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Social Capital and Irrigation Resource Management in Japan

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ABSTRACT: This paper concerns an empirical case study on the collective action of a large number of irrigators who successfully manage their large-scale irrigation system, a humanly-made closed-access common-pool resource (CPR) in Japan. While government's economic investment is important, the study has observed that the social capital that the irrigators have traditionally built in is a critical factor for the successful self-management of common irrigation resource system. When Japanese government invests in physical capital, it plays a supportive role attaching a special priority to the irrigators' social capital and does not coerce them to manage their irrigation system. A Land Improvement District (a legal corporate body of irrigators), which has been formed under the structure of postwar agriculture, has put a greater importance to the social capital that considerably has improved the irrigators' pre-exiting self-management of irrigation system in a much more systematic way than ever. While economic investment is important, our case study particularly reveals that irrigation Institutions, which are a certain form of social capital, significantly contribute to the successful self-management of the irrigators' common irrigation system. This study, which confronts the central theme of Hardin's (1968) "the tragedy of the commons" and Olson's "the logic of collective action" that external coercion is necessary to produce collective action, argues that social capital can reduce the necessity of external coercion to foster sustainable collective action on common irrigation resources.

KEYWORDS: Irrigation Common-Pool Resource (CPR), Irrigation Institutions, Physical Capital and Social Capital.

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1 Introduction:

Historically, irrigation management in most of Asia has been the responsibility of the government, with a limited role assigned to the water users; while, conversely, in Japan irrigation management has been the responsibility of water users or cultivators themselves even in the large-scale irrigation projects, with a very limited role played by the government (Nagata 1994, 1; Mizutani and Mase 1999, 324-5). This is the reason, they further described, the farmers bear all the expenses concerning operation and management (O&M) by collecting members fees; and historically there is no subsidies for O&M. The common thread that runs through both the pre-war and post-war management of large-scale irrigation systems is the irrigators' "self-governance" of these systems.[1]

Self-governing village communities arose in central Japan in the late medieval era (1300-1600) and the villages took over, among other things, the management of common land and irrigation (Troost 1990, 1). And that local administration after 1600 continued to see the village as its lowest unit and depended substantially on the peasant control of internal village affairs (Troost 1900, 9). During the medieval era, when the basic system was the manorial, decentralized government and dispersed, localized irrigation systems were ubiquitous and the village community was most important as an autonomous organization with binding control on water utilization, being an exceptional case in Asia (Hatate 1978, 3-4).

The right to use water, to refer to the 17th century, was not in the hands of individual farmers themselves, but was placed under the joint control of the

[1] There, however, existed in feudal times some cases in which large-scale irrigation facilities that affected the interests of a broad area were placed under the direct control of the Shogunate government. And even after the emergence of Japan as a modern state there were irrigation facilities the management of which was placed under the charge of prefectural government, although the costs of their management were shouldered by the farmers. However, with the improvement of legal system and promoted by the government's severe financial straits at that time, self-governing farmers' organizations gradually came into being. (Up to this, this note refers to Tago 1983, 293). In spite of water shortages and dislocations, there was no shift toward a centralization of irrigation task performance after 1700 (Kelly 1982, 3).

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). The pages also noted down that the irrigation, which was closely related to the social customs and land conditions of each community, required their own rules-in-use for the whole community as well as village people who jointly maintained irrigation facilities such as repairing damaged canal and cleaning weeds in the waterways. By the Tokugawa period (1603–1867), the responsibility for the management of irrigation and commons, the resolution of civil disputes and the assessment and collection of taxes resided in the village (Troost 1990, 7). And although land was held individually by competing households in the period, water was controlled communally by solidary village (Kelly 1982, 12). In traditional village, an individual household did not undertake the creation and maintenance of irrigation system; certainly villagers as a whole had to make collective efforts to do so (Fukutake 1989, 34). The practical, strategic advantage that this had provided for the water users is that they themselves could make much 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,[2] could avoid the formation of those rules that might have negative impact on the irrigators' collective choice.

As the post-war agriculture has been remarkably reshaped by the major economic insurgence and the vast land reforms,[3] the government, as an external

[2] 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 conflict; a water management association concerned resolved the water disputes (Nagata 1994, 2-3).

[3] 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). Saito (1991, 46-7) stated that land reform was carried out in 1945 and 1946 and its main contents were as follows: (i) all tenanted farmland owned by non-resided landlords and that of over 1 ha owned by resided landlords was purchased compulsory and sold to the tenant farmers; (ii) the rent of the farmland became 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 the vast reform, which

entity, attached much more importance than ever to the irrigators' self-governance of the irrigation system by entrusting agricultural water-use facilities especially to Land Improvement Districts (LIDs), legal corporate bodies of water users.

The main objective of this study is to figure out how the indigenous "institutions" [4] __ a certain form of social capital __ that the irrigators have crafted have significantly helped the irrigators self-manage or self-govern their large-scale irrigation system, a humanly-made closed-access common-pool resource (CPR) in Japan. Government does not coerce but plays a supportive role when it invests and as the irrigators craft their irrigation institutions.

The main reason for setting forth such an objective is to empirically confront the traditional belief[5] of policymakers and political scientists that "the tragedy of the commons" (Hardin 1968) will occur unless a coercive force is there to manage a commons. By confronting the belief, this study on irrigation common-pool resource attempts to establish that irrigators themselves can manage their common irrigation system, while they avert the tragedy of the commons even without the exogenous coercion [i.e., Hobbe's (1949) Leviathan coercion] of external entity.

By the words "without the exogenous coercion of external entity," we do not mean the absence of the external entity such as government whose cooperation and financial assistance is essential. We mean that the existing external entity has no explicit or implicit design to *force* the appropriators to produce their collective action, because such a force is very likely to aversely affect the

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was never done by the previous policy over the farmland.

[4] Indigenous institutions, which are an important source of social capital for forming noncentral institutional arrangements within which development of sustainable infrastructure is possible, represent what a community knows about how to get things accomplished that require a collective effort (Ostrom, Larry Schroeder, and Wynne 1993, 209).

[5] According to Becker and Ostrom (1995, 114-5), when the National Academy of Sciences first established a panel to study common-property institutions, many scientists presumed that users of common-pool resources are helplessly caught in the tragedy of the commons, and thus destined to continue overharvesting, unless external solutions are imposed.

formation of both social and physical capitals.[6]

This study empirically confronts the central theme of Hardin's (1968) "the tragedy of the commons" and Olson's (1965) "the logic of the collective action"[7] that external coercion is necessary to produce collective action, and argues that social capital can substantially reduce the necessity of external coercion. Hardin deals only with the "appropriation problems," neglecting "the provision problems" of the CPR situation; while conversely, Olson deals only with the "provision problems," neglecting "the appropriation problems" of the CPR situation (Lee 1994, 12 –13).

This study will be useful for those policymakers, engineers and donor agencies who invest in physical capital (such as engineering works), without considering that the social capital is a considerable factor to develop the management of common-pool resource. We collected secondary and primary data as we interviewed concerning irrigators, representatives of the land improvement district, researchers and government officials to perform this empirical study.

To understand the postwar management of common irrigation system in Japan, it is essential to be familiar with the *Land Improvement District* (LIDs) [formed under the Land Improvement Law (tochi-kairyô-hô) of 1949], because these districts have played an increasingly direct and practical role in determining the irrigators' main collective action on their irrigation system.

