THE POLITICAL ECONOMY OF GREEN DEVELOPMENT

Managing the Institutional Diversity of Japan's Irrigation Commons

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Summary

Scholars have identified three types of policies used to govern shared community resources—government ownership, privatization, and users' self-governance. Some scholars have recommeded government ownership and privatization as panaceas to resolve all complex problems of commons in a social-ecological system (SES). However, these two policy alternatives have not been successful in addressing the oversue issue in a majority of cases. Although users' self-governance has proven to be the most powerful policy alternative in many cases, it has also failed in some contexts.

This study addresses which policy alternative is most credible for governing shared community resources by examining the case of Japan's community-based irrigation commons in a complex SES, which is known to be the most successfully managed shared-resource in Asia. It illustrates the institutional arrangements for self-governing Japanese irrigation commons. The research site is Nishikanabara Land Improvement (post-war water users associations) located in Niigata Prefecture, Japan.

The finding indicates that a special form of users' self-governance, which could be described as "state-reinfornced self-governance," has contributed to the successful management of the Japanese irrigation commons. In a state-reinforced self-governance system, a financially, legally, and politically strong government supports the resources users to strengthen their existing capacity to protect and reconstruct institutional diversity of the commons. This contributes to those recent studies that demonstrate that there is no "panacea" for a single type of goverance system and successful managment of commons is possible through the protection and promotion of institutional diversity. In Japan's case, the strong government neither privatizes nor claims ownership of community resouces. Instead, users self-govern their resources as a complex, adaptive, institutionally diversified commons. While the users have common-property rights to the irrigation commons, their farm lands are privatized. State-reinforced self-governance is different from co-management but it possesses the characteristics of polycentric governance. It involves the elements of other policy alternatives and emerges as a more powerful and sustainable policy alternative to address the oversue issue, which is technically known as "the tragedy of the commons."

1. Introduction

Since Olson's (1965) book, *The Logic of Collective Action*, was released and Hardin's (1968) article, "The Tragedy of the Commons," was published in *Science*, scholars and practitioners have believed that users of the commons (e.g., forestry and irrigation systems) are always rational, and consequently, are trapped in a system in which they cannot cooperate and communicate. As a result, common properties or shared resources are overused; the destruction of resources due to overuse (i.e., the tragedy of the commons) is inevitable. Olson (1965) and Hardin (1968) argue that strong government ownership and privatization of the commons are the only ways to prevent the destruction of the commons. Other influential works such as studies by Gordon (1954) and Demsetz (1967) advanced a similar concept and recommended an imposition of government ownership or privatization to resolve the overuse issue of commons in all contexts.

Many scholars and practitioners continued to believe that no other ways existed to manage commons. However, Ostrom's (1990) influential book, *Governing the Commons*, as well as her subsequent publications (e.g., Ostrom 2005) provided an entirely new focus on the overuse of the commons. Ostrom argued that overuse is a serious problem, but not an inevitable tragedy. Moreover, she argued privatization and strong government regulation are not the only options to address the overuse issue. Citing hundreds of international case studies, Ostrom established that users are not necessarily rational and are not always trapped in a SES where they cannot communicate. Ostrom and colleagues (Dolšak & Ostrom, 2003; Ostrom, 1990; Ostrom, 2005) demonstrated that users can cooperate and communicate to design self-governing institutional arrangements and resolve overuse problems in a SES system. Ostrom (1990; 2005) proposed that self-governing can be a third and substantially powerful policy alternative to avert the tragedy of the commons in a complex social–ecological system (SES).

In *Governing the Commons*, Ostrom primarily challenged the theories of Olson and Hardin. These theories advance the rigid argument that government ownership and privatization are the only alternate policies to manage commons. Ostrom did not dismiss Olson's and Hardin's theories as useless. However, scholars may perceive two mistaken notions from the work. The first misperception is that users' self-governance is also a blueprint for resolving every problem of the commons. This notion is likely to persist perhaps because the work is substantially influential and has demonstrated the users' self-governance is successful in many situations. The second is that a strong government is a coercive force and therefore should be isolated from users of the commons. Instead, resource users should self-govern their commons; otherwise, the strong government will disrupt users' self-governing institutional arrangements. Recent studies (e.g., Meinzen-Dick, 2007; Ostrom, 2007; Ostrom, 2009; Ostrom and Cox, 2010; Poteete, et al., 2010; Ostrom , 2011) have clearly stated that users' self-governance policy is also not a blueprint or "panacea." The studies emphasize that institutional diversity involving the three policy alternatives can address the specific problems of a coupled SES.

In spite of significant expansion of literature on policies and management of irrigation water, the issue of which policy alternative is useful or which combination of policy alternatives can formulate suitable irrigation institutional diversity for a specific SES remains an important concern for policy makers. This study addresses the issue by investigating the highly successful management of Japan's irrigation commons. It demonstrates that users' self-governance system has strongly dominated the past several hundred years in Japan; however, the system has become institutionally diversified over time by involving the elements of other policy alternatives to sustain. The self-governance policy alternative stands out as the most efficient option in the set of three alternate policies. Japan's users' self-governance system possesses unique features, and it can be termed as "state-reinforced self-governance."

The remainder of this paper is structured as follows. Section 2 describes the evolution of institutions of Japan's irrigation commons. Section 3 examines the case of Japan by drawing on the insights of polycentric governance system and IAD framework. Section 4 briefly examines how a state-reinforced self-governing system contributes to institutional diversity. Section 5 provides a conclusion.

2. Evolution of Institutions of Japan's Irrigation Commons

According to North (1990), irrigation institution can be described as a set of rules in action to supply and use water in an irrigation area (Ostrom, 1992). Japanese irrigators withdraw irrigation water from a river to fill irrigation channels, and then feed it into their paddy fields. They develop and abide by a set of agreed-upon rules—traditional, formal, or combined—for sharing the irrigation water fairly. This set of rules is called irrigation institution.

Japan's irrigation management can be exemplified as highly successful in Asia (Kono, et al., 2011; Nagata, 1994; Tanaka & Sato, 2005). Irrigated rice yield in Japan ranges from seven to eight tons/hector/one season a year (Okamoto, 2006), which is several times higher than the yield in many other Asian countries. The irrigation rate for paddy cultivation is nearly 100 % (Okamoto, 2006).

