The Evolution of Self-governance in Korean Irrigation System: with reference to the Farmers' Self-governing Model District Program[1]

by

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ABSTRACT

In 2001, KARICO launched the 1st Farmers' Self-governing Model District Program (FSMDP). It is a kind of participatory irrigation management (PIM) through the new institutional arrangements. The paper evaluates the performance of the FSMDP based on the IAD framework. To do this, three research questions can be broadly raised: 1) what kinds of factors are needed for the sustainable self-governing irrigation systems? 2) how is the 1st Korean FSMDP designed for sustainable self-governing irrigation systems? 3) What is the performance or outcome of 62 Korean irrigation systems under the FSMDP? To answer these queries, research method and data collection were conducted by KORIS DB, farmers' perception survey, and KARICO data. First of all, the 1st FSMDP has been designed with profound sustainable self-governing factors. In terms of physical, community, and institutional attributes, 18 variables are identified for the sustainable governing irrigation systems. Second, reflecting on the propositions and three attributes in the IAD framework, most of 62 irrigation systems satisfy positively the propositions (4 propositions in physical attributes, 6 propositions in community attributes, 8 propositions in institutional arrangements). In other words, three attributes (physical, community, institutional) for sustainable self-governing systems affect very positively the performance or outcomes of 62 irrigation systems under the 1st FSMDP. Also, design principles for sustainable resource are identified in the FSMDP, which produce the positive performance and outcomes of irrigation systems under the FSMDP. Finally, most of irrigation systems under the 1st FSMDP are being operated with de jure and de facto rules under greater sustainable self-governance. These results come from the indigenous and traditional cooperation of KARIO officials and farmers before the KARICO reform. Also, such outcomes are due to the traditional experience of organizing farmers' self-organization. The limitation of this study does not provide the in-depth discussion of specific biophysical (i.e., regions of Korea, the impact of being hilly or not hilly) and community attributes of district irrigation systems beyond the table, which will be conducted in the future research.

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INTRODUCTION

History and Background of KARICO

Very recently, the South Korean government has taken a more active role in governing the irrigation organization & management to improve agricultural productivity. Most of Korean irrigation systems are being operated mainly by both the Korea Agricultural and Rural Infrastructure Corporation (KARICO: public enterprise) under the Ministry of Agriculture and Forestry (MAF) and local governments. On January 1st 2000, a significant structural adjustment of Korean irrigation policy was conducted. As a representative of organizational reform, the KARICO as a unified central irrigation agency was established by consolidating the existing three agencies of irrigation O & M (Farmland Improvement Association, Federation of Farmland Improvement Association, and Rural Development Agency). Before the KARICO, large scale irrigation systems had been managed by the Farmland Improvement Association (FIA) and Rural Development Agency through the formation of water users' group called Heung-nong-gye (HNG), while small farmers' self-governing systems (5-50 ha) had been operated by Water Users' Association (WUA) formed by the farmers outside the FIA boundary under the supervision of the local government (KARICO, 2000; Joo, 1998).[2]

A total of 62,936 irrigation facilities in Korea are being managed by both KARICO and local governments. Table 1-1 shows diverse types of headworks in Korea. Of them, reservoirs are the main production resources for irrigated area. The irrigation facilities managed by the KARICO are 11,707(19%), while those by local governments are 51,229(81%). Also the KARICO manages 3,126(18%) reservoirs, while local governments 14,739(82%). Concerning on irrigated area, of a total of 880,679ha irrigated paddy field, 18,000 reservoirs provide 517,079 ha (58.7%) benefited area. Of 18,000 reservoirs, the KARICO manages 372,409ha (72%), while local governments 144,670ha (28%).

Table 1-1. Number of Irrigation Facilities and Their Irrigated Benefit Area by Management Agency in South Korea (2000)

(Unit: Number, ha, %)

Type of Headworks	Total	KARICO	Local Government
Total	62,936 880,679ha	11,707 (19%)	51, 229(81%)
Reservoir	18,000 517,079ha (58.7%)	3,261 (18%) 372,409ha (72%)	14,739(82%) 144,670ha (28%)
Pumping and Drainage Stations	6,209	3,246	2,961
Weirs	18,277	3,730	14,567
Infiltration galleries	3,826	523	3,303
Tube wells	16,624	945	16,679

Note: KARICO (2000).

[2] The FIAs were established in 1900s as the farmers' own water management organizations and they had been carrying out important roles in water management. FIAs were given responsibility to look after a number of irrigation systems. By December 31, 1999, FIAs were managing 54.5 %(494 thousand ha) of total benefited areas (907 thousand ha). FIAs managed irrigation systems more efficiently compared with district offices (local governments) (Joo, 1998).