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[6] In this regard, we can refer to the self-organization system in magnetization in physics. A magnetic bar consists of a multitude of tiny magnets, called "spins" and each spin has a relative position. The higher the temperature, the stronger the random movements of molecules affecting the ordered arrangement of spins. Conversely, the lower the temperature, the weaker the random movements accelerating the spontaneous, ordered alignment, which produces a strong overall field. This is a good example of self-organization system in magnetization where "temperature" is an external force.

[7] Garrett Hardin's challenging article in Science (1968) argues that degradation of the environment is to be expected whenever many individuals commonly use a scarce resource, and therefore, the application of coercion is necessary to solve these problems. Mancur Olson (1965, 2) argued, "... unless there is coercion or some other special device to make individuals act in their common interest, *rational, self-interested individuals will not act to achieve their common or group interest*" (italics in original.) There is also a number of instances in *Governing the Commons* (Ostrom 1990) of self-governance.

2 Brief Outline of Land Improvement District (LID, *tochi kairyô ku*)

2.1 An Introduction to LID

LID[8] is a corporate, decentralized and financially autonomous association of those farmers who self-govern or self-manage the agricultural water system.[9] **Land Improvement Law** (*tochi kairyô hô*) enacted in 1949, after World War II, abolished the prewar feudal land improvement system and established owner-farmers based land improvement system instead.[10] The distinguished contribution that the law constituted to the development of Japanese agriculture is the establishment of Land Improvement Districts,[11] which are legal corporate bodies to conduct cost-sharing negotiations between the government and the water users involved.

Irrigation facilities constructed under national projects are usually entrusted to LIDs, which are supposed to derive the full benefit from those facilities. Some facilities such as dams and headworks, the operation of which affects the

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[8] 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 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 did not hold any legal rights in the prewar period.)

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

[10] In 1949, when the farmland ownership reform was ending, the Land Improvement Law was enacted to abolish the pre-war land-improvement system, which depended mainly on landowners. This 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. Compared to the previous water user associations, this concept was a radical change as 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).

[11] The General Headquarters of the post-World war II American Occupational Forces suggested the concept of LID when a draft of the Land

interests of more than one prefecture are placed under the direct control of the Ministry of Agriculture, Forestry, and Fisheries. Irrigation and drainage facilities constructed by prefectures, municipalities or other organs, being much larger in number than those constructed under national projects, are placed under the charge of land improvement districts or irrigation associations. Customarily, major facilities are placed under the direct control of the LID and the minor facilities are placed under the charge of the village or an association organized with the consent of the villages. This paragraph refers to (Tsutsui 1996, 72 – 3; Tago 1983, 304).[12]

2.2 Characteristics, Establishment and Functions of LIDs

While national and local governments, with the general consent of beneficiary groups, undertake the major responsibilities of irrigation engineering works of the concerning irrigation facilities (beneficiary groups also undertake or share some responsibilities of irrigation engineering works), they usually entrust the entire administration of these facilities to water users' organizations such as LIDs other than to the local public entities. The characteristic of the Japanese paddy fields, where land ownership right is private but irrigation water appropriation is conducted in common cannot be 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).

A LID, which is a corporate, public association with elected council-of-representatives and employed staff, has the legal authority to collect contributions to costs. The election of the representatives is held under the supervision of the Election Administration Commission at the city, town and

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Improvement Law was first drawn up (Nagata 1994, 6).

[12] Tsutsui mentioned that the operation and maintenance of facilities is carried out according to an operation and maintenance plan specified through established procedures. When the management of certain facilities constructed under a national project is entrusted to a land improvement district, a management manual specified by the agreement of entrustment is used for arranging the operation and maintenance of the facilities and the expenses involved for this purpose, while the land improvement district is required to prepare an operation and maintenance plan and a management directory.

village levels. The officers and the representatives of the LID are punishable, such as for the bribery, as is the case with public service personnel.

Initially, to apply for the establishment of a LID, the qualified farmers who are usually elected or selected to participate in the project must be more than 15 in number. It is they who will carefully elect or select those persons who will choose certain regions to constitute the area of the LID, outline the project plan and draw up the articles of the LID under some provision previously designed in law. The elected or selected applicants are also required to make an official notification at the city, town or village offices for more than five days to observe the public attitude towards the plan of the LID that they are going to carry out, as well as to receive the general, unanimous consent of more than two-thirds of those farmers who participate in the project and also of those who are going to be the members of the LID. The most essential, guiding principle of obtaining the consent they follow is that the consent of the two third farmers not only of the LID district but also of every village or town or city in the LID is ensured.

The applicants, thus after seeking the consensus of more than two-thirds of the farmers concerned apply for the prefectural government's approval for the establishment of the LID. The prefectural governor carefully screens the application to ascertain whether the objectives of the LID are consistent with the basic principles of a LID mentioned in the law. If the prefectural government finds that the project is legal fulfilling the basic requirements of a LID, it will notify the concerning city, town, or village offices in this regard and make several copies of the project open for the public to judge the public opinion about it for a period of more than 20 days.

The prefectural government will deal with all the objections made within 15 days of expiration of the public-opinion judgement period, by those people whose interests are going to be affected with the implementation of the project. The government either ignores or accepts the objections depending on the seriousness of the objections. If the government is able to ignore the objections or if there is no objection, it approves the establishment of the LID covering a specific area. The persons, who are qualified to take part in the LID project, also become the association members of the district. A general meeting attended either of more than two-thirds of the whole membership or of the representatives

when the council-of-the representatives is elected, is convoked to confirm any revision of the articles obtaining the consent of the two-thirds members present. Thus upon obtaining the consent, a necessary draft is made and sent to the prefectural government, which judges and approves if the revision both reflects the majority's opinion and conforms to the existing law.

Land Improvement Districts 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 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 & operation costs (usually paid fully by the farmers) and (c) conducting operation and maintenance of irrigation and drainage facilities.

The proper operation and maintenance of land improvement facilities has enabled the rational control of irrigation and drainage, contributed to establishing the intensive rice-production technique, and constituted a basic condition to increase productivity in postwar agriculture. LIDs, which have the fundamental principles of equitable water use, have both the hardware to provide infrastructure (land improvement facilities), and the software (management and institutions) to complement it (Mizutani and Mase 1999, 326; Nagata 1994, 8).

2.3 Government Subsidies for the LIDs and Collection Rate of Members Fees

While LIDs usually pay all the operation and management costs, the central and prefectural governments subsidize construction projects. Central government, prefectural government and farmers groups (LID), share the capital costs (Table 1). LID collects O&M costs, personnel expenses and salaries of LID officers from members every year. LID also collects the farmers' share of the capital costs, when required. The collection rate is very high, which is almost 100 percent (Table 2).

3 The Nishikanbara Land Improvement Area and the Nishikanbara Land Improvement District:

Nishikanbara Land Improvement area is located nearly in the middle of the coastal region of Niigata Prefecture (see Fig 1). It is an elliptic zone, 15 km from east to west, and 35 km from south to north. On the east, it is bounded by the Shinano River and the Nakanokuchi River, while on the west and north it is adjacent to the Kakuda Mountain range and Japan Sea Dune and reaches Niigata City in the northeast. The Niigata Plain, which was once a huge marsh with scattered lagoons, is now an alluvial area. The Okozu divided waterway (the New Shinano River), which is an artificial river (completed in 1925), protects the Niigata Plain from flood water by diverting the excess water into the Sea of Japan.

Reinforcement of the embankments along the Nakanokuchi River stabilized flood control in this district. While the Nishikawa River, the Nakanokuchi River and the Shinano River are usually used for irrigation water, the Shinkawa River is usually used for drainage water. There are also other rivers for irrigation and drainage. When need arises, drainage water is reused for irrigation water especially in some upper-stream areas.