Due to the strained diplomatic relations between Japan and China during the ninth to fifteenth centuries (i.e., Medieval Period), the control of agricultural water was transferred from the state to feudal governments that decentralized agricultural water management (Fukuda, 1984; JNCICID, 1994; Shimura, 1984). This simple, decentralized agricultural water management practice marked the genesis of self-governing irrigation system in Japan (JNCICID, 1994; Shimura, 1984). This government ownership turned into users' self-governance. Although the government was closely involved in the system, the government remained distant from participating in the irrigation water allocation activities and related issues at the local level.

The decentralized, users' self-governance brought in its wake new challenges such as severe water disputes. The government stayed away from the water dispute-resolution process. Government's non-participation in water allocation and dispute resolution led the irrigators to agree to certain institutional arrangements as part of a dispute resolution mechanism for sharing water. In this process, irrigators within a community and among the communities cooperated to formulate irrigation institutions (JNCICID, 1994; Shimura, 1984).

In the late Medieval Period and throughout the Tokugawa Period (1600–1868), village people organized themselves to form an autonomous village council creating informal rules for irrigation water utilization. Consequently, the right to use water was not under the jurisdiction of an individual farmer but under the common control of the village council (AFNBC, 1992; Hatate, 1978). The feudal government's involvement in irrigation management this time evolved to take on a special characteristic. Although the feudal government improved land and water by financing repairing materials such as wood, the village people had to maintain and repair irrigation canals and weirs; self-govern their irrigation facilities; and share irrigation water in accordance with the decisions of their village council.

Towards the end of the Medieval Period, self-governing irrigation institutional arrangements were strong and became even stronger. Even the power conflicts and political chaos among the feudal lords did not disrupt the self-governing institutions (Shimura, 1984). Instead, village people strengthened ties and followed rules in managing irrigation water to share water harmoniously and avoid social isolation that could result from disobeying irrigation institutions. These ties and rules later became the basis of the Japanese irrigation water management system at the local level. Thus, as JNCICID (1994) notes, community-based or

village-based "self-governance" of irrigation water management systems evolved as the primary model of systematic water management at the terminal point of irrigation networks in Japan.

Even during the Tokugawa Period (1600–1868), feudal lords were primarily involved in the administration of water management systems; however, the autonomous village associations were the actual users of agricultural water, and the paddy fields remained the private property of households (Kelly, 1982; Shimura, 1984). The feudal lords in particular managed flood control because their economic viability was based on the land. Since feudal lords were unable to judge the local conditions adequately to resolve conflicts judiciously, they rarely intervened. Instead, they encouraged the village associations to develop their customized conflict-resolution mechanisms appropriate to a situation (Nagata, 1994; Shimura, 1984). The Meiji government enacted Water Users Association Ordinance in1890 to establish Water User Associations (WUAs) comprising landlords or landowners, instead of villages. However, the tenants who actually cultivated the lands were excluded from the associations.

A land reform occurred in Japan during 1946 to 1950; the reform was most significant in Japan's history. Japan's government purchased excess farm lands from the landlords and sold them to tenant–farmers or actual farmers at a low price. The government assigned clearly defined private property rights to the actual farmers, while the common property rights to the water remained intact. The LIL, enacted in 1949, allowed only the actual farmers to become the members of a WUA. It also gave legal recognition, and renamed it as the Land Improvement District (LID).

A LID can be illustrated as a corporate, decentralized, and financially autonomous association of actual farmers who use irrigation water. A LID constructs, operates, and maintains land improvement or irrigation-drainage facilities such as diversion weirs and main canals, whereas the village-based water-use organizations operate and maintain branch canals and small-scale facilities (Sato, 2001; Tanaka & Sato, 2005). Formerly, WUAs operated and maintained small-scale irrigation and drainage facilities at the local level. In contrast, a LID operates and maintains irrigation and drainage facilities at all levels. The government authorities may have ownership rights to some of the irrigation and drainage facilities, but their operaton and management is entrusted to LIDs. The irrigators pay water fees to their LID in proportion to their land size to cover the operation and management costs.

The LIL, as described by Sarker and Itoh (2001), added substantial momentum to the self-governing institutions by legally recognizing the users' associations. The bundle of clear private and common property rights and self-governance system, which is reinforncced by a financially, politically, and legally strong government have all made the irrigation commons unique in Asia. Because of these unique features, the irrigation governance system can be described as a "state-reinforced self-governance system," which can be interchangeably termed as a government-assisted self-governance system or patronized self-governance system (Sarker & Itoh, 2001; Sarker & Itoh, 2003). Japan's state-reinforced self-governing irrigation institutions have evolved over the past 500 years. State authorities at the higher level of organization have empowered rather than coerced irrigators to self-govern their irrigation water. The state-reinforced self-governance system gained more strength and legal recognition due to the LIL in 1949.

A "state-reinforced self-governance system" is a special form of self-governance, different from co-management. It possesses the characteristics of polycentric governance system, which was introduced by Ostrom et al. (1961). Institutional diversity and complexities of irrigation commons have evolved adaptively around the "state-reinforced self-governance" in Japan.

3. Examining Institutional Diversity of Irrigation Commons in Japan

3.1 Method

This paper is based upon a review of extant literature, conceptual analysis, and five years of participant observation, as well as extensive visits to the Nishikanbara LID (NLID) area in Niigata Prefecture, Japan (**Figure 1**). This study examines the institutional diversity of Japan's LID (i.e., irrigation commons) in general and that of NLID, identified through literature review, interviews, and visits. We interviewed relevant farmers, scholars, practitioners, and policy makers between 1998 and 2011.

NLID, which is located in the middle of the coastal area of Niigata Prefecture, is one of the biggest irrigation commons in Japan. It is surrounded by the Shinano River, the Nakanokuchi River, Niigata Dune, and Yahiko Range. NLID was established in March 1951 through the dissolution of five previously existing irrigation organizations under the LIL. These five organizations, which were formed in the Meiji Period (1868–1912), were a modern approach designed to cope with irrigation and drainage problems in the Nishikanbara area in that time.

