Japan's Agriculture

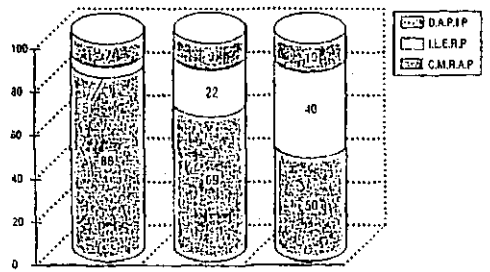
Particulars	Year	Values
Total population (million)	1970	104.345
	1980	116.807
	1990	123.537
	1997	125.638
Economically active population in agriculture (%)	1970	19.6
	1980	11.2
	1990	7.3
	1997	4.8
Land area (1,000 ha)		37,652
Arable land & land under permanent crops [1,000 ha (%) of land area]	1980	4,881 (13)
	1990	4,596 (12.20)
	1996	4,336 (11.51)
Forest and woodland (%)		67*
Irrigated Area (1,000 ha)	1970	3,250
	1980	3,250
	1993	2,782
	1996	2,724
Productivity of rice (kg/ha)	1981	5,629
	1992	6,275
	1994	6,770
	1996	6,191

Sources: FAO Production Yearbook 1983, 1996, and 1997; * World Fact Book

(b) development of agricultural roads, integrated development of rural areas, and environmental improvement of rural areas (within the framework of "Living Environment in Rural Areas"); and (c) prevention of disaster, conservation of farmland, and maintenance and management of facilities (within the framework of "Conservation and Maintenance of Rural Areas").

Figure 1 shows structural changes of agricultural and rural development based on budget. The Agricultural and Rural Development Project is now shifting to the sector of rural area improvement converting its budget for

Figure 1 Structural Changes of Agricultural and Rural Development (Budget Base)



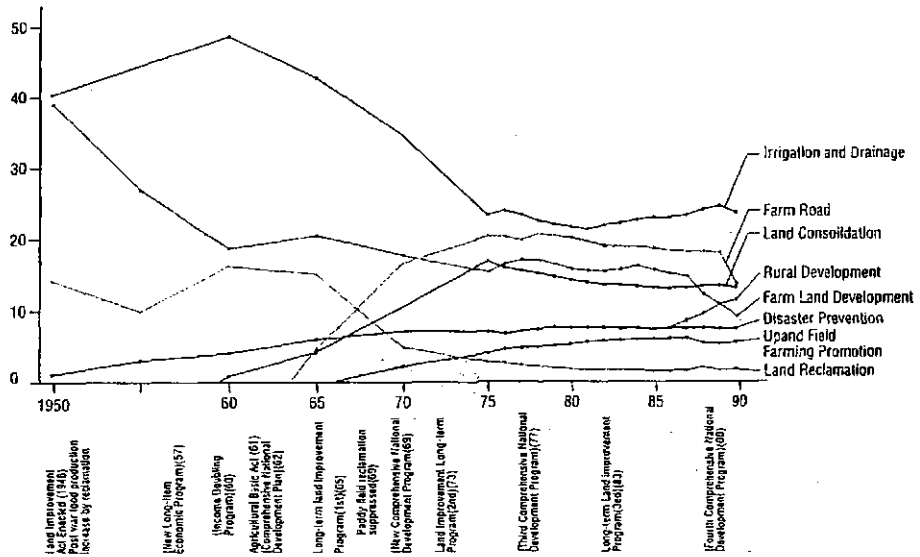
Development of Agriculture Production Infrastructure Project (D.A.P.I.P)
:Irrigation and Drainage Farmland Consolidation
Farmland Development

Improvement of Living Environment in Rural Areas (I.L.E.R.P)
:Agricultural Roads Improvement
Integrated Development of Rural Areas
Environmental Improvement of Rural Areas

Conservation and Maintenance of Rural Areas (C.M.R.A.P)
:Disaster Prevention and Conservation of Farmland
Maintenance and Management of Facilities

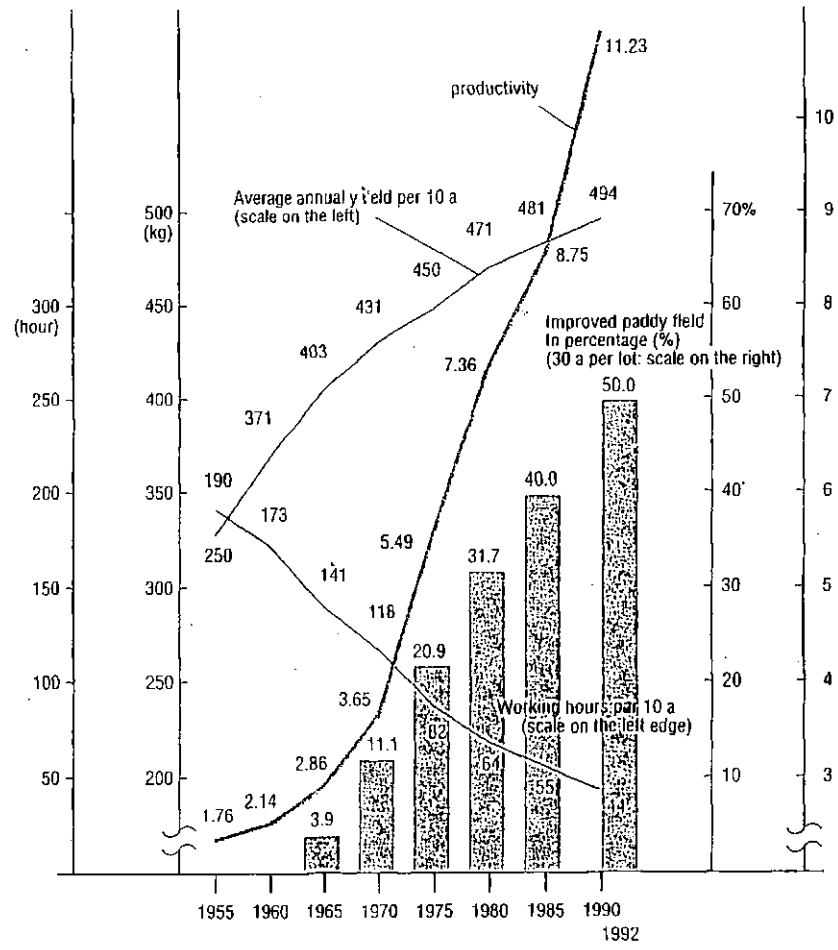
Source: Agricultural Structure Improvement Bureau, MAFF, 1996