The Nishikanbara Land Improvement District, which was established comprising five exiting water users' associations in 1951, is one of Japan's largest water users' associations. The LID covers 5 villages, 5 towns and 2 cities. At present (1998), its total farming land area is 19 156 ha (18,136 ha of paddy field and 1,020 ha of upland field) and the association members are 14 280 (Table 3). The area is enriched with *physical capital* such as the Okozu Divided Waterway (about 10 km long),[13] irrigation pump stations/plants (about 402 ones), drainage pump stations/plants (472 ones; the Shinkawa estuary drainage pump station[14]

[13] The Okozu divided waterway is an important part of river improvement and irrigation. It has a main weir at the dividing point of the main river, and a movable weir on the divided waterway side. At the time of flooding, the main weir is closed and all the water is channeled to the divided waterway to protect the downstream area from the potential flood.

[14] The Shinkawa estuary drainage pump 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.

is the biggest in the orient), branch irrigation channels (607 ones, 676.23 km), and branch drainage channels (598 ones, 647.530 km) (Table 4).

The office building of the LID, which has 12 branch offices, is the most essential physical capital of all these physical capitals. The farmers are also richly endowed with built-in *social capital*, such as socially embedded group consciousness and rules-in-use that the irrigators have crafted for appropriating (withdrawing) the resource unit (irrigation water) from the CPR stock (the irrigation system).

4 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 130 elected or selected farmers (Fig 2), and (b) the Administration Bureau (Fig 3), which comprises 196 employed staff.

The LID members elected or selected 130 representatives from among themselves at the village, town and city level. These representatives formed the council-of-representatives, which then, based on the resolution at a general meeting, elected the board of directors (18 persons) and the board of supervisors (5 persons). About 196 staff members under the elected directors carry out the routine business affairs of the LID office. The office has two main divisions, consisting of general affairs division (under general affairs division chief) and business affairs division (under divisional manager). The general affairs division has 6 sections, namely planning section, information system section, general affairs section, management section, financial section and branch office section. The business affairs division has 5 sections, namely farm village maintenance section, construction section, machine station/plant section 1, machine station/plant section 2 and maintenance of facilities section.

One of the roles of the Nishikanbara land improvement district, besides participating in planning various land improvement projects and coordinating the opinions of association members, is operating and maintaining the facilities that the district constructs (Toyota 1985, 81).

5 Nishikanbara Irrigation System as a Common-Pool Resource (CPR)

A common-pool resource (CPR), which is sufficiently large natural or humanly made resource, can be defined based on the two attributes, regardless of the property rights involved: the difficulty (involving nontrivial costs) of excluding individuals from benefiting from a good pertaining to provision problems, and the subtractability of the benefits consumed by one individual from those available to others pertaining to appropriation problems (Gardner, *et al.* 1990, 335; Ostrom, *et al.* 1994, 6-7; Ostrom *et al.* 1999, 278-9).

The Nishikanbara irrigation system can be characterized by these two attributes and defined as a closed-access humanly made CPR,[15] in which a well-defined group of farmers enjoy property rights and use the irrigation water in common, while confronting but resolving collective action problems, namely (a) appropriation problem and (b) provision problem.[16] The Nishikanbara LID has been able to address and resolve the two major problems through the self-governance of the irrigation system.

We would describe how indigenous institutions that the irrigators involved have

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[15] Ostrom (1990, 222) and Furuboton and Richter (1998, 98) referred to Ciriarcy-Wantrup and Bishop (1975), and mention two variant cases of CPRs: (i) the open-access CPR, in which no one enjoys property rights in the resources such as open sea and outer space, and (ii) the closed-access CPR, in which a well-defined group enjoys property rights in the resources such as the irrigation system under our present study.

[16] The management of CPR usually encounters two broad types of problems namely, (a) appropriation problems and (b) provision problems. Appropriation problems, which are time-independent, are concerned with the allocation of the flow or in other words, with the effects that various methods of allocating a limited quantity of resource units (such as irrigation water) will have on the net return obtained by the appropriators (such as irrigators). On the other hand, provision problems, which are time-dependent, are concerned with the stock or in other words, with the effects of various ways of assigning responsibility for building, restoring, or maintaining the resource system (such as irrigation system) over time, as well as the well-being of the appropriators. [Up to this, the note refers to Ostrom (1990, 47-9)]. In irrigation systems, water allocation (appropriation of irrigation water) and provisions are two major sources of collective-action problems, frequently contributing to sub-optimal performances in irrigation systems (Tang 1992, 5; Lee 1994, 9).

crafted are entangled in three spectra of collective action, determining their choice.

6 Irrigation Institutions as the form of Social Capital (Rules-in-Use) and the Three Spectra of Collective Action

North (1990, 1; 1991, 97) stated that *institutions* are the rules of the game in a society, or the humanly devised constraints that structure political, economic and social interaction. Referring to North, Ostrom (1992, 19) more particularly characterized *irrigation institutions* as the set of working rules or "rules-in-use" for supplying and using water in a particular location. Social capital, which means the shared knowledge, understandings, institutional arrangements, and patterns of interactions that a particular group of individuals brings to any activity, is invisible in nature (Coleman 1988, extensively explained; Ostrom 1997, 158), but it profoundly shapes the visible physical capital as the former creates the latter. In other words, they are like the human mind and body -- two separate things that coordinate to determine a human.

We can broadly distinguish two different categories of institutions in our study: macro-institutions (macro-level forms of social capital),[17] which are commonly widespread in the Japanese society, and micro-institutions (micro-level forms of social capital), which are particular cases, individually influenced by the macro-institutions. Irrigators' indigenous irrigation institutions are collectively the most

[17] *Japan: Illustrated Encyclopedia* (1993, 478) states that Japanese people learn in their family about group consciousness and the patterns of interaction in cliques. *Japan As It Is* (1990, 39) states that in Japanese society the group defines the individual and the individual is only significant in so far as the person represents the group. And unlike nomadic societies, agrarian cultures need communal cooperation, discipline and a sense of shared fate. About the conflict resolution process, *Japan: Illustrated Encyclopedia* (1993, 221-2) states that, irrespective of source or extent, individuals regard it extremely unpleasant to experience direct, face-to-face confrontation. And the most general technique is consensus decision-making. In our view, all of these (such as group consciousness, and conflict-resolution mechanism through consensus) are macro-institutions or macro-social capital of Japanese society. Fukutake (1989, 55), Sasaki (1990, 7), Nakane (1990, 20) and Rehfeld (1994, 74) identify some macro-institutions in Japanese society such as "group egoism," "group cohesiveness as unconscious social norm," "cohesive sense of group unity," and "sense of collective identity," respectively.

influential micro-level forms of social capital, when the irrigators appropriate resource unit from the irrigation resource stock. In our study, micro-institutions include the irrigators' indigenous irrigation institutions, which are the particular form of social capital.

We can distinguish three spectra of farmers' collective action) in which there are three types of rules-in-use (as institutions); these "operational rules," "collective-choice rules," and "constitutional-choice rules" cumulatively affect the actions and outcomes (Kiser and Ostrom 1982) in the Nishikanbara irrigation system, as a CPR (see Fig 4). The operational level is concerned with the relationship of appropriators to the CPR, collective-choice level is concerned with the appropriators' community, and the constitutional choice level is concerned with the association of the communities when they decide or modify the terms and conditions (V. Ostrom, Feeny and Picht 1993, 455).