The general structure of a LID is that it has one federation at the national level with approximately 47 prefectural federations and 5,554 LIDs in 47 prefectures. NLID comprises 14,382 member irrigators with 18,457 ha of paddy field (NLID, 2008). It has 658 branch irrigation channels of 670.83 kilometers, and 619 branch drainage channels of 571.63 kilometers (NLID 2008) with many irrigation and drainage pumping stations across the district.

3.2. Model: Institutional Analysis and Development (IAD) Framework and Polycentric Governance

The IAD framework examines how institutions affect human incentives, actions, and outcomes in the context of governance of SES interactions (Ostrom, 2005). According to Ostrom et al. (1961), a polycentric governance may have multiple overlapping centers of authorities (McGinnis, 1999). These centers of authorities are independent but well linked and operate interdependently to resolve particular problems of commons.

As indicated in **Figure 2**, each level of organizational authority (i.e., national, prefectural, and local) has independent but interconnected centers of decision-making authorities, while each level is interlinked by institutions. A complex network of indepedent but interconnected centers of authorities facilitates an efficient allocation of water allocation at the local level. Drawing on the theoretical insights of Berkes (2007) and Ostrom et al (1961), we can state that each level is independent and has a distinct center of authority; all of these levels and centers are then horizontally and vertically linked in a complex network of institutions. At the national level, the national LID federation works closely with the national government. While a prefectural federation and prefectural government work side-by-side, a LID maintains strong collaboration with local governments. In a large and complex irrigation management system, a LID has many branches, each of which has independent management authorities. At the local level of organization, a LID operates with three layers of operation. At the first layer, LID representatives, with technical assistance from the LID's staff, supply the required quantity of water from the main canal into the branch canals. At the second layer, groups of users provide feedback to the LID about the amount of water to be supplied. At the lowest layer, terminal water users groups determine the amount of water to be withdrawn to an individual farm land.

The state-reinforced self-governing irrigation institutions develop at the local level but are linked to multiple levels of organization. The unique feature of the Japanese irrigation commons is that the institutional linkages occur through a non-coercive support from the higher levels of organization. Japan's higher government authorities provide financial, legal, and political

supports to irrigation users to reinforce their capacity to formulate self-governing rules for water allocation; however, the authorities do not participate in the actual management and operation activities (Sarker & Itoh, 2001; 2003). Even government staff and engineers are not allowed to participate in the day-to-day operation and maintenance activities of the LID (Watanabe & Ogino, 2003).

The state-reinforced self-governance system is not a co-management system; instead, it assumes some principles of a polycentric governance system. In resource co-management, decisions are usually shared between government and resource users (McCay & Jentoft, 1996). In a state-reinforced self-goverance system, the authorities provide information and modern technology and necessary financial assistance (Sarker & Itoh, 2003) either to support the existing self-governance system or to assist the users to create a new form of self-governance system.

Within the state-reinforced self-governance system, the government authorities develop a non-coercive, top–down approach to assist (rather than coerce) the users to adopt a participatory, decentralized bottom–up process. In this process, users develop adaptive state-reinforced self-governing institutional arrangements in conformity with the dynamic context of SES.

As shown **in Figure 3,** the IAD framework has two major components: the exogenous variables and action arena. The exogenous variables consist of biophysical and material conditions, community attributes, and users' self-governing institutions or rules-in-use. The action arena comprises two components: action situation and participants. Action arena is a social or shared space in which participants perform a variety of activities (Ostrom, 2005). The elements of the action situation include the following: (1) participants, (2) positions that the participants hold, (3) acceptable actions by the participants, (4) control that a set of participants have over an action, (5) the outcomes linked to a set of actions, (6) information, and (7) the costs and benefits linked to actions and outcomes (Ostrom et al., 1994; Ostrom & Cox, 2010).

As illustrated in **Figure 4**, participants (including irrigators, their representatives, directors, and auditors) jointly interact to perform a variety of activities, such as distributing irrigation water to the paddy fields in the action situation in Japan. The attributes of the irrigation water system differ from those of a paddy field to which the irrigators have private property rights. These various attributes of the resources influence the action arena in various ways. For example, irrigators make individual decisions about growing crops in their privatized paddy fields. Irrigation water is a common good, so irrigators they act jointly to allocate the water to their paddy fields.

Far-sighted rationality is one of the most important exogenous attributes of Japanese rural community influencing the action arena. From the perspective of individuals' self-interest in attaining benefits through collective action, rationality can occur in two types: "farsighted rationality" and "short-sighted rationality" (Sarker & Itoh, 2003, 161-2). In both types of rationality, individuals attempt to maximize self-interest; however, outcomes about how the attempt is made to maximize this self-interest vary. Far-sighted rational individuals believe that if they contribute to the entire group, the group will sustain them; therefore, they benefit in the long run. Short-sighted rational individuals believe that even if they do not contribute to the entire group, they will still reap rewards and thus maximize their benefits. This is true in the short term; however, over a long period of time, these individuals experience the consequences of their actions as the group eventually collapses. Given the long-enduring commitment of Japan's rural people to their customs and customary rules, irrigators are usually far-sightedly rational in that they maximize personal self-interest and benefits by contributing to sustaining the irrigation group in the process of collective action. Irrigators can achieve personal benefits through making

a contribution to the entire group's benefits; therefore, they exhibit a far-sightedly rational behavior in self-governing their irrigation commons.

Users' self-governing institutions or rules-in-use are perhaps the most important and influential exogenous variables that affect the action arena where participants undertake various activities. The rules-in-use are classified into seven categories as follows: (1) position rules, (2) boundary rules, (3) choice/authority rules, (4) aggregation rules, (5) scope rules, (6) information rules, and (7) payoff rules (**Figures 4**). As illustrated in **Figure 5**, the seven rules affect the seven elements of the action situation in a variety of ways. We have used Ostrom's language and insights in describing the theoretical aspects of the seven rules (Ostrom, 2001; 2005; 2010).

3.2.1 Position Rules

Position rules specify the set of positions assigned to participants. When the participants are assigned positions, they directly affect the "positions" element of the action situation, which is linked to the potential outcomes. In a LID, the rules determine what position an irrigator may or may not hold. The positions include general member, representative, or auditor. When an irrigator is assigned the position of representative through selection or election, the irrigator undertakes certain actions such as ensuring that the right amount of irrigation water is flowing in the Nishi River. These actions affect the potential outcomes (e.g., the availability of irrigation water in a certain area and the productivity of the rice).