Figure 2 Changes in the Share of Various Projects



Source: Agricultural Structure Improvement Bureau, MAFF, 1996

Figure 3 Changes in the Improved Paddy Field and Productivity of Rice



Source: Agricultural Structure Improvement Bureau, MAFF, 1996

agricultural production. Figure 2 shows the changes in the share of various projects such as irrigation and drainage and farmland development from 1950 to 1990. National government, prefectural government, municipalities, and Land Improvement Districts (LIDs) invest in these projects depending on the scale and objectives of a project. Nevertheless, when investments are made in CPRs, the investors require users' agreement. LIDs usually carry out the management of irrigation and drainage systems regardless of whether the national government or local government or the LID itself has constructed these systems.

Figure 3 shows changes in the improved paddy field and productivity of rice. The Agricultural and Rural Development Project has substantially contributed to reducing farm working hours, and increasing both the yield and productivity of rice. In 1949, the Land Improvement Law was enacted and the postwar food production policy was executed. Irrigation and drainage projects and land reclamation projects in mountain and sea areas were accelerated in line with national agricultural policy. In the 1960s, the land consolidation projects and agricultural road projects were promoted to increase productivity of labor and land. Consequently, the productivity of agricultural production per unit area has increased and farm working hours have decreased. The productivity of rice between 1955 and 1990 has increased by seven times.

Although the government has undertaken huge projects and invested substantially, we have observed that the government has encouraged (such as by law enforcement and investment) the CPRs users to self-manage their resources based on the internal institutions that they traditionally craft. In a very recent study by NIRA (National Institute for Research Advancement, 1999) on Japan's CPRs, the research group emphasized the self-governance of CPRs as a result of its empirical studies in certain areas of Japan. Based on the interviewees' opinions, the study has pointed out that a "regional network with multiple channels or connections" is an effective mechanism to both control over-appropriation of CPRs and retain a continuous development. We will mainly discuss irrigation CPRs and briefly address fishery and forestry CPRs.

4 Common-Pool Resource (CPR) Institutions and Collective Action

We can classify resources and goods into four types depending on two distinct, independent attributes (see Table 1): (a) the difficulty of excluding beneficiaries (appropriators) from benefiting from a good or resource; and (b) the subtractability of the benefits received by one beneficiary from those available to others (Ostrom, V. and E. Ostrom 1977; Gardner *et al* 1990; Ostrom *et al* 1994). A CPR, which is a sufficiently large natural or human-made resource, can be defined based on the two attributes, regardless of the property rights involved: the difficulty of excluding beneficiaries and the subtractability of the benefits consumed by one individual from those available to others (Gardner *et al* 1990, 335: Ostrom *et al* 1994, 6-7; Ostrom *et al* 1999, 278-9).

Appropriation and provision problems are the two major problems of CPRs and while the appropriation

problems are related to the flow aspect of CPRs, the provision problems are concerned with the stock aspect of them (Gardner *et al* 1990, 336; Ostrom 1990, 46; Ostrom *et al*, 1994, 8–18). For irrigation CPRs, appropriation problems relate to the amount of irrigation water to be withdrawn (i.e., flow), whereas provision problems relate to installing irrigation and drainage channels (i.e., stock). For fishery CPRs, the appropriation problems relate to the amount of fish to be caught (flow) and provision problems relate to filling the CPRs with young fish (stock). For forestry CPRs, appropriation problems relate to gathering wood (flow) and provision problems relate to filling the CPRs with young trees (stock).

Table 1 Classification of Goods and Resources

	Low Subtractability of Benefits	*High Subtractability of Benefits*
Difficult to Exclude the Beneficiaries	Public Goods (national defense, national radio)	**Common-Pool Resources** (large irrigation systems, common pasture land or forestry)
Not Difficult to Exclude the Beneficiaries	Toll Goods (cable TV)	Private Goods (a private farmland)

Source: Adapted from Ostrom, V and E. Ostrom (1977); Ostrom, *et al* (1994)

We can broadly divide the CPRs into two categories (according to Ciriarcy-Wantrup and Bishop 1975), namely open-access CPRs in which property rights have not assigned, such as the open seas and outer space, and closed-access CPRs in which property rights have been granted to a well-defined group. We will call these closed-access CPRs "local CPRs" in our study. These local CPRs include common fisheries, common forestry, and common large irrigation systems.

Institutions reflect the socially evolved conventions and humanly devised constraints that structure political, economic, and social interaction in a society (or in an organization) (Hayami and Ruttan 1985, 94; North 1990, 1; North 1991, 97). In Ostrom's (1992, 19) words, "an institution is simply the set of rules actually used (the *working rules or rules-in-use*) by a set of individuals to organize repetitive activities that produce outcomes affecting those individuals and potentially affecting others." Therefore, a CPR institution is the set of working rules for managing the CPRs. When the state (or government or external agency) directly governs the CPRs, the most common problem that arises is that the state does not have complete information about the CPRs appropriators, such as their socio-economic conditions, group behavior, micro-level situations, and the rules-in-use that the

appropriators collectively have or want to craft. When the center of CPRs management changes from the state or government control to CPRs appropriators' self-governance, appropriation and provision problems directly face the appropriators who must determine their own collective action. Because CPRs appropriators have nonexclusive rights to appropriate the resource units of the CPRs, they are apt to take advantage of other appropriators' contributions, causing free-riding problems and, consequently, they are required to formulate their own rules-in-use and create an enforcement agency to monitor and punish any opportunistic behavior. Thus, the CPRs users' internal rules or institutions remarkably influence their collective action and resource management, requiring the serious attention of rural development planners.