6.1 Constitutional-Choice Spectrum: 14 280 farmers collectively decide how to contribute to the formation of the spectrum of constitutional-choice rules-in-use by electing 130 representatives, who then form the spectrum of collective-choice rules-in-use. Based upon the principles of "one member-one vote" and secret ballots (usually selected on consensus), once every four years at the city, town and village levels, this council-of-representatives is elected by the farmers. Amongst their own ranks, the auditors elect a general auditor and organize a board of auditors, who are required to audit the business and properties of the LID at least twice each fiscal year. Within this spectrum of constitutional-choice rules-in-use, the council-of-representatives is the supreme decision-making organ of the LID, and, with the cooperation of government agencies, deals with all matters pertaining to the LID's *constitutional-choice rules-in-use,* such as changes in the articles and bylaws, budget balancing, and the methods of imposing and collecting levies.[18]

6.2 Collective-Choice Spectrum: As the spectrum of constitutional-choice rules-in-use is formed, it deliberately forms the spectrum of collective-choice rules-in-use. At this spectrum, the irrigators, under constitutional-choice rules, decide their *collective-choice rules,* such as general irrigation water distribution

[18] As stated earlier the land improvement district has an administration bureau comprised of 196 staff for internal business processing.

policy.

6.3 Operational Spectrum: Once the spectrum of collective-choice rules-in-use is formed, the irrigators decide to form the spectrum of operational rules-in-use, under the collective-choice rules and constitutional-choice rules. The operational rules directly influence their daily decisions with regard to who will open and stop the sluice gates for irrigation/drainage and when or how to drain out surplus or used water. The farmers of a community based "terminal water-using group"[19] at this spectrum, work with strong community consciousness and form the operational rules-in-use that make the group the sole, working agent of water distribution at the community or the group of community. At this spectrum, under the built-in or on-the-spot devised working rules, "communication" among the farmers (representatives) becomes intense and substantially contributes to the self-governance action arena.

Within the above-mentioned spectra of rules-in-use, social capital evolves to produce necessary physical capital, and together they work to produce the collective action benefits. Social capital, which means the shared knowledge, understandings, institutional arrangements, and patterns of interactions that a particular group of individuals brings to any activity, is invisible in nature (Coleman 1988, extensively explained; Ostrom 1997, 158), but it profoundly shapes the visible physical capital as the former creates the latter. In other words, they are like the human mind and body -- two separate things that coordinate to determine a human. In addition, with the cooperation, not the coercion, of government agencies, the concerned farmers of the Nishikanbara LID coordinate their social capital with physical capital that they create with their

[19] In the case of irrigation water distribution, the main duty of the LID is to make necessary irrigation water flow from production resource to the distribution resources (main canals). The LID does not distribute water to the appropriation resource (branch canals) or to the use resource (fields.) A community (or a group of communities) has its own "terminal water-using group," whose members withdraw the water from the distribution resource to the appropriation resource. Then, individual farmers withdraw the water from the appropriation resource to their respective use resources. Usually a community (a group of communities) administration forms a "terminal water-using group" and discuss at the spring meeting __which is held once a year, just the beginning of crop season __ about the water appropriation policy. As a water-using group lets the necessary water flow by a farmland, the farmland owner withdraws water individually.

social capital.

When the government agencies invest in physical capital, they strategically consult with the LID in order to ascertain whether these farmers are in need of, or will appreciate, the physical capital that they intend to either improve themselves or allow the farmers to improve within the structure of their built-in, or evolving, social capital. The agencies do not invest unless the LID collectively welcomes such an investment, because the agencies are well aware that physical capital does not produce at an optimum level unless the social capital does its part to make it produce. Even within the structure of LID, the LID authorities seriously consult with the farmers when they invest in any project. What is more, at the very operational spectrum, the representatives of a "terminal water-using group" consult with the concerned irrigators, for instance, when they repair a branch canal. While the irrigators form the abovementioned spectra, they also develop, through the LID, some design principles that characterize the irrigation institutions, or the rules-in-use.

7 Design Principles that Characterize the Irrigation Institutions

We can discuss some design principles [according to Ostrom (1990, 90-102; 1992, 67-76] that characterize the irrigation institutions and that the farmers of the Nishikanbara LID have collectively crafted to self-manage the irrigation system.

7.1 ***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 LID has records of all the farmers' farmland area under the irrigation system, and there is no chance that the non-members who do not contribute to it can appropriate irrigation water.

7.2 ***Design Principle Two: Congruence between appropriation and provision rules:*** The LID has formulated the rules, specifying the amount of water that an irrigator is allocated. If an irrigator has greater area of land, he has to pay higher water fees. The farmers not only share the project costs but also pay operation and maintenance costs.

7.3 ***Design Principle Three: Collective-choice arrangements***: The LID in general or a community based "terminal water-using group" in particular, through several discussions, fulfills the "requirement of unanimous agreement as a collective-choice rules." [Ostrom *et al.* (1999, 282) argued that this is a basic collective-choice rule for CPR management.] The irrigators of a community based "terminal water-using group" collectively participate in modifying their daily operational rules.[20]

7.4 ***Design Principle Four: Monitoring***: While the LID monitors the overall irrigation system such as distribution of water, a "terminal water-using group" within the group selects certain irrigators to look closely at its own particular area especially with regard to the flow of water. Interestingly, the cost of monitoring either at the LID level or at the terminal level is extremely low due to the group's tendency, under the institutional arrangements that have been endowed with credible commitments, to work collectively and rationally with a basis in mutual trust and by economizing the "transaction costs," to use those words of Coase (1937) that Williamson (1985) so frequently used. Leibenstein (1984, 80) argued that conventions and institutions are very often self-enforcing and may not require much monitoring, whereas the same rule imposed by an (external) authority may require considerable monitoring. This leads us to argue that endogenous, self-enforcing institutions are far more effective than the exogenously imposed institutions that are costly as well.

7.5 ***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 conventionally institutionalized group consciousness and predominant mutual trust (social capital). Such kind of particular behavioral approach in CPR can be

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[20] This accords with Ellickson's (1994, 97) argument that informal interactions can spontaneously generate (complex) institutions. Ellickson's (1991) book *Order without Law* challenged the view of many scholars who assume that only governments can produce the rules through which a society governs itself, and demonstrates that in rural areas in which neighbors repeated interact aspire to be "good neighbors" by following the institutions they themselves formulate without the requirement of the law that the government enforces.

explained by Ostrom's (1998, 12) argumentation. "At the core of a behavioral explanation," Ostrom argued, "are the links between the trust that individuals have in others, the investment others make in trustworthy reputations, and the probability that the participants [i.e., irrigators] will use reciprocity norms." This kind of behavioral approach draws our attention to Buchanan's (1994, 124- 5) argument that many persons do not behave opportunistically, even when the possibilities to enjoy apparent advantage are available, because they act within a set of endogenous self-imposed constraints.

The irrigation facilities that the irrigators have collectively established in the form of physical capital can successfully distribute necessary water among the farmers, solving the water scarcity problems and thus reducing the rule violation problems. This reveals that when social capital determines the physical capital it becomes the appropriate arena in which the actors involved can pose rational collective action. The irrigators either in the LID level or in the community level attach more importance to their social trust or the behavioral approach than to an open description of rules violations and sanctions.[21] Shared norms or conventions or institutions in the form of social capital have substantially reduced the cost of monitoring and sanctioning activities.

7.6 ***Design Principle Six: Conflict resolution mechanism:*** When a general conflict does arise due to water scarcity between upper-stream and down-stream areas, for example, the irrigators inform the LID, which is to resolve the conflict. A "boundedly rational," to use Simon's (1957) words, individual irrigator, who may not have all the necessary information about why a certain problem, such as a shortage of water, occurs in his land, contacts the rational LID, which either has the necessary information or is capable of furnishing that information needed to address the instant problem with less transaction costs.