NLID has two bodies: the Council of Representatives and Administrative Bureau. The council, which is a decision-making governing body, is made up of 103 general members (elected or selected out of approximately 14,382 member irrigators), five auditors, 13 directors for the 13 branches, and five members for a steering committee (NLID, 2008). The bureau, which is an executive body, includes 178 employees to provide official assistance to the council. The bureau is comprised of a General Affairs Section with 16 staff, a Financial Affairs Section with seven staff, a Maintenance Section with nine staff, a Planning Section with nine staff, a Construction Section with 16 staff, a Water Management Section with 56 staff and a Branch Office Section with 53 staff (NLID, 2008).

Participants operate at three levels in NLID. Representatives with technical assistance from the bureau operate at the first level to withdraw irrigation water from the Nishi River to supply it into the branch canals. At the second level, special irrigator groups provide feedback on the estimated amount of water to be required in an area. At the lowest level (i.e., village), several community-based "terminal water user" groups determine the amount of water required for a particular farmland. This three-tier system has existed from the Tokugawa Period in Japan (Nagata, 1985). This irrigation institution has survived a long time in NLID, despite heavy modernization of irrigation systems.[1]

A person cannot participate in a LID just because he or she is interested in it. A LID applies boundary rules to constrain the participation of an individual and allows only the eligible individuals to participate in the action situation.

[1] In 1949, the LIL legally recognized the LID; however, it did not abolish the traditional practices which are an important part of social capital. Japan's higher authorities communicate extensively with irrigators via LID to ensure the physical capital's acceptability in their commons system. The coordination of the two capitals is a vital part of the process in strengthening local users' capacity to modify and adapt the social capital for the development of new physical capital.

3.2.2 Boundary rules

Boundary rules specify the set of criteria (e.g., qualifications or eligibility of a member or a director) that participants are required to fulfill to hold or not to hold their positions. The rules directly affect the "participants" element of action situation, which is linked to the potential outcome. Not everyone who lives in a LID area is qualified to be a member (i.e., participant) of the LID. To qualify, participants must be engaged in farming activities in the designated area, must comply with the principles of the prospective LID, and must agree to contribute to the costs of running the project (JNCICID, 1994). In a prewar irrigation management system, only the landlords or land owners became members of an irrigation association. Actual farmers who did not own farmland could not become members. A LID assesses the criteria of a member.

In NLID, council members are the actual farmers; they must maintain certain qualifications. For example, they should be the members of the LID, at least 25 years of age, and not be adjudged bankrupt or criminals). Qualifications are a vital concern; only qualified irrigators can join the NLID. A participant is assigned positions and actions to coordinate through collective effort; non-actual farmers are unable to have these positions and actions, let alone coordinate them, in the action situation.

A LID assigns an eligible participant both positions and actions. However, a participant may possess a position to undertake certain actions relevant to their position; nonetheless, their abilities and choices can be limited. One participant might be accountable to other participants in an interdependent situation. A LID exercises choice/authority rules to restrict a participant's abilities and choices in undertaking a certain action.

3.2.3 Choice/Authority Rules

Choice/authority rules specify the set of allowable actions assigned to a position in a certain situation (e.g., what the chairperson, or the council, a representative must or must not do, or can or cannot do). The rules directly affect the "actions" element of action situation and map the actions into potential outcomes.

The council is the primary decision-making body of a LID and deals with all important matters that concern the organization and management (e.g., amendment of the association's articles and bylaws), as well as the budget and method for determining and collecting water fees. However, in deciding these important issues, the council's authority or choice is restricted; it requires approval from at least two-thirds of the representatives who attend the general assembly. At least two thirds of all representatives must attend the general assembly.

Thirteen directors are responsible for overseeing 13 branches in NLID, while the bureau is responsible for executing routine business affairs. The 13 directors fulfill the resolutions made by the council, while the bureau (which has no decision-making powers) performs routine business works. The auditors inspect the business and activities of the NLID; however, they are required to report the assessment to the council.

A terminal water user group, which usually has a command area of 10 hectares, manages irrigation and drainage facilities at the terminal level and withdraws water from the canals into minor channels that run alongside the farms based on day-to-day rules (Sarker & Itoh, 2001). Although a member (participant) of the terminal water user group may be entitled to the water, the member may not withdraw an excessive amount of water when the water becomes scarce.

A participant's choices may need to be restricted. A LID or a group of participants under the jurisdiction of the LID deploy aggregation rules, where applicable, to have control over a

participant's choices, authorities, and influences. The higher government authorities (i.e., participants at the higher levels) also deploy aggregation rules when they establish a LID.

3.2.4 Aggregation Rules

Aggregation rules determine whether multiple participants are required to have control over a decision-making process. The rules, which require multiple participants, directly influence the "control" element of the action situation and then determine the potential outcome. A single participant is not strong enough to have control over the final outcome.

In Japan, irrigation water does not belong to irrigators, but to an entire village; irrigators make aggregation rules to have control over the allocation of water among the irrigators. This history of formulating aggregation rules to make important decisions affecting the public or multiple participants dates back to the Tokugawa period, when decentralized management emerged. This is one of the most important irrigation institutions that endured shifts and challenges from changes in acts, ordinances, and land reform policies.

The significance of aggregation rules becomes extremely high in the process of establishing a new LID that affects the public in a certain area, or carrying out a LID's important activities that affect the multiple participants of the LID. To establish a LID—regardless of its size—the qualified irrigators select or elect at least 15 qualified irrigators in the area. The 15 (or more) qualified irrigators then circulate public notices in the city, town, or village for more than five days to gather public opinions from more than two thirds of the irrigators. If positive feedback is received, qualified irrigators apply for the approval of the prefectural governor.

After a LID is established, it convenes an organized general meeting to approve a change in important rules. In NLID, the council elects the 13 directors and five auditors form the representatives. The directors organize a board of directors to participate in decisions regarding matters such as water allocation and budget; the employees of bureau execute the policies and directions of the council.