5 Fishery and Forestry CPRs

Japan's government currently emphasizes the importance of the self-governance of fishery CPRs. Fishermen in Japan now have both community-based coastal fishery management systems and fishermen's cooperatives for inland water fisheries. During the enforcement of the *ura* law (1743–1867) and the old fisheries law (1901–1948), the government itself was the resource manager and fishing rights were exercised at the government's discretion. Under the current fisheries law (1949 – present), the fishermen themselves act as resource managers and decide how to make the best use of the fishing grounds and resources under their jurisdiction. Fishing rights are awarded to groups of fishermen rather than to individuals or private corporations. While the government has established fishing rights, the fishermen themselves decide actual fishery CPRs management activities. The fishing rights are given to the fishery cooperative associations (FCAs) with many economic activities and social services. There are about 2,118 Japanese FCAs and the total membership is over 500,000. The switch from government-managed to fishermen-managed system is perhaps the most substantial development in the history of fishing rights and was necessary to create the present community-based coastal fisheries management system (Yamamoto 1996, 25-6).

Iida (1993) cited an interesting case study on how local people collect kelp (*kombu*) in the northern part of Japan. The author described that kelp collectors (local fishermen) have traditionally formulated their own working rules called the *hatamochi* system in which they fly white flags when it is time to collect kelp and "the tragedy of the commons" does not occur. The author concluded that the local institutions that fisherman craft play an important role in sustaining CPRs.

Table 2 shows that 67 percent of Japan is under forest and woodland covering about 25.21 million hectares. At present, 10 percent of the forest area is now under common property management and the form of ownership has been integrated into modern property management (McKean 1991).

6 Irrigation CPRs

6.1 History of Self-Governance of Irrigation CPRs in Japan

Historically, irrigation management in most of Asia has been the government's responsibility, with a limited role granted to the water users; while, conversely, in Japan, irrigation management has been the responsibility of the water users or cultivators themselves even in large-scale irrigation projects, with a very limited role played by the government (Nagata 1994, 1; Mizutani and Mase 1999, 324-5).[2] During the medieval era (1300–1600), Japan's government was manorial and decentralized and dispersed, localized irrigation systems were ubiquitous; the village community was the most important autonomous organization with binding control on water utilization, which was unusual in Asia (Hatate 1978, 3–4). The right to use water in the 17th century was not in the hands of individual farmers themselves but under the joint control of the autonomous water supply union of each farming village and the utilization of water was governed by the union's customs (Asian Productivity Organization *et al*, year not available, 6–7). Irrigation, which was closely related to the social customs and land conditions of each community, required its own rules-in-use for the whole community as well as for the villagers who jointly maintained irrigation facilities such as repairing damaged canal and cleaning weeds. By the Tokugawa period (1603–1867), the responsibility to manage irrigation and commons, the resolution of civil disputes, and the assessment and collection of taxes resided in the village (Troost 1990, 7).

Management of irrigation water was essential and village people strengthened ties and observed rules, the breaking of which could lead to social ostracism, and such ties and rules became the basis of Japanese irrigation water management (Nakashima 1994, 9). Furthermore, although competing households held land individually in the Tokugawa period, the villages controlled water communally (Kelly 1982, 12). In a traditional village, an individual household did not undertake the creation and maintenance of an irrigation system; villagers as a group had to work collectively to do so (Fukutake 1989, 34). The village-based system had the practical, strategic advantage that water users could make more suitable rules-in-use for appropriating irrigation water, while the government, which was not well acquainted with the collective choice of the farmers' communities,[3]

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[2] To be precise, from the 3rd century B.C. to the 8th century A.D., Japan had a centralized state modeled on China and managed irrigation facilities through state control. When the relationship between Japan and China began to diminish during the period of the 9th to the 15th centuries, the state approach shifted towards privatization as *samurai* warriors (military gentry) adopted it, and a decentralized water management policy came into being. In the later part of the Middle Ages, when communities were established and paddy fields were expanded along branches of rivers, water management necessitated cooperation both within a community and among communities. After a number of disputes, communities gradually developed rules-in-use for water allocation. Thus, community "self-governance" of irrigation water management came into being as the fundamental model of an orderly water management system at the terminal end of irrigation networks. [Japan National Committee of the ICID (year not mentioned, 2)]

[3] Even in the Edo Period (1603-1867), when water disputes occurred between upstream and downstream villages, the feudal lords who were in higher positions lacked the ability to resolve the disputes by themselves, since they normally could not understand the conditions sufficiently to evaluate judiciously all aspects of the

could avoid establishing rules that might have negative impact on the irrigators' collective choice. The "Regulation on the Subsidy of Irrigation and Drainage Main Canal Improvement" was enacted in 1923 as a result of the so-called "rice revolt" due to rice shortage and price hike. This regulation offered a prototype of the present Land Improvement Act leading the government to make a major financial investment in agricultural development (Nakashima 1994, 2–3). As the post-war agriculture has been remarkably reshaped by the major economic insurgence and the vast land reforms (agrarian reforms),[4] the government attached much more importance than ever to the irrigators' self-governance of the irrigation system by entrusting agricultural water-use facilities specifically to Land Improvement Districts (LIDs). To understand the postwar management of Japanese irrigation CPRs, it is essential to be familiar with LIDs because these districts have played an increasingly direct and practical role in determining the irrigators' main collective action.