7.7 ***Design Principle Seven: Minimal recognition of rights to organize***: The farmers substantially enjoy the freedom to devise their own institutions with regard to both coordinating water utilization in order to ensure the supply of

[21] This is consistent with a recent study of Knight (1998, 759) arguing that when the content of social norms (social capital) ordains cooperative behavior, social actors can establish stable expectations about the likelihood that others will cooperate and then make a decision to act accordingly.

water from the river and the control over water distribution, and conducting the operation and maintenance of irrigation facilities that are not challenged by government agencies. The reason is that the government is aware that the rules that the farmers of a community based "terminal water-using group" in particular continuously craft are congruent with physical, social and institutional features of the community.[22] It is generally recognized that a Japanese social organization is fundamentally closed to outsiders, even to the government agencies. When a LID convokes a general meeting or calls farmers to decide important affairs, it does allow neither reporters nor government agencies to attend the meeting.

7.8 ***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.

We find that the most of these design principles that they farmers have crafted for themselves have not only contributed to the institutional robustness in the common-pool irrigation resource system, but also solved provision and appropriation problems of the common irrigation system or irrigation CPR.

8 Why is It that Social Capital is an Important Factor?

Our empirical study leads to this answer that when social capital is given a special priority and the social capital and physical capital[23] are *well-coordinated*,

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[22] Schlager and Ostrom (1992, 255) studied (with reference to fisheries) that self-organized collective-choice arrangements can produce operational rules closely coordinated to the physical and economic conditions of a particular area.

[23] Our intuition may tell us that the mere improvement of physical capital by installing sophisticated irrigation facilities can substantially improve the collective action and reduce conflicts about the water distribution policy, for instance. But the puzzle is that this is not always true especially when external forces such as government agencies or international donor agencies develop the physical capital without placing proper importance on social capital of the irrigators involved. It is evident from Lam's (1998, 202) study that sophisticated engineering infrastructure does not always bring about better irrigation

they contribute to each other positively, making a positive impact on the irrigators' collective action, as they self-manage or self-govern their common irrigation resource. The farmers can consequently develop to attain their rational collective choice and actions even without requiring the coercion of external entity. The national and prefectural governments[24] substantially consider such coordination before they invest in physical capital because formation of any physical capital, which is not in congruence with the social capital, may cause institutional failure, seriously affecting irrigators' collective action situation that they bring to the action arena.

The coordination of social capital with physical capital under the institutional arrangements solves the problems of "the tragedy of the commons" and consequently, freedom (in the sense, there is no coercion) brings no ruin to the irrigation CPR. (Hardin mentioned that "Freedom in a commons brings ruin to all.") "The links between the trust" (stated earlier) automatically reduces free-riding problems and lets the freedom bring success to the CPR management. Such institutional arrangements also lead the irrigators to face "common destiny" at every group level. According to his "institutional view" of Japanese culture, Yamagishi [Yamagishi *et al* (1998, 167)] argued, "the Japanese 'often' prefer to belong to groups and place group interests above their own individual interests *not because they intrinsically like to do so* (italics ours), but because it is in their long-term interest." [25]

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performance. Lam (203) argued, "the construction of physical capital and the development of social capital are intricately related and should not be considered as two isolated domains."

[24] Since the government invests money in the major physical development works, related government agencies regularly ask the LID to submit business and management reports for inspection. Nonetheless, it is not a coercive force, but, rather, it is in cooperation with farmers who voluntarily and interdependently organize the LID.

[25] If we endorse the words in italics, we should argue that while Japanese people in a group are basically rational individually, they can also be practically rational collectively. This draws our attention to the physical infrastructure of Japanese irrigation system, in which the farmers have so consolidated their fields that every field has its own inlets & outlets and the water appropriation for every field is *independent*, indicating that the irrigators are individualists. But the irrigators act collectively to withdraw water from the common irrigation system to their individual plot, indicating that they do so for their long-term interest such as an irrigator, who is rational, self-interested can

The quality of social capital that the irrigators in the LID create by laying out their human capital, does not largely depend on how individually great or not their human capital is but substantially on how efficiently they invest it (human capital) in the creation of social capital.[26] We observe that the formation of social and human capital takes place through a reciprocal process i.e., a capital contributes to the other in the process, when government plays a supportive role but does not exercise any external force.

When communication successfully allows individuals to increase their trust (one form of social capital) in the reliability of others, individuals change their expectations from the initial probability that others use reciprocity norms to a higher probability that others will reciprocate trust and cooperation (Ostrom 1997, 13). It is generally recognized that drop-out of a social organization is principally restricted and it (social organization) is fundamentally closed to outsiders, even to the government agencies. In group identification, a frame such as an "association" is of primary importance; the attribute of the individual is a secondary matter in Japanese society (Nakane 1986, 173).

The groupism or collectivism rather than individualism sustains not just because the individuals are included in the same group, but fundamentally because they expect that the favor an individual does to the group will be somehow returned to him or her individually.[27] This expectation, which is based on trust and commitments they make, has made a self-interested individual both individually

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rationalize water cost collectively.

[26] Our intuition is that every actor of a CPR may have rich human capital such as his or her knowledge, but if they do not share it with each other within the CPR action arena, the formation of efficient social capital is not possible. Conversely, CPR actors having comparatively poor human capital can form efficient social capital when they share it well.

[27] Referring to the characteristics of Japanese collectivist culture and in-group favoritism, Yamagishi (1996, 1) argued that the maintenance of harmony among group members and voluntary cooperation towards group goals is not fundamentally psychological. He (10) found that an individual who practices in-group favoritism expects that other members would also act on the principle of in-group favoritism.

and collectively rational in the collective action arena in which the coercion of external agencies is not necessary. This confronts also the central theme of Olson's (1965) "*the logic of collective Action*," which, as stated earlier, argues that coercion is necessary to make the self-interested individuals achieve their common or group interests. We do not try to establish that the Hardin and Olson are absolutely wrong, but we argue that the generalization of their theories are very likely to mislead the policymakers who deal with people's collective action on a commons and indiscriminately formulate or prescribe policies based on these theories. Utilization of social capital is essential to reduce the necessity of external capital.

9 Conclusion

Our major observation is that, for irrigators' self-management of the large-scale irrigation system, coordination of social capital with physical capital is an indispensable prerequisite, because this substantially lets the rational irrigators form endogenous incentives to craft necessary indigenous irrigation institutions, under the existing macro-institutions (i.e., macro-level form of social capital).[28]

We recognize that absence of government coercion is a necessary condition but not a sufficient one to self-govern or self-manage a closed-access CPR. While absence of coercion does not always guarantee that the appropriators will pose collective action, the presence of exogenous coercion is likely to seriously perturb both self-management structure and collective action situation. This is why absence of government coercion is a necessary condition, which is not sufficient by itself. One of the sufficient conditions is government's supportive role that it plays to help the rational actors produce endogenous incentives to craft their indigenous institutions to act rationally and collectively on the action arena of CPR.

Land Improvement District, which has come into existence through the farmers' collective choice, with the government's presence and supportive activities but without its any form of exogenous coercion, has played the most important role

[28] The macro-social capital such as group consciousness that has historically and culturally evolved and embedded itself in Japanese society in general has also influenced (micro) social capital in particular.

to coordinate social capital with physical capital in order to make the irrigators' indigenous institutions __ which they craft through their endogenous incentives __ sustainable. Our study furnishes an authentic instance that a large number of rational irrigators collectively using their large-scale irrigation system, a humanly-made closed-access common-pool resource, can sustainably pose successful collective action through self-management, without the need of external coercive force[29] but of course, with the active support of government. Accordingly, the irrigators can solve the appropriation and provision problems of their irrigation CPR.