Even at the very local level where the terminal water users groups allocate water and clean irrigation channels by removing mud, the members of the groups make an aggregated effort to develop and modify rules consistent with the development of the engineering works.

Participants with positions undertake certain actions as the aggregation rules allows; however, a LID uses "scope rules" to delimit their actions, if the final outcome is potentially undesirable.

3.3.5 Scope Rules

Scope rules specify the outcome of an action that a participant undertakes. The rules directly affect the "potential outcomes" element of the action situation. A LID allows a terminal water users group to withdraw as much water from the water channel as the group requires. However, when there is a scarcity of water, the LID uses the scope rules to forbid a group to withdraw water beyond a certain amount to prevent a harmful effect on the outcome. In the NILD, many irrigators work in the urban area and return home late. Sometimes, they forget or are unable to close the small devices or kits that control the flow of water to their paddy fields, affecting the availability of water for other irrigators or the efficiency of the NLID's performance. The aggregation rules may allow them to withdraw unlimited water; however, the NLID uses the scope rules to limit the withdrawal to achieve an optimal outcome. When the lower-stream irrigators withdraw water, the upper-stream irrigators are not allowed to withdraw.

A member pays a water fee to buy water; moreover, the member may decide not to use the water. However, a LID uses scope rules to forbid members from selling irrigation water they once buy. LID council uses scope rules to restrict the overproduction of rice and encourage farmers to produce other crops. A LID also uses scope rules to encourage famers to adopt rotational cropping systems.

A LID employs "information rules" to demonstrate the performance of irrigators, members, and representatives. This information is important for better performance and outcomes.

3.3.6 Information Rules

Information rules specify the availability of information for a position when a decision is being made. The rules directly affect the information "element" of the action situation, which is linked to the potential outcomes. In NLID, there are annual and casual meetings to exchange opinions and information throughout the year. In an annual meeting, NLID informs members about the current situation of management, operations, and business. NLID also publishes an annual report on business and financial activities, including the amount of revenue and expenditure. The report contains information on the structure and responsibilities of the Council of Representatives and the Administrative Bureau, as well as the entire engineering, business and financial activities (including the amount of revenue and expenditure), and trends in rice productivity. This information is crucial to irrigators and their representatives to access the current performance and undertake further activities for potential outcome.

3.3.7 Payoff Rules

Payoff rules specify rewards or penalties to be assigned to a particular action (e.g., salaries provided to an irrigation officer for responsibilities undertaken). The rules directly affect the "net costs and benefits" element of the action situation, which then contributes to the potential outcomes. NLID collects water fees from the irrigators in proportion to the size of their land. The water fee is the sum of the following components: (1) management and operation costs (usually 100 %); (2) local project implementation costs (usually 100 %); and (3) the share of the large-scale project implementation costs (depending on the size and nature of the projects).

Regarding national government projects, the cost ratios between national government, local government, municipality, and LID are: 67:17:8:8. In local government projects, the ratios are: 50:25:12.5:12.5 (Okamoto, 2006). LIDs bear 100 % of the costs for the LID's local projects. According to a 1992 estimate, 58 % of reservoirs, 94 % of ponds or tanks, 83 % of head works, and 77 % of irrigation and drainage pumping stations were entrusted to LIDs (see JNCICID, 1994). LIDs bear 100 % of the operation and maintenance costs of those facilities that are directly related to agricultural water management.

A large-scale LID is a complex water management system in which officials and employees are hired with salaries and remunerations for technical assistance and services. NLID has constructed a modern monitoring system to remote monitor the availability of irrigation water at major locations. NLID provides salaries and remunerations to the technical experts.

LID staffs receive salaries for the following tasks: (1) general administration and accounting work; (2) construction and O&M work; and (3) land consolidation projects.

In NLID, the productivity of rice has increased from 3,090 kg/ha in 1951 (the year of the LID establishment) to 5,140 kg/ha in 2004. As of 2008, the revenue of the Nishikanbara area was

3.8 billion yen (with 12.8 % balance brought forward); expenditures were 3.8 billion yen (with 24.3 % operation and maintenance costs, and 3 % balance carried forward) (NLID 2008).

In summary, position rules specify the capabilities and responsibilities of irrigators in positions (e.g., general member, representative, and auditor) in a LID. Boundary rules specify the qualifications of an irrigator. Choice/authority rules specify the set of allowable actions for an irrigator in a position. These three rules are closely interconnected; changes in these rules affect the potential outcomes (e.g., water allocation and rice yield). Both aggregation rules, which specify the number of irrigators in positions (e.g., representatives and auditors) required to make a major change in important affairs of the LID and information rules, which specify the information available to an irrigator in a position during a particular decision-making process, affect the control over an action–outcome linkage and potential outcomes. Pay-off rules, which specify rewards and penalties (e.g., salaries and remunerations), affect the benefits and costs associated with the action–outcome linkage. Scope rules, which limit the activities of an irrigator, determine the level of allowable and non-allowable outcome (e.g., the level of water to be withdrawn and prohibition on selling of water). "Information, scope, and aggregation rules tend to be used in ways that complement changes in boundary, authority, payoff, and position rules" (Ostrom, 2001, p. 783).

The seven rules significantly affect the elements of action situation, including the final outcome. Presence of multiple exogenous variables clearly challenges human ability to fully cope with the changes and find an appropriate rule configuration for a desirable outcome. However, it is obvious that institutional diversity can contribute substantially to the sustainable performance of large-scale commons. Consequently, understanding, developing, persevering and maintaining the institutional diversity is important to save large-scale commons from the tragedy of the commons.

4. Development as institutional diversity

Scholars usually distinguish three major alternate policies—government ownership, privatization, and users' self-governance—to address the overuse issue or "the tragedy of commons" in the governance of commons as a SES. Each of these alternate policies presents both benefits and challenges. Government ownership or privatization has failed to address the overuse problems of shared resources in the majority of cases; it undermines institutional diversity and disintegrates users' local institutional arrangements. Although users' self-governance has emerged as a highly successful and powerful policy alternative, it involves challenges and complexities of institutional diversity to the development process.

This study on Japan's irrigation management demonstrates that a single, non-flexible policy alternative involving overly simplified institutional prescriptions is not useful for sustainable management of a complex, large-scale irrigation commons. Rather, institutional diversity that concerns a combination of different alternate policies and evolves adaptively can help a complex, large-scale commons system sustain.