6.2 Outline of Land Improvement Districts: Formation, Functions and Responsibilities

An LID[5] is a corporate, decentralized, and financially autonomous association of farmers who self-govern or self-manage the agricultural water system.[6] The Land Improvement Law (*tochi kairyô hô*), enacted in 1949 after World War II, abolished the prewar feudal land improvement system and established an owner-farmers-based land improvement system instead.[7] The law's major contribution to the development of Japanese agriculture is the establishment of Land Improvement Districts, which are legal corporate bodies to conduct mainly cost-sharing negotiations between the government and the water users involved.

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conflict; the water management association concerned resolved the water disputes (Nagata 1994, 2–3).

[4] After the second World War, landowners released their lands to tenants because of the law of land reform and the government reclaimed new paddy fields to settle unemployed persons who lost their jobs by the end of the war (Hasegawa and Tabuchi 1955, 104). According to Saito (1991, 46–7) the land reforms of 1945 and 1946 provided that: (i) the government purchase all tenanted farmland owned by non-resident landlords and that of over 1 hectare owned by resident landlords and mandated the resale of the land to the tenant farmers; (ii) the rent of the farmland had to be paid in money instead of in products; (iii) the whole process of purchase and sale of farmland was done by the government; and (iv) the purchase and sale of land was planned by the farmland committee in each local government. This reform was vast, never before attempted by any previous policy regarding farmland.

[5] The term "Land Improvement District (LID)" refers either to "the water users' association of a particular area" or to "the particular area of the water users' association." The reason the term is used to mean the association, people say, is that it differentiates the LID association (which is a legal body holding legal rights in the postwar period) from the old village-based irrigation management (which held only community-based regulatory power but no legal rights in the prewar period.)

[6] LID is created not only to manage the water system but also to perform other work related to land improvement. In practice, the main activities of LID are usually limited to water system management.

[7] In 1949, when the farmland ownership reform was ending, the Land Improvement Law was enacted to abolish the prewar land-improvement system, which depended mainly on landowners. The 1949 law created a new land-improvement system based on owner-farmers. One major achievement of the Land Improvement Law was the creation of Land Improvement Districts. This concept was a radical change from the previous water user associations because the Land Improvement District consisted of cultivator-farmers, in contrast to the old Irrigation Association or Arable Land Readjustment Association composed of landowners. This reflected the spirit of the farmland ownership reformation (Nagata 1994, 8).

To reiterate, irrigation facilities constructed under national projects are usually entrusted to LIDs, which are supposed to derive the full benefit from those facilities. The national government, local governments, or municipalities manage large reservoirs and headworks that benefit a large public area. Irrigation and drainage facilities constructed by prefectures or municipalities, being much larger in number than those constructed under national projects, are placed under the charge of land improvement districts or irrigation associations. LIDs were responsible for approximately 78 percent of the operation, maintenance, and management of reservoirs, pond, headwork, and irrigation/drainage pumping stations in 1992.

A LID usually entirely controls the management of common irrigation system in a specific area.[8] An LID has an elected council of representatives and a staff, and the legal authority to collect contributions to offset expenses. It has a board of directors that comprises at least five directors and a board of auditors that comprises at least two auditors to carry out LID administration. The election of the representatives is held under the supervision of the Election Administration Commission at the city, town, and village levels. The officers and the representatives of the LID are subject to punishment for crimes such as for the bribery, as is the case with public service personnel.

Initially, to apply for the establishment of a LID, more than 15 qualified farmers must be elected or selected to participate in the project. They designate a specified area and post public notices at the city, town, or village offices for more than five days to allow public review of the LID plan. If the LID plan receives the general consent of more than two-thirds of the farmers at the city, town or village level, they apply for the prefecture government's approval. The prefecture governor carefully determines whether the objectives of the proposed LID are consistent with the principles set out by law. If the project fulfills the legal requirements of a LID, the prefecture government sends the concerned city, town, or village offices several copies of the project for public review and comment for a period of more than 20 days.

If the government is able to overcome public objections or if there is no objection, it approves the establishment of the LID covering the specified area. Those persons who were qualified to take part in the LID project also become the association members of the district. The members elect a council of representatives. Any revision of the articles of association requires the approval of two-thirds of the members present at a general meeting attended by more than two-thirds of either the whole membership or of the representatives. The revision approved by the association must then be sent to the prefectural government, which determines whether the revision both reflects the majority's opinion and conforms to the existing law. Table 3 shows that there were

[8] The characteristic of the Japanese paddy fields, where land ownership rights are private but irrigation water appropriation is conducted in common is not seen in other Asian countries except in particular areas, such as *subak* in Bali, *tuo banda* in West Sumatra, *muang fai* in northern Thailand, *zenjera* in the Philippines and *huengnonggye* in Korea (Mizutani and Mase 1999, 325 referred to Mizutani 1992).

8,096 LIDs covering an area of 3.3 million hectares and a total of 4.7 million members in 1993. LIDs have the following major functions (Nagata 1994, 7-8; Hasegawa and Tabuchi 1955, 116-7): (a) applying for or promoting a land improvement project. In order to increase the productivity of their lands, the farmers actively try to promote land improvement projects through the land improvement districts. National or local governments subsidize part of the project costs, while farmers bear the rest of the costs; (b) collecting money from the member farmers to repay both the project costs (subsidized by the government) and the maintenance and operation costs (usually paid fully by the farmers); and (c) conducting the operation and maintenance of irrigation and drainage facilities.

Table 3 Number and Area of LIDs in Japan (as of 1993)

Area of agricultural land	Less than 100 ha	100 to 500 ha	500 to 5,000 ha	Over 5,000 ha	Total 3.3 million ha
Number of LIDs	3, 802	2, 828	1,364	102	8, 096
(%)	(47.0)	(34.9)	(16.8)	(1.3)	(100)
Membership					4.7 million

Source: Japanese National Committee of the ICID

The LID Federation conducted a survey of 6,199 (out of 7,992) LIDs in 1997 and found that about 46.2 percent of the LIDs are engaged primarily in O&M activities, and 25.8 percent are in both construction and O&M activities (Table 4).