When government mostly plays supportive role but does not exercise its exogenous force, the concerning irrigators interdependently produce endogenous incentives to craft the indigenous institutions collectively, under the existing social norms and shared beliefs and expectations (i.e., social capital), to successfully and sustainably self-manage their own irrigation system. Accordingly, appropriation and provision problems of the irrigation CPR situation are addressed.

Engineers, policymakers and donor agencies should attach considerable importance to the understanding of irrigators' social capital, especially the indigenous irrigation institutions when they invest in physical capital. They should not take it for granted that an external entity to coerce is always necessary. The reason is that the development of institutions and institutional arrangements (the most important forms of social capital) can substantially solve the collective action problems that "the tragedy of the commons" and "the logic of collective action" address and attempt to solve prescribing the necessity of external coercion. In addition, the investors should bear in mind that, while economic investment in physical capital is important, the formation of physical capital must also be consistent with the development of irrigation Institutions and institutional designs, or the institutional failure may occur, disrupting the appropriators' collective action situation that they (appropriators) bring to their action arena.

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[29] Conditions of reciprocity between the government and the appropriators' association are necessary. When government use instruments of coercion to exercise dominance over others the conditions of reciprocity are breached (V. Ostrom, Feeny and Picht 1993, 455)

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Table 1 Central and Prefectural Government Subsidies for the Capital Costs of Construction Projects (%)

Type of project	Central government subsidy	Prefectural government subsidy	Total subsidy	Shared by members of LID
Central government project				
Large-scale irrigation & drainage	60-70	20	80-90	10-20
Land reclamation	75	12.5	87.5	12.5
Disaster prevention	60	35	95	5
Prefectural government project				
Medium-scale irrigation & drainage	50	25	75	25
Land consolidation	45-50	27.5-30	70-72.5	27.5-30
Integrated land improvement	50	25	75	25
Land reclamation	65	17.5	82.5	17.5
Disaster prevention	60	23	83	17
Farmers' group project				
Small-scale irrigation & drainage	45	--	45	55
Land consolidation	45	--	45	55
Land reclamation	55	--	45	45

Note: The figures listed in the table are not applied in Hokkaido and Okinawa

Source: Adopted from Mizutani and Mase (1999, 330)

Table 2 Collection Rate of Members Fees (1995)

Size	Ordinary Fees (%)	Special Fees (%)
Under 100 ha	98.2	97.7
100 --- 500 ha	98.1	97.7
500 ---1,000 ha	99.0	99.0
1,000 --- 2,000 ha	98.0	98.2
Over 2,000 ha	99.0	99.3
Average	98.3	98.0

Source: Ministry of Agriculture, Forestry and Fisheries (MAFF)

Statistical Survey on Management of LIDs, F. Y. 1995

Adopted from Mizutani and Mase (1999, 331)

Table 3 Area of City, Town & Village and the Number of the Association Members (1998)

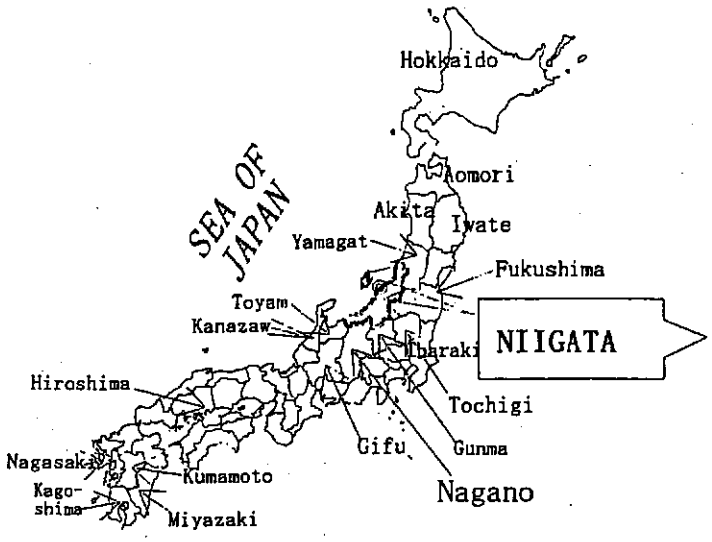
Name of City, Town and Village	Area of Paddy Field (ha)	Area of Farm Field(other than paddy field) (ha)	Total Area (ha)	Number of Members
Tsubame City	1,744	123	1,867	1,516
Yoshida Town	1,842	80	1,922	1,259
Bunsui Town	1,324	35	1,359	1,249
Yahiko Village	941	13	954	716
Iwamuro Village	1,246	68	1,314	993
Maki Town	2,374	93	2,467	2,113
Nishigawa Town	1,633	91	1,724	1,023
Nakanokuchi Town	1,176	90	1,266	905
Katahigashi Village	1,643	50	1,693	1,019
Ajikata Village	965	67	1,032	577
Niigata City	1,940	190	2,130	1,928
Kurosaki Village	1,308	120	1,428	982
TOTAL	18,136	1,020	19,156	14,280

Table 4 Number of Irrigation and Drainage Pumping Stations and Operation & Maintenance (O&M) Costs (1998)

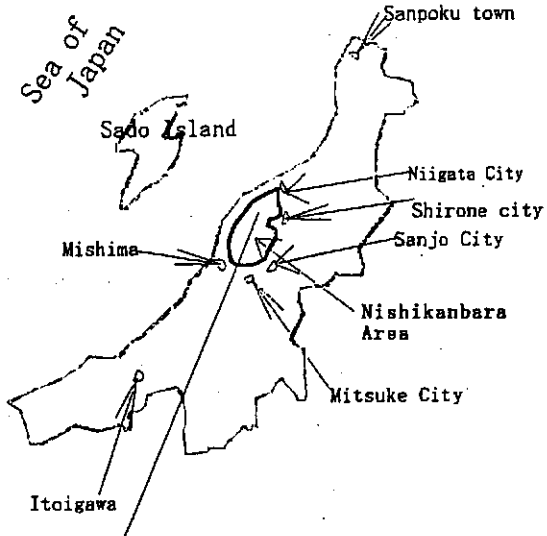
Classifications	Scale of land	Electricity contracted		Costs paid (%)		No. of stations/plants		
				LID	Br. Off.	Irrigation	Drainage	Total
Under the direct control of the LID	More than 10 ha	More than 50 kw		100	0	32	20	52
Entrusted to the LID branch offices	More than 10 ha	More than 50 kw	No.1	100	0	99	19	118
			No. 2	50	50	154	20	174
Under the control of the branch offices and villages	Less than 10 ha	Less than 50 kw		0	100	117	11	128
Total						402	70	472

Source: Nishikanbara Land Improvement District (1998, 48) (translated)