The irrigation management in Japan shows that resource users have the capacity to self-organize and develop self-governing institutional arrangements to manage their commons sustainably. Governments are often viewed as Leviathan forces, and are thought to be destructive to self-governance. However, governments do not always act or have to act as Leviathan forces when managing the shared resources. Governments play strategic roles in strengthening the users' capacity to self-govern, rather than governing the commons itself and disintegrating the users' customs, norms and traditional institutions in Japan. This is consistent with Sen's (1999)

theoretical perspective that providing users with the freedom to develop their capabilities to utilize resources can help them better achieve societal goals.

Japan's management of large-scale irrigation commons identifies a new policy alternative titled "state-reinforced self-governance system," which assumes the dynamics of a polycentric system. In this policy alternative, government plays the role of a non-coercive, non-participatory, independent yet interconnected, external authority; government provides information, modern technology and necessary financial assistance either to prop up the existing self-governance structure or to assist natural resource users to create an improved form of self-governance (Sarker & Itoh, 2001; Sarker & Itoh, 2003; Sarker, 2008).

Mono-centric, simplistic approaches like privatization or government ownership of Japanese irrigation commons could simplify the irrigation institutional arrangements; however, this could disintegrate institutional diversity and David's (1985) "path dependence" of institutional change, leading the commons to encounter the tragedy of the commons. A state-reinforced self-governance system within a polycentric governance system allows institutional diversity to fit the variety and complexities of developmental changes occurring in a complex, large-scale irrigation commons. It also addresses how to deal with the challenges associated with the institutional diversity emphasis.

5. Conclusion

This study has demonstrated that a single, rigid, overly simplified policy is not effective in sustainably resolving the problems of complex, large-scale irrigation commons. In Japan, users' self-governance has evolved to be a dominant governance alternate policy over the past several hundred years. However, in the course of policy development, it has become institutionally diversified by incorporating elements of other alternate policies in a multi-tiered, polycentric governance regime to sustain and better cope with the changing context of the SES. The study also shows that in the agenda of three alternate policies, no policy is "panacea." However, a self-governance system stands out as a substantially promising policy alternative that has helped preserve and strengthen the institutional diversity of commons.

A strong government is not necessarily a coercive force; it can provide strategic financial, political, legal, and technological supports to reinforce users' capacity to self-govern their commons sustainably. State-reinforced self-governance, which is a special type of self-governance policy option, engages the higher authorities to use a top–down approach so that users can deploy a stronger bottom–up approach to connect with higher authorities and adopt flexible, complex, and diversified self-governing institutional arrangements. A self-governing policy in general and reinforced self-governance option in particular lead us to deal with institutional diversities and associated complexities; however, the challenges of diversities and complexities spur us on to achieve deeper and long-lasting sustainability of interconnected SES.

Finally, this study contributes to the view that there exists no panacea or simple, single approach to resolve all complex problems associated with commons in a SES; understanding and adapting diversified institutional arrangements to specific contextual realities is substantially important (Ostrom, 2011; Ostrom, 2007; Evans 2004). It also affirms that a combined approach is highly promising to unify the benefits of different policy alternatives in resolving specific issues in a particular context (Sarker et al., 2008; Brock & Carpenter, 2007).

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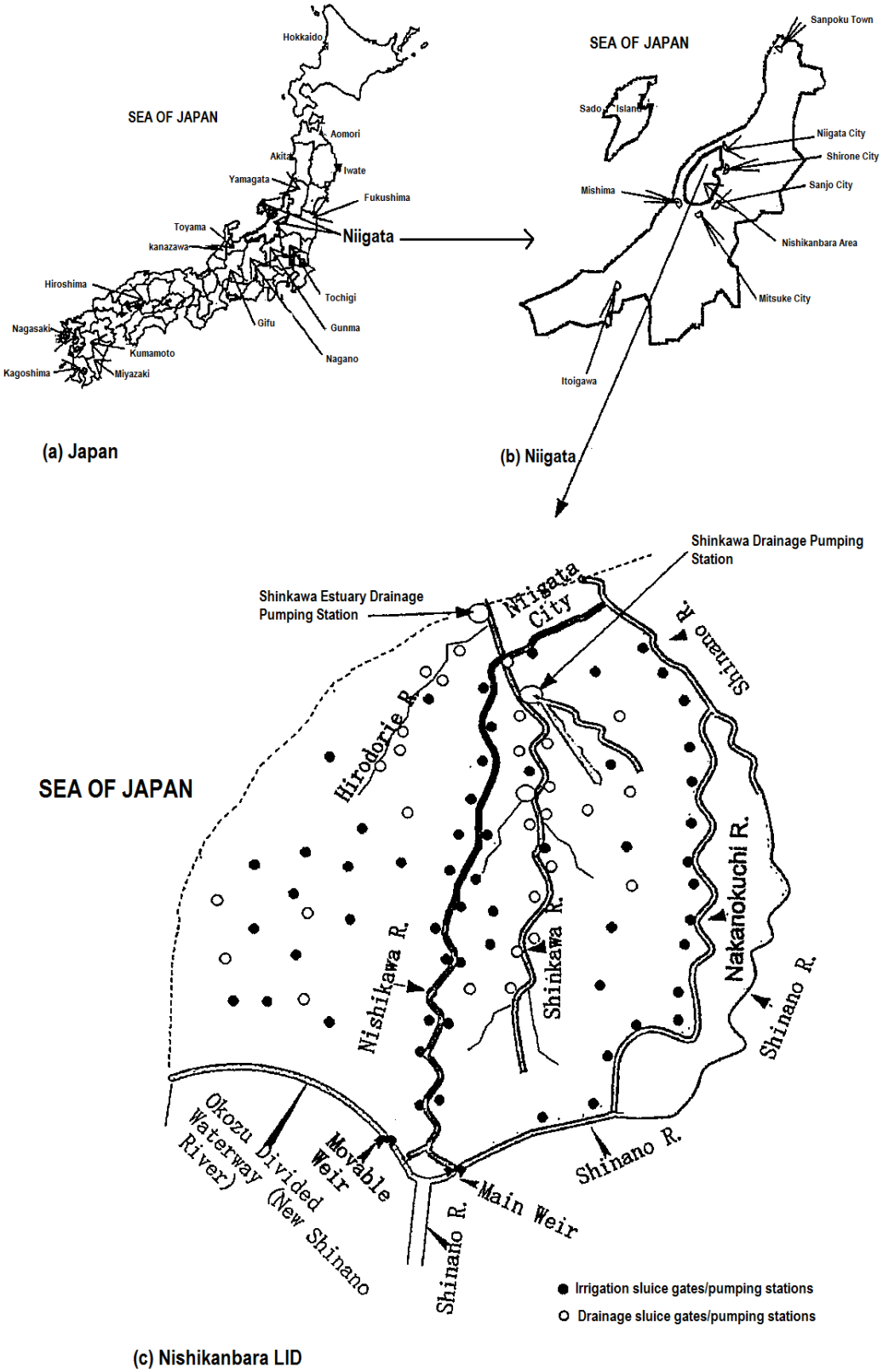