KARICO has several objectives for contributing to both economic and social development of rural areas due to the increased revenues of farmers and productivity enhancement through rural area development projects, comprehensive management of agricultural infrastructure facilities, construction of an eco-friendly production system, and promotion of agricultural scale optimization. In order to achieve these objectives, KARICO succeeded the systems and farmers of former three irrigation agencies. In particular, water fees (water taxes) established in 1906 as FIA membership fees were abolished, which amounted to about $30 millions per year. Instead, KARICO intends to recover the operation costs of irrigation systems through the water management automation (TM/TC) project, Data Base construction, lining canals, management innovations, and introducing the advanced water management technique.

As a new experimental design of irrigation policy, in 2001, KARICO launched the 1st Farmers' Self-governing Model District Program. It is a kind of participatory irrigation management (PIM) through the new institutional arrangements. PIM has been adopted as a distinct policy alternative by the government to improve the performance of the irrigation system around the world (Shukla, 2002). The paper evaluates the performance of Farmers' Self-governing Model District Program (hereafter, FSMDP) based on the Institutional Analysis and Development framework (hereafter IAD framework. The organization of the paper is divided into four sections. Following the introduction, first of all, major attributes in the IAD framework are discussed for identifying the factors of sustainable self-governing irrigation systems and evaluating the performance of the FSMDP. The third section evaluates the performance of 62 Korean irrigation systems under the FSMDP. It will explain how the FSMDP is designed for sustainable self-governing irrigation systems and diagnose the outcomes of 62 irrigation systems in the FSMDP. Finally, the policy implications (strengths and weaknesses) of the 1st FSMDP are discussed based on good lessons of other countries in the context of sustainable self-governing system (Participatory Irrigation Management).

Farmers' Self-governing Model District Program: Overview

Purpose

In 2001, the 1st FSMDP was initiated by the KARICO to increase the efficiency of water management through the rational role division of irrigators and the water manager (agency: KARICO). It is a kind of participatory irrigation management (PIM). For the special irrigation districts which can be easily managed by farmers themselves based on the geographically conditions, the FSMDP intends to minimize the indirect cost (personnel and materials) of O&M and utilize effectively the direct cost (water supply cost), which would improve the service quality for farmers. In the meanwhile, special technical labor forces have conducted even simple works and managed directly the small size irrigation facilities located far away from the production resources (headworks) without being self-governed by the local farmers. Such traditional governing mechanism has decreased the efficiency of water management and facilities maintenance. Ultimately, the FSMDP is designed to establish the foundations of agricultural productivity development and is being operated by the new institutional change based on the formal rules such as the Article 17 of KARICO Establishment Law and Farmland Management Fund Act (Self-governance of the irrigated water users).

The 1st FSMDP's experimental design timetable

- February 20, 2001: Preparing the plan (draft) for operating the program

- March – April 2001: Selecting the 62 Model Districts and concluding the contract document with head farmer in the district
- April - September 2001: Implementing the program
- April 24, 2001: Distributing the operational record book of the program to the responsible heads of 62 Model Districts
- July, 2001: Checking or monitoring the implementation process of the program by the KARICO
- November 2001: Evaluating the 62 Model irrigation districts and survey of potential irrigation districts for the 2nd (2002) FSMDP implementation
- December 2001: Award to the contributors of the Program

A THEORECTICAL FRAMEWORK FOR THE EVAUATION OF THE 1st FSMDP

Collective Action Issues in Irrigation systems

Irrigation resource is a major asset for improving the agricultural productivity around the world. Many common pool resources (CPRs) including irrigation systems have similar collective action issues in appropriation and management due to the following two types of characteristics: non-excludability and subtractability. The former is that the resource is so immense that it is costly to exclude potential users from appropriating it. The latter is that the supply is restricted so that consumption by one user reduces its appropriation to others (E. Ostrom, 1990; Tang, 1992). These two characteristics permit CPRs users to face two sets of incentives problems: free-rider problem and overuse problem (Ostrom et al., 2002; Ostrom et al., 1994; Hardin, 1968; Olson, 1965, Demsetz, 1967; Anderson, 1983).