Table 4 Number of LIDs Based on Projects (as of 1997)

Only construction	Construction and operation & management	Only operation & management	Only repayment	Others	Total
358	1, 599	2, 862	986	394	6, 199
(5.8 %)	(25.8 %)	(46.2 %)	(15.9 %)	(6.4 %)	(100.0 %)

Source: Statistical Survey on Management of LIDs, F.Y. 1999

The proper operation and maintenance of land improvement facilities has enabled the rational control of irrigation and drainage and contributed to establishing the intensive rice-production technique; it is the primary reason that productivity has increased in postwar agriculture. LIDs, which have the fundamental principles of

equitable water use, have both the hardware to provide the infrastructure (land improvement facilities), and the software (management and institutions) to complement it (Mizutani and Mase 1999, 326; Nagata 1994, 8).

While LIDs usually pay all the operation and management costs, the central and prefecture governments subsidize construction projects. The central government, prefecture government, and farmers' groups (LIDs), share the capital costs. LIDs collect O&M costs, personnel expenses, and salaries of LID officers from members every year. LIDs also collect the farmers' share of the capital costs, when required. The collection rate is very high, almost 100 percent in 1995 (Mizutani and Mase 1999, 330-1).

6.3 Case Study: The Nishikanbara LID

6.3. 1 General Description

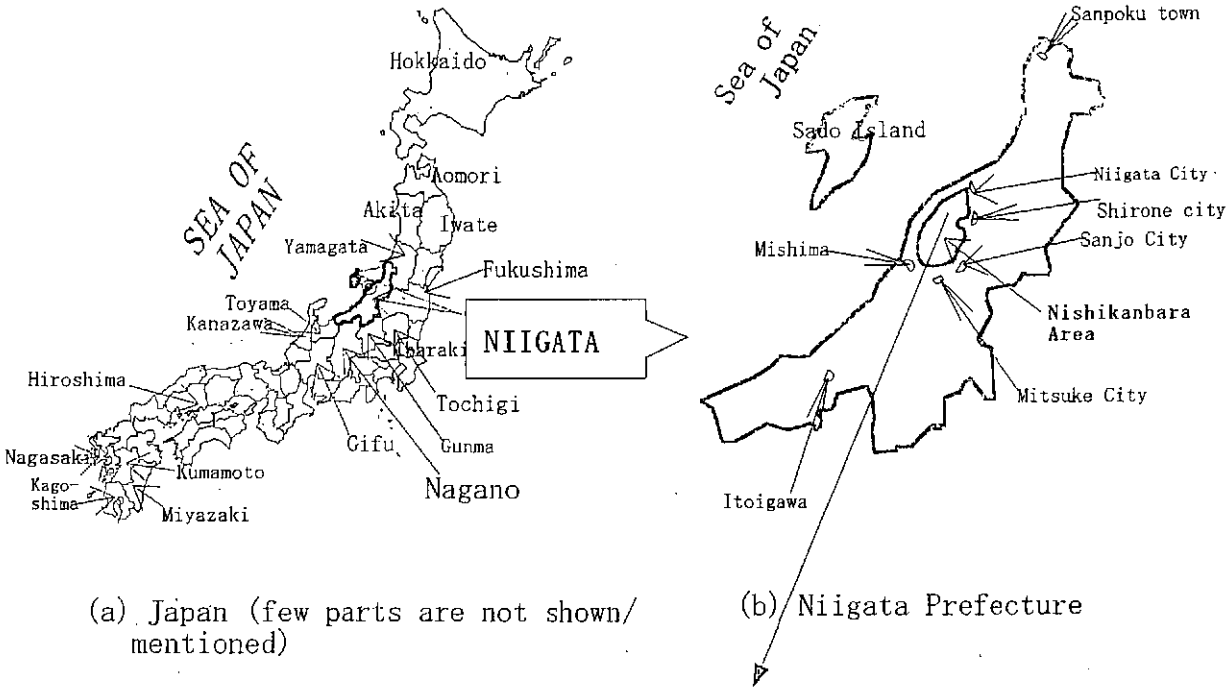
The Nishikanbara Land Improvement area is located nearly in the middle of the coastal region of the Niigata Prefecture (see Figure 4). It is an elliptic zone, 15 kilometers from east to west, and 35 kilometers from south to north. The Nishikawa River, which originates from the Shinanogawa River, is the main irrigation source. The Shinkawa River is the main drainage source. The Nishikanbara LID, which was established by consolidating five former water users' associations in 1951, is one of Japan's largest water users' associations, having 12 branch offices throughout the area. The LID covers five villages, five towns, and two cities. As of 1999, its total farming land area is 19,103 hectares (18,089 hectares of paddy fields and 1,014 hectares of upland fields) and there are 14,199 association members. The area is enriched with about 402 irrigation pumping stations or plants, about 472 drainage pumping stations or plants (the Shinkawa estuary drainage pumping station[9] is the biggest in Asia), 607 branch irrigation channels covering 676.23 kilometers, and 598 branch drainage channels covering 647.53 kilometers).