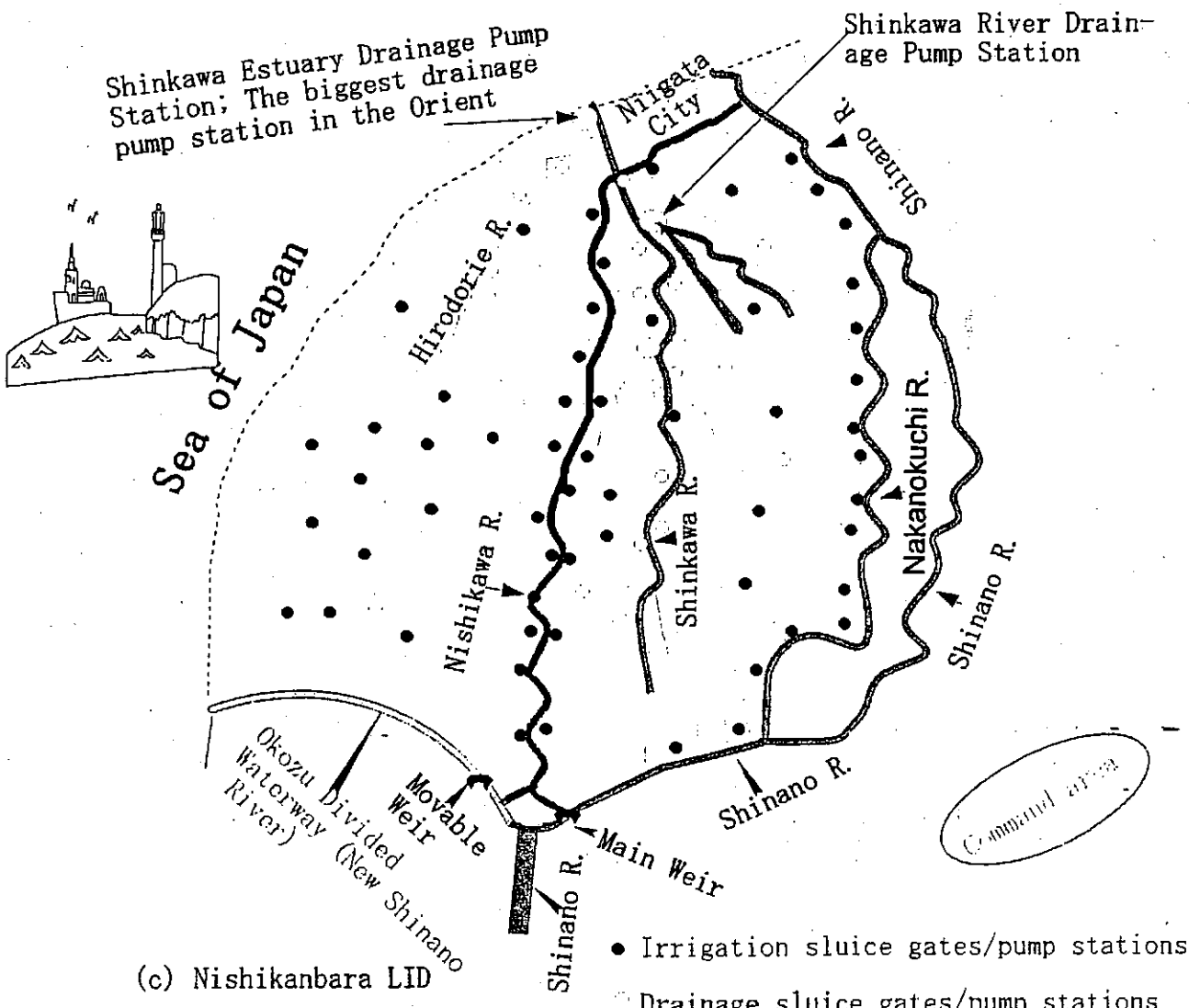
Fig 1 Location of the Nishikanbara Land Improvement District



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



(b) Niigata Prefecture



(c) Nishikanbara LID

NB: Figures are not in exact scale

Fig 2 Organizational Structure of the Nishikanbara Land Improvement District

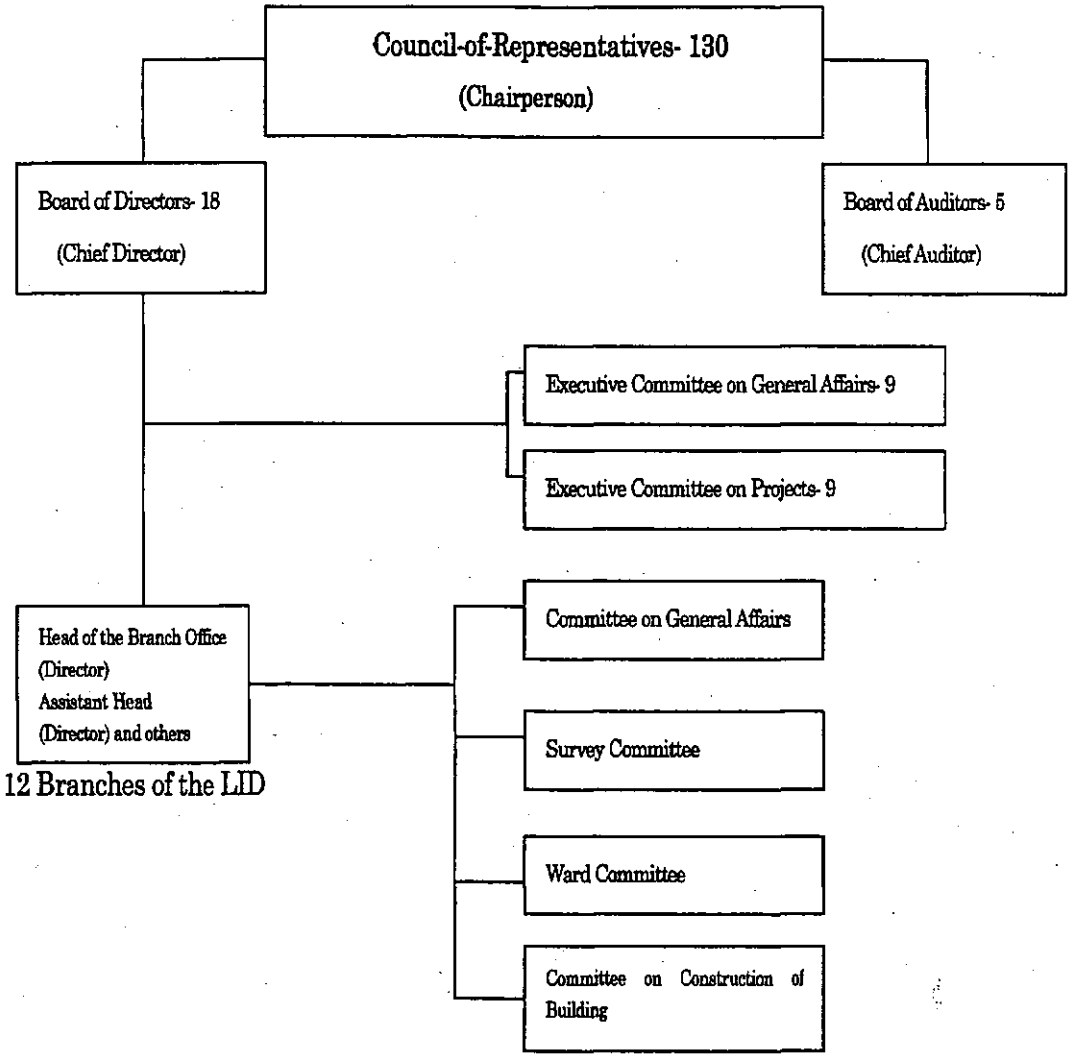


Fig 3 Administrative Structure (Staff)