Irrigation systems are typically facing these collective action issues. Once an irrigation system is constructed, it is impossible and costly to exclude potential irrigation water users from appropriating it. The rehabilitation and improvement of irrigation facilities would benefit all irrigation water users of the system regardless the degree of resources contribution to the improved facilities, which could lead to the temptation of free-rider in mobilizing the resources. Also once one farmer withdraws the amount of needed irrigation water from the canals, other farmers are not allowed to withdraw the amount of water used by one farmer due to the characteristics of subtractability. In short, these collective action issues in the action situation of irrigation systems can be summarized as 1) irrigation facilities provision (management) problems and 2) irrigation water appropriation problems. The former means free–rider incentive problems, while the latter means overuse incentive problems in the irrigation action situation. Therefore, as Tang (1992) mentioned, the bottom line is how institutions can be utilized to solve collective action problems (appropriation and management problems) in irrigation.

As emphasized in many irrigation researchers (Shivakoti and Ostrom, 2002; Lam, 1998; Ostrom, 1992; Tang, 1991, 1992; Hilton, 2002), no one best way exists to solve the collective action problems in irrigation systems. Different countries have different managed irrigation systems based on their culture and other factors to tackle the collective action problems for improving the performance of irrigation systems. Multiple types of institutional arrangements have been devised to reduce the problems of overuse and of free-riding (Ostrom et al. 2002: 25). They include government (agency)- managed irrigation system (AMIS), farmer-managed irrigation system (FMIS), and joint-managed irrigation system (JMIS). The Korean FSMDP is a kind of JMIS or participatory irrigation management (PIM) (Vermillion and Sagardoy, 1999). That is, under the AMIS, farmers participate to cope with the collective action problems.

Drawing on prior theoretical and empirical CPR works including irrigation, one common research question is how various institutional arrangements affect the performance of CPRs by reducing aforementioned two collective action issues. Many scholars of CPRs have identified the most significant factors as being critical to the sustainable functioning of CPR institutions. As shown in the Table 2-1, Agrawal (2002) summarizes four types of categories as critical enabling conditions for sustainability on the CPRs: 1) resource system characteristics, 2) group characteristics, 3) institutional arrangements, 4) external environment. In general, these characteristics can be merged into the IAD framework developed by the Workshop in Political Theory and Policy Analysis, Indiana University, USA (Kiser and Ostrom, 1982; Tang, 1992; E. Ostrom, Gardner, and Walker, 1994; E. Ostrom, Gibson, Shivakumar, and Anderson, 2002). Three variables in the Agrawal's summary can be linked to the three variables in the IAD framework: physical attributes-> resource system characteristics, community attributes-> group characteristics, institutional arrangements (same). External environment can be explained in the interactions of these three variables. In particular, E. Ostrom (1992) and E. Ostrom & Benjamin (1993) investigate 8 design principles for the sustainable self-governance of the CPR. These are listed in the Agrawal's summary. They are clearly defined boundaries, proportional equivalence between benefits and costs, monitoring, graduated sanctions, minimal recognition of the right to organize, conflict-resolution mechanisms, and nested enterprises.

<Table 2-1> Critical Enabling Conditions for Sustainability on the Commons

(1)Resource system characteristics (i)small size (RW) (ii)well-defined boundaries (RW, EO) (iii)low levels of mobility (iv)possibilities of storage of benefits from the resource (v)predictability (2)Group characteristics (i)small size(RW, B&P) (ii)clearly defined boundaries (RW, EO) (iii) shared norms (B&P) (iv) past successful experience-social capital (RW, B&P) (v)appropriate leadership-young, familiar with changing external environments, connected to local traditional elite(B&P) (vi) interdependence among group members (RW, B&P) (vii) heterogeneity of endowments, homogeneity of identities and interests(B&P) (viii) low levels of poverty (1 and 2) Relationship between resource system characteristics and group characteristics (i)overlap between user group residential location and resource location (RW, B&P) (ii)high levels of dependence by group members on resource system (RW)	(iii)fairness in allocation of benefits from common resources (B&P) (iv) low levels of user demand (v) gradual change in levels of demand (3) Institutional arrangements (i) rules are simple and easy to understand(B&P) (ii) locally devised access and management rules (RW, EO, B&P) (iii) ease in enforcement of rules (RW, EO, B&P) (iv) graduated sanctions(RW, EO) (v) availability of low-cost adjudication (EO) (vi) accountability of monitors and other officials to users (EO, B&P) (1 and 3) Relationship between resource system and institutional arrangement (i)match restrictions on harvests to regeneration of resources (RW, EO) (4) External environment (i) technology: a) low-cost exclusion technology(RW) b) time for adaptation to new technologies related to the commons (ii) low levels of articulation with external markets (iii) gradual change in articulation with external markets (iv) state:

	a) central governments should not undermine local authority (RW, EO) b) supportive external sanctioning institutions(B&p) c) appropriate levels of external aid to compensate local users for conservation activities (B&P) d) nested levels of appropriation, provision, enforcement, governance (EO) Sources: RW, Wade (1988); EO, Ostrom (1990); B&P, Baland and Platteau (1996).