6.3.2 Organization and Administrative Structure of the Nishikanbara LID

We can divide the Nishikanbara LID office into two broad divisions, namely (a) the Council of Representatives, which comprises 100 elected or selected farmers (Figure 5), and (b) the Administration Bureau (Figure 6), which comprises 181 staff. The LID members elected or selected 100 representatives from among themselves at the village, town, and city level. These representatives formed the council of representatives, which then, based on a resolution at a general meeting, elected the board of directors (12 persons) and the board of supervisors (5 persons). About 182 staff members under the elected directors carry out the routine business affairs of the LID office. The office has two main divisions, consisting of a general affairs division (under the

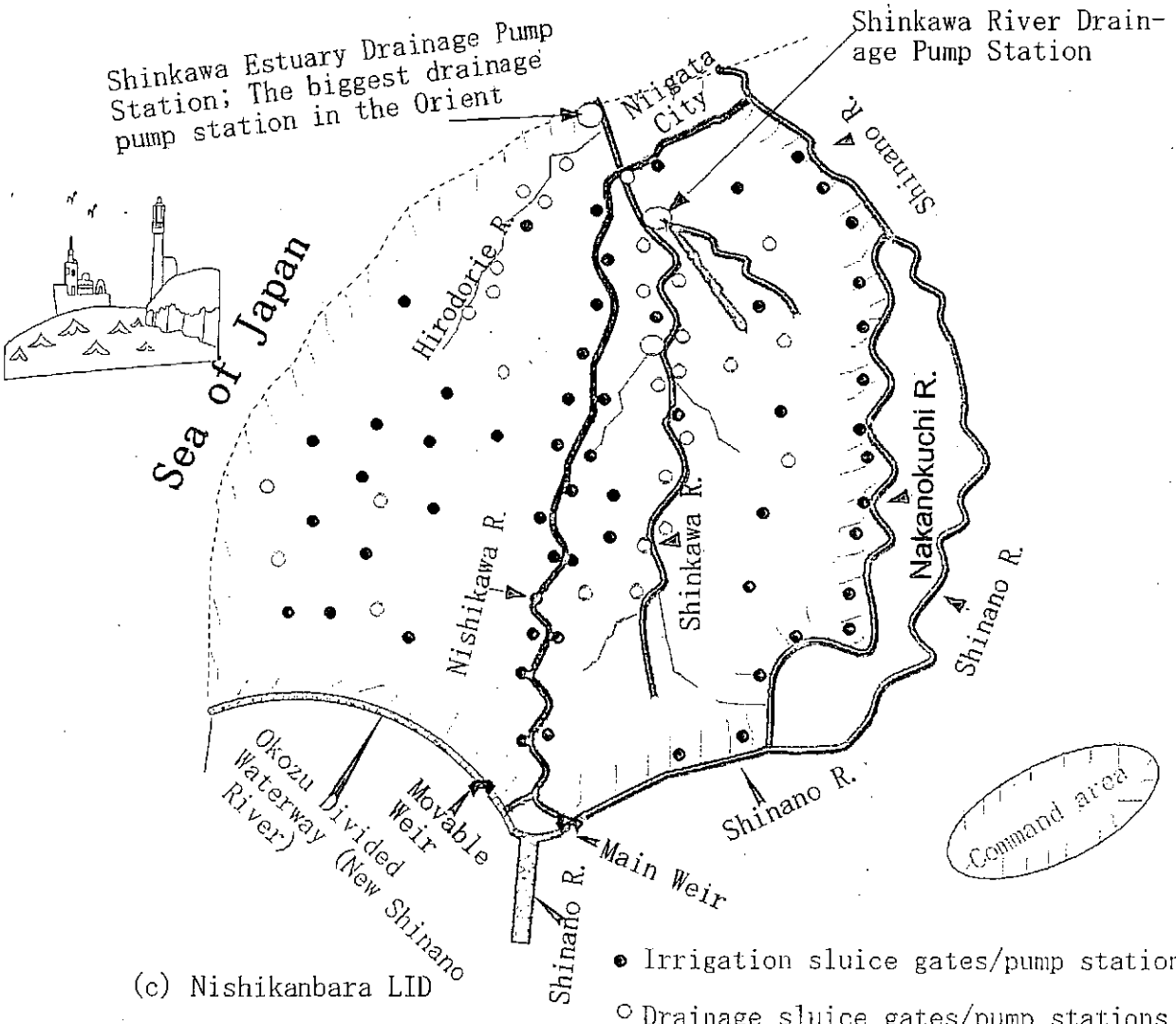
[9] The Shinkawa estuary drainage pumping station is intended to drain off the design flood discharge of 240 m3 per second, and its whole displacement and capacity of each main pump are the largest class in the world.

Figure 4 Location of the Nishikanbara Land Improvement District



(a) Japan (few parts are not shown/ mentioned)