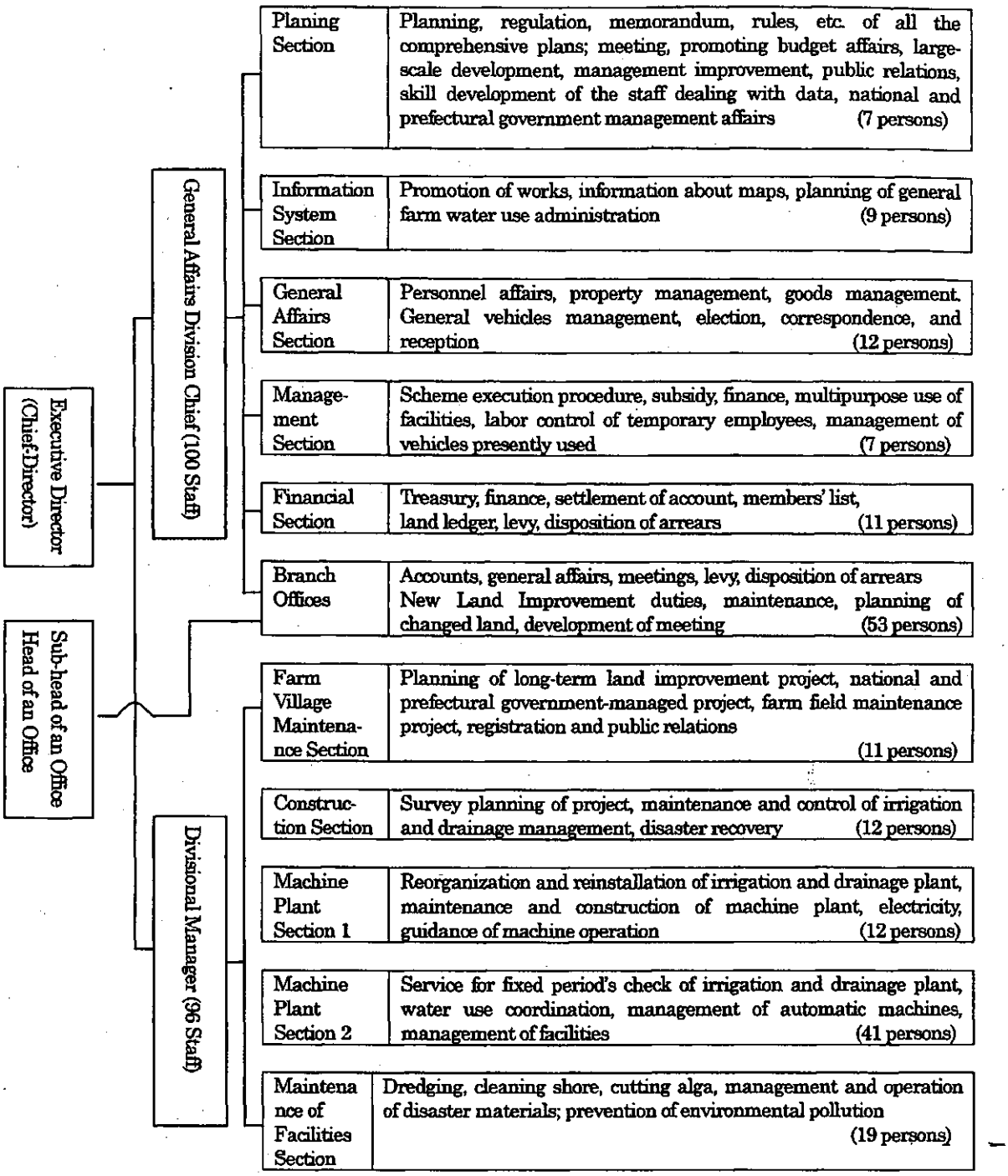
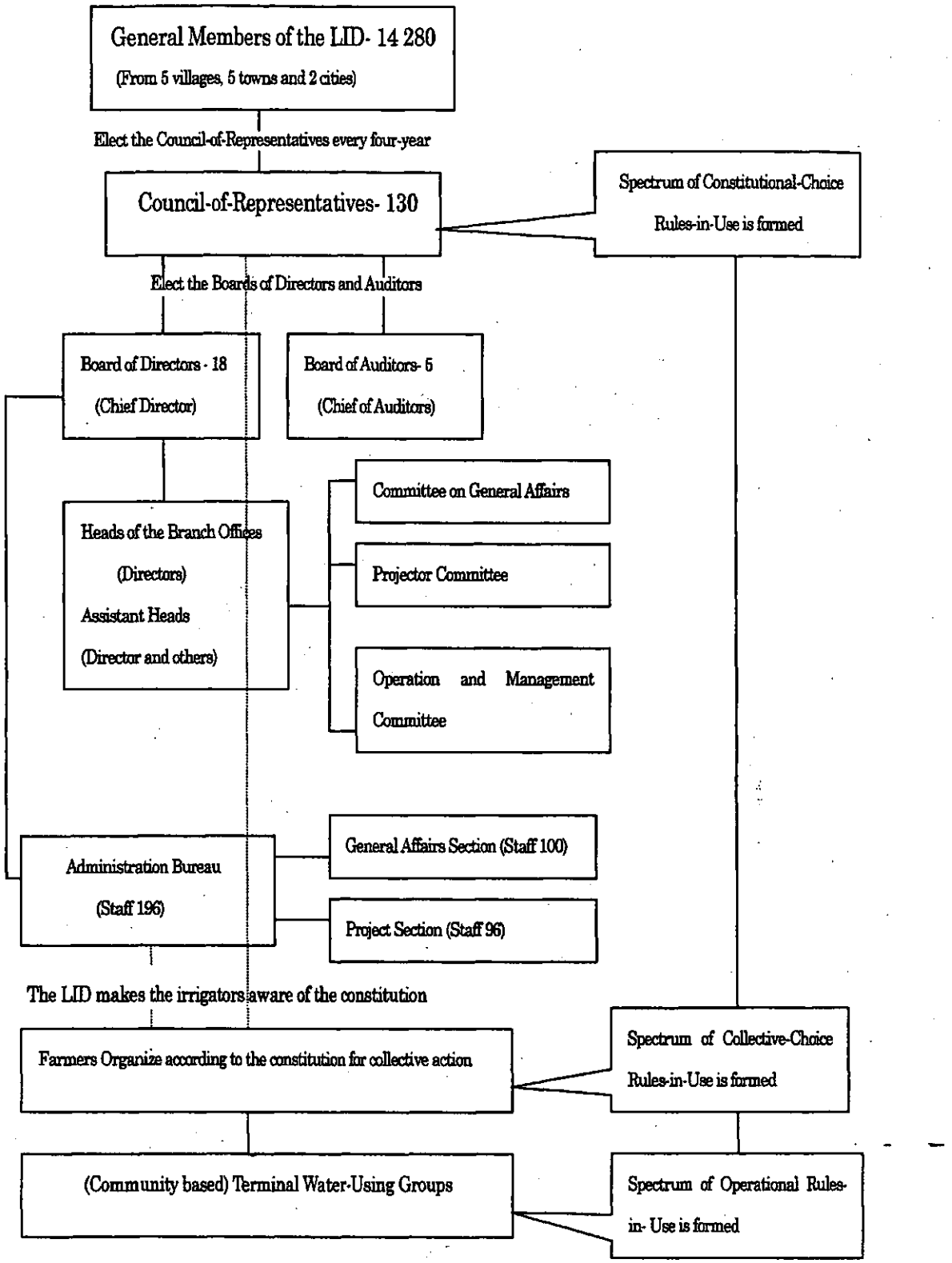


Fig 4 Organization and Spectra of Institutions (Rules-in-Use) of the Nishikanbara LID



Note: We have very simply identified the three spectra of the rules-in-use. In fact, the rules are so nested within the organizational structure that it is difficult to identify the clear location of an individual spectrum.