Fig. 1. Location of Nishikanbara Land Improvement District (LID)

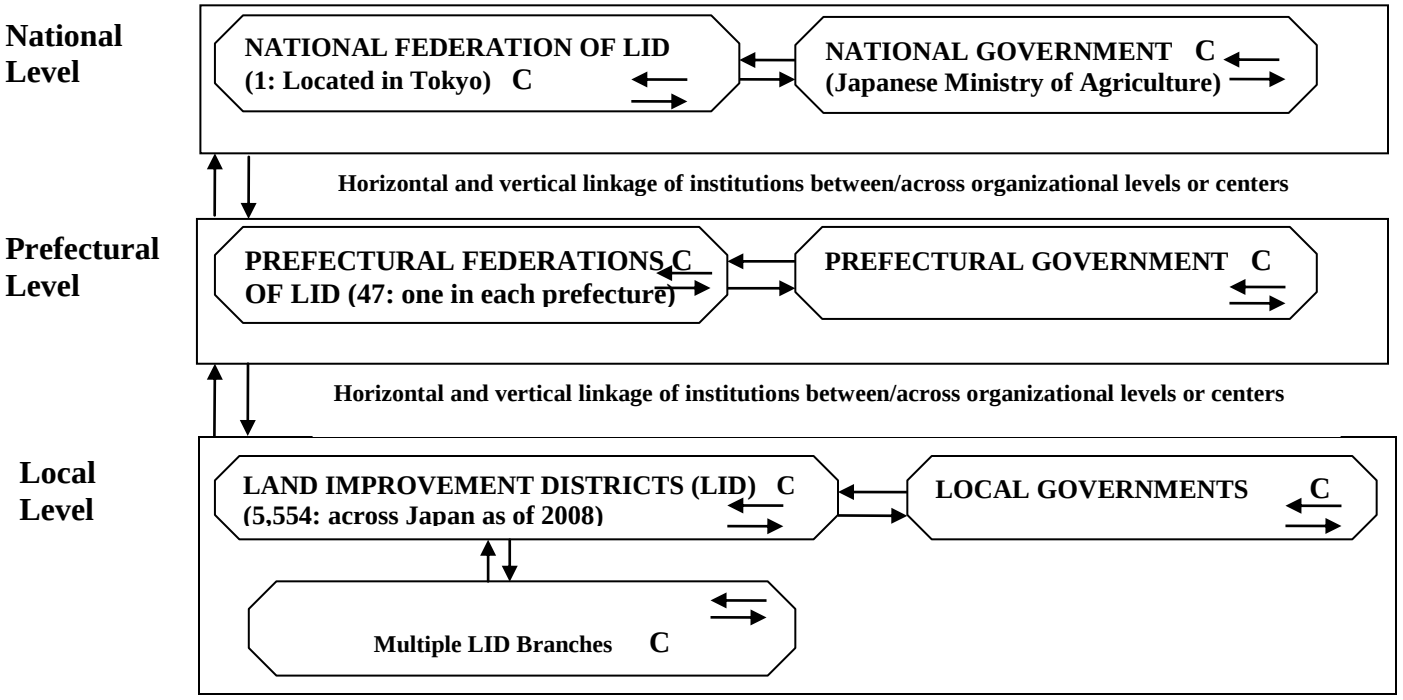

Fig. 2. Institutional linkages at multiple levels of authorities
Notes: "C" indicates center of polycentric governance; an arrow mark indicates the direction of institutional linkage. The idea of horizontal and vertical linkage is due to Berkes (2007).

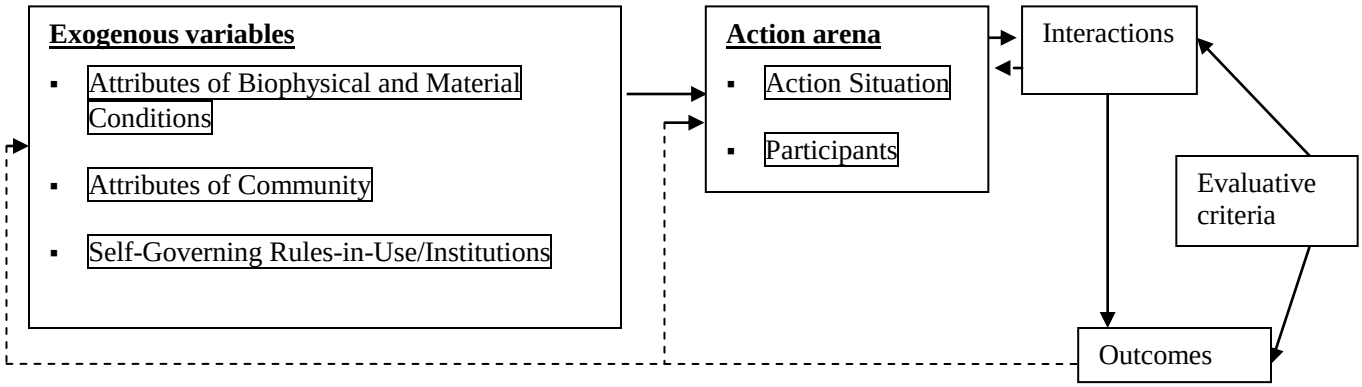

Fig. 3. Institutional analysis and development framework. Source: Adapted from E. Ostrom, Gardner, and Walker (1994, 37).