(b) Niigata Prefecture

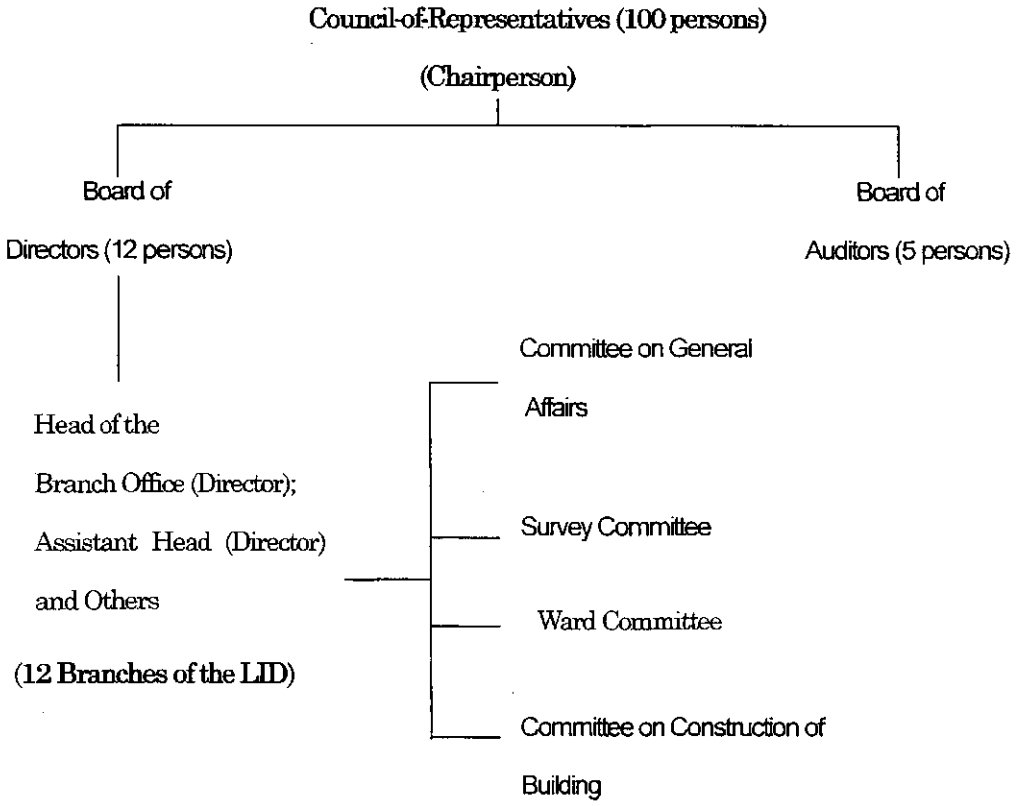


(c) Nishikanbara LID

NB: Figures are not in exact scale

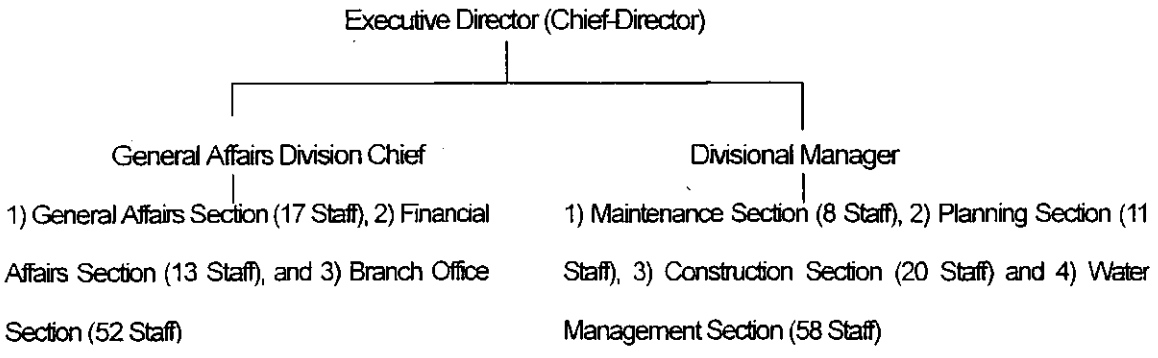
general affairs division chief) and the business affairs division (under a divisional manager). The general affairs division has six sections, namely the planning section, information system section, general affairs section, management section, financial section, and branch office section. The business affairs division has five sections,

Figure 5 Organizational Structure of the Nishikanbara Land Improvement District



Source: Personal Contact with the Nishikanbara LID staff

Figure 6 Administrative Structure (181 Staff)



Source: Personal Contact with the Nishikanbara LID Staff

namely the farm village maintenance section, construction section, machine station/plant section 1, machine station/plant section 2, and maintenance of facilities section.

Based on general meetings, the representatives formulate the working rules to address appropriation problems and provision problems. Appropriation problems relate to how to withdraw water and provision problems relate to how to improve the physical infrastructure so that the water is available when they need it.

6.3.3 Financial and Productivity Analyses of the Nishikanbara LID

For one hectare of land, a farmer has to pay 122,700 yen for paddy field per year. About 64.1 percent

Table 5 Rice Yield (Kg/Ha), Working Hours and External & Internal Finances

Year	Rice yield (kg/ha) in Japan	Rice yield (kg/ha) in Nishikanbara LID	Working hours/ha	Subsidy for the LID projects (1,000 yen)	N. LID's share of the project costs (1,000 yen)
1953	3,200	3,950	2,123	37,862	175,314
1958	4,030	4,290	1,790	6,656	181,321
1963	4,430	4,960	1,438	7,639	126,776
1968	5,180	5,900	1,167	70,548	217,947
1978	5,060	5,450	456	435,088	781,243
1983	5,010	5,530	406	471,316	610,077
1988	5,280	5,960	318	384,556	388,447
1993	4,700	5,370	287	540,089	530,145
199(7) 8	5,210	5,540	256	518,440	456,461

Source: Personal Contact with the Nishikanbara LID Staff

constitutes O&M costs, and 32.8 percent constitutes repayment cost.

Table 5 shows that, in the Nishikanbara area, not only the LID financed its projects but also the external sources (national government, prefectures, cities, etc.) continuously subsidized them. The projects usually relate to farmland consolidation, irrigation & drainage improvement, conduit improvement, farm road improvement, conversion of farmland for other crops, etc. Rice yield of the Nishikanbara LID, always higher than that of national average, has increased considerably over the years. Rice yield per hectare was increased from 3,200 kg in 1953 just after the establishment of the LID to 5,210 kg in 1997. Working hours per hectare have

decreased from 2,123 hours in 1953 to 293 hours in 1997, mainly due to high farm mechanization. The decreasing rate of working hours allows farmers to hold part-time jobs to earn extra income.

7 Institutional Analysis of Irrigation CPRs

Obviously, while the government subsidizes the project, neither the state nor market governs the Japanese irrigation CPRs; yet, their management has been sustained and has endured over a long period. The immediate question that arises is what brings success to the resource management, when the state does not apply coercion or when the CPRs are not privatized. The best answer that we have is the "irrigation institutions" that the irrigators themselves have crafted for the self-governance of the long-enduring irrigation CPRs are working out the "tragedy of the commons." By "irrigation institutions" we mean a set of working rules or rules-in-use for supplying and using irrigation water in a particular area (Ostrom 1992, 19). The issues of supplying water refer to provision problems and those of using water refer to appropriation problems. Irrigation institutions may not work well unless there are suitable design principles that characterize the institutions. We will briefly describe some design principles based on Ostrom's (1990, 90–102; 1992, 67–76) works that suggest that these design principles are necessary to make the institutions be long enduring. Although the design principles described below refer to the Nishikanbara LID, they are consistent with other LIDs as well.