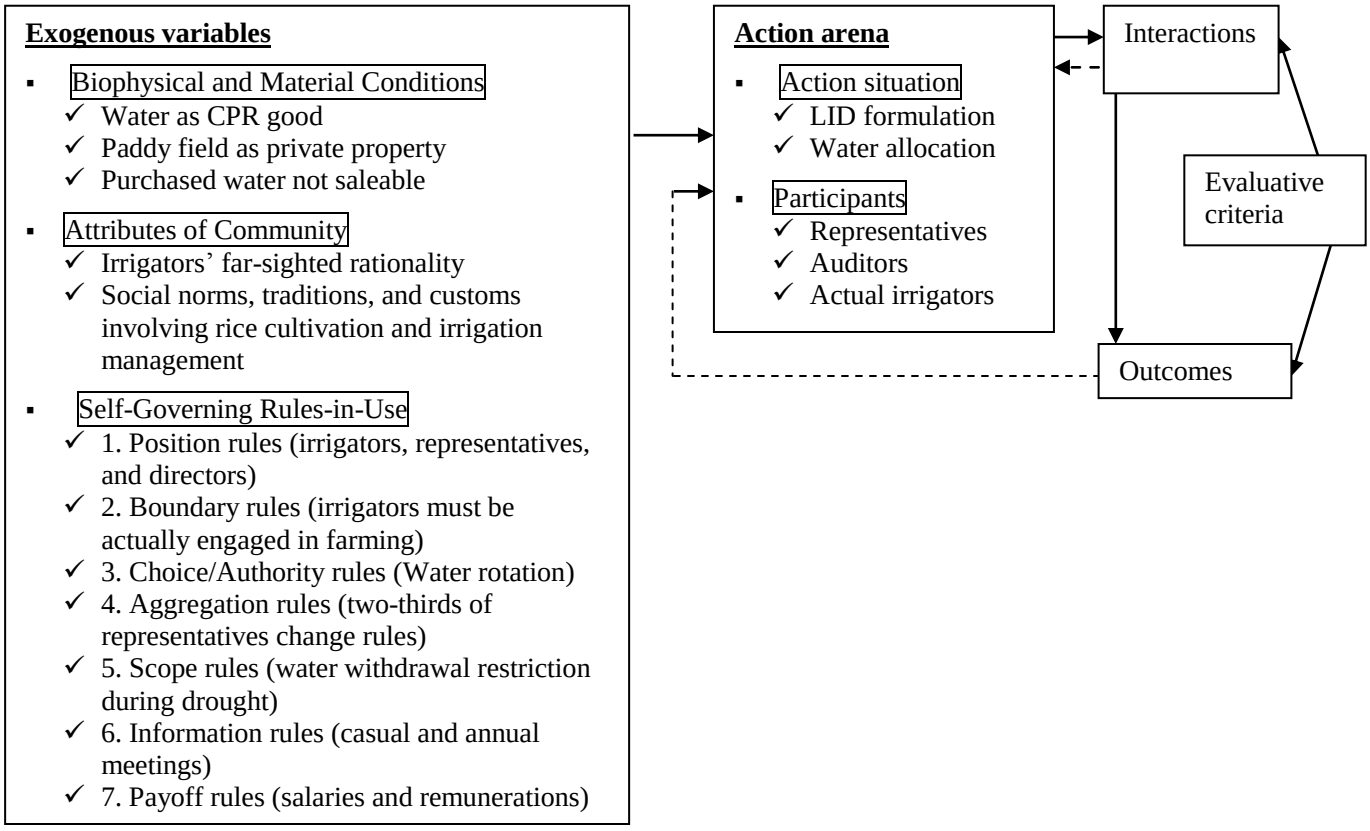

Fig. 4. Institutional analysis and development framework. Source: Adapted from E. Ostrom, Gardner, and Walker (1994, 37).

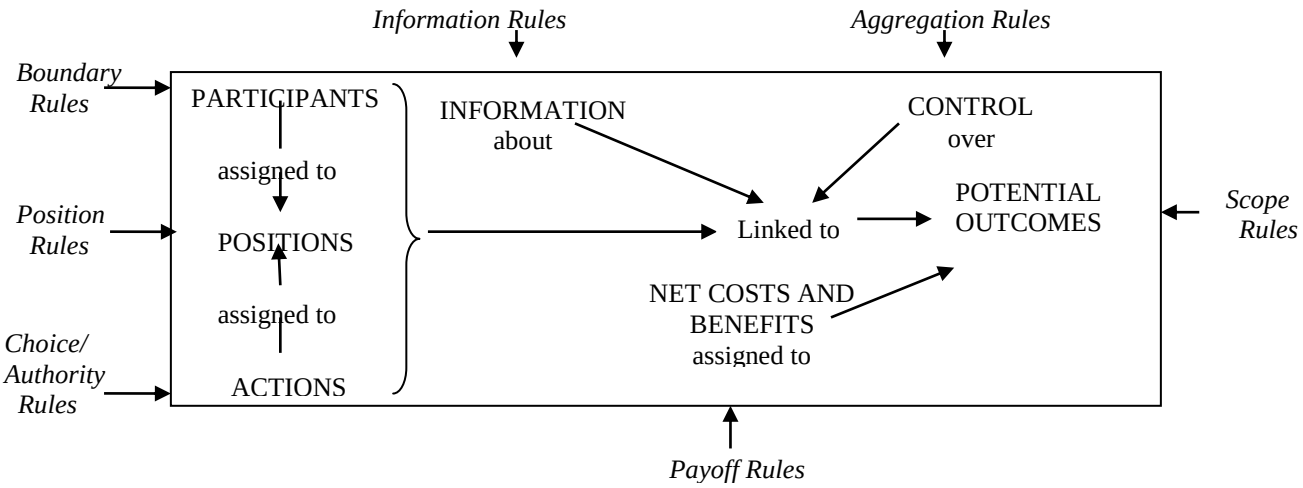

Fig. 5. Rules as independent variables affecting elements of action situation. Source: Adapted from Ostrom (2005, 189)