Design Principle One: Clearly defined boundaries. As the postwar agriculture changed from a landlord to an ownership system, the Nishikanbara LID defined clear boundaries for the irrigation system. The area has 19,103 hectares of land.

Design Principle Two: Congruence between appropriation and provision rules. While some traditional rules are present, the LID has formulated or restructured rules to specify the amount of water that an irrigator is allocated. If an irrigator has a greater area of land, he has to pay higher water fees. Per hectare water fees for a year are 125,700 yen for a paddy field and 41,900 yen for other fields. Therefore, the irrigators not only appropriate water (appropriation problems) but also pay fees to conserve the irrigation system (provision problems). We can broadly divide the provision problems into two: hardware provision problems that relate to, for instance, the construction of irrigation pumping stations and software provision problems that relate to management aspects of the irrigation facilities. However, it is worthy to note that government pays a considerable portion of capital cost, largely solving the hardware provision problems.

Design Principle Three: Collective-choice arrangements. While the LID in general collectively decides general rules, a community based "terminal water-using group" collectively decides to modify daily operational

rules.

Design Principle Four: Monitoring. While the LID monitors the overall irrigation system such as distribution of water from main rivers, a community-based "terminal water-using group" selects certain irrigators to look closely at its own particular area especially with regard to the flow of water. When there are any problems at the terminal point, the irrigators inform either a branch office or the main office of the LID to take necessary actions.

Design Principle Five: Graduated sanctions. Violations of those rules-in-use that are formed to appropriate water either in general or in particular (i.e., at the "terminal water-using groups") are exceedingly rare because of the Japanese people's group consciousness and predominant mutual trust. While it is historically true that group consciousness is achieved in Japanese society, the irrigators' tendency to violate rules may grow if the group is not well defined or well formed based on some specific problems.

Design Principle Six: Conflict resolution mechanism. When a general conflict does arise between upper-stream and down-stream areas, due to water scarcity for example, the irrigators inform the LID, which resolves the conflict through meetings. External authority is not used to solve any internal problems.

Design Principle Seven: Minimal recognition of rights to organize. The LID and farmers substantially enjoy the freedom, independently of government agencies, to devise their own institutions to ensure the supply of water and conduct the operation and maintenance of irrigation facilities. The government, the distant authority, is aware that the rules that the LID in general and the farmers of a community-based "terminal water-using group" in particular continuously craft are congruent with the physical, social, and institutional features existing there. Here irrigation institutions crafted within the sociopolitical conditions are a special form of social capital.[10] The government does not interfere with such social capital. Before investing in any projects, the government carefully consults with LID farmers so that no investment goes against their social capital. This implies that if the CPRs users do not welcome an investment in the physical structure, the investment in turn brings with it some considerable disincentives that may lead the users not to cooperate. Therefore, the coordination between social capital and physical capital is achieved in the LID. Again, this coordination is very important when investments are made.

Design Principle Eight: Nested enterprises. According to Tang (1992, 38–9), we can characterize the Nishikanbara LID as a complex irrigation system, which has a production resource (dam), a distribution resource (main canal), an appropriation resource (watercourses), and a use resource (fields). To maintain the irrigation system, appropriation, provision, conflict resolution, and governance activities are organized in multiple layers of nested enterprises.

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[10] Social capital is the common knowledge, understanding, and institutional arrangements that a particular group of people brings to an activity (Coleman 1988; Ostrom 1997, 158).

We find that these design principles have not only contributed to the institutional robustness in irrigation CPR systems, but also have solved the provision and appropriation problems of these systems. The application of these design principles that make irrigation institutions robust is not narrowly limited to the area of irrigation CPRs management; rather, they can explain how other CPRs institutions can achieve robustness. The nature of such CPRs management in Japan proves that self-governance can be a suitable alternative to state and market solutions. Some other Asian countries, which have tried to impose state and market solutions for rural or local CPRs as a part of rural development planning, can learn a lot from this study of Japan's CPRs as well as from those that have been done on many developing countries' CPRs (see Hess 1996 to find literature on case studies of CPRs of developing countries).

8 Conclusion

Both infrastructural and non-infrastructural rural environmental issues are important when a country considers planning for rural development. Policies that take into consideration both internal and external sources of environmental pollution need to be included in rural development planning.

Diseases like Minamata (for mercury pollution) and Itai-Itai (for cadmium pollution), which were caused by external sources, i.e., industrial wastes, contaminated the rural environment in Japan. These incidents forewarn other countries to consider these environmental issues in rural development planning as the countries may have mining or chemical industries in urban areas. An Environmental Impact Assessment (EIA) is necessary to prevent potential degradation.

While Japanese national and local government has invested a substantial amount of money and energy in rural development planning, it has given much importance to CPRs users' self-governance so that they can devise and preserve their own rules-in-use in accordance with their own communal customs. The reason why the Japanese government does not exercise a state solution or a market solution is because there is a clear reciprocal relationship between the users' social capital (internal rules, cultural characteristics, and group consciousness) and the development of local CPRs. A self-governance, institutional solution to CPR problems may not work out those problems that concern the tragedy of the commons and the logic of collective action. Yet, what is obvious from our study of Japan's CPRs and from those of some developing countries' CPRs is that the approach can be a suitable alternative to state and market solutions. In institutional solution, while local CPRs institutions are important, the design principles that can characterize them are equally essential to make these institutions robust over a long period of time.

Finally, for any rural development planning, an economic investment (maybe huge) in the physical infrastructure of local CPRs may not guarantee that the CPRs will pose collective action, unless the CPRs users

welcome the investment within the framework of their existing socioeconomic and sociopolitical conditions and needs. While an economic investment that the CPRs users do not appreciate is a great disincentive for them, a small but solicited investment is very likely to afford powerful incentives to optimize the uses of CPRs. Policymakers and donor agencies who are planning to invest in rural development projects such as those that concern local CPRs management and rural natural resources conservation should substantially address these vital points beforehand.

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