Source: Agrawal (2002).

Institutional Analysis and Development Framework for the Evaluation of 1st FSMDP

The IAD framework can be specified as shown in Figure 2-1. Based on the IAD framework, five elements can be broadly categorized: context, action arena, incentives, pattern of interactions and outcomes (Kiser and Ostrom, 1982; Tang, 1992; E. Ostrom et al., 2002a; E. Ostrom et al., 2002b; Agrawal, 2002). The context consists of three types of attributes: 1) physical attributes, 2) community attributes, and 3) institutional arrangements or rules-in-use. These three attributes can be named as an action situation in the IAD framework. The action arena contains both action situations and actors. Action situations are structured interactions among farmers and KARICO officials under the FSMDP. Different action situations may create different incentive structures of actors' cooperation or conflict, which produce the outcomes of the irrigation systems through the patterns of interactions of participants.

Physical and Community attributes, Institutional Arrangements, and Outcomes for Sustainable Self-governing Irrigation Systems

It is expected that these physical, community, and institutional attributes are very important for evaluating the sustainable self-governing Korean irrigation systems under the FSMDP. Different institutional arrangements (operational and collective-choice rules) along with the physical and community attributes of an irrigation system may create different incentive structures that induce cooperation or conflict among farmers. Based on the aforementioned research works, the research propositions in the IAD framework can be drawn from those three attributes as follows.

<Physical attributes>
P1: Small irrigated size and small number of farmers (spatial extent)
P2: Clearly defined boundaries
P3: Predictability of water supply and alternative water sources
P4: Physical infrastructure and terrain conditions (feasible improvement)

In terms of physical attributes in the sustainable self-governing systems, four propositions can be drawn for the evaluation of the 1st FSMDP. First, *it may be easier to organize collective action for self-governance under the small irrigated area along with small farmers* **(Proposition P1)**. As an irrigated area and the number of irrigators are small, transaction costs (i.e., information gathering, communication and negotiation, contracting, decision-making, and monitoring costs) will decrease (Williamson, 1975, 1985; Coase, 1988). Second, *the sustainable self-governing* *irrigation systems have clearly defined boundaries to solve the collective action problems because farmers themselves can easily manage their own designated systems* **(Proposition P2)**. Third, the predictability of water supply and the existence of alternative water sources might encourage or discourage the farmers' collaborative irrigation interactions. *Farmers with sufficient and predictable water supply and alternative supplementary water sources might have more incentives to organize the self-governing collective action* **(Proposition P3)**. Fourth, the facilities or terrain conditions of irrigation systems can affect the possibility of self-governing. *If the conditions of irrigation system facilities are in good situation, farmers will have more incentives to cooperate for the sustainable self-governing irrigation systems* **(Proposition P4)**.

<Community attributes>

C1: Income dependency's on irrigation (Salience).
C2: Shared norms and common understanding
C3: Past organization experience and local leadership (social capital)
C4: Interdependent trust and reciprocity among group members
C5: Autonomy
C6: Low discount rate of irrigation future

In terms of community attributes in the sustainable self-governing systems, six propositions can be drawn for the evaluation of the 1st FSMDP. First, *incentives of farmers' cooperation will depend on how much they rely on the irrigation system* **(Proposition C1)**. Farmers can rely on the irrigation system as a source of income. Second, social and cultural gaps can inhibit collaborative teamwork for sustainable self-governance among irrigators. *Farmers with sustainable self-governing irrigation system will have shared norm and common understanding* (**Proposition C2)**. They have shared image of how the irrigation system works. Third, farmers have learned skills and local leaderships of organization and management through the experience of sustainable self-governance. So *farmers with the sustainable self-governing irrigation system may have past indigenous organizational experience and local leadership* (**Proposition C3)**. Fourth, *farmers with the possibility of sustainable self-governance may have interdependent trust and reciprocity each other* (**Proposition C4)**. They follow well the rules and make promises in the process of irrigation organization and management. Fifth, *autonomy should be awarded to farmers for the sustainable self-governing irrigation system* (**Proposition C5)** (E. Ostrom, 1998). In such systems, farmers can determine access and irrigation management rules without external agencies blocking them. Sixth, *farmers will choose a sufficient low discount rate concerning the future benefits produced in the sustainable self-governing irrigation systems* (**Proposition C6).**

<Institutional arrangements or rules>

I1: Simple and understandable rules
I2: Locally devised access and management rules
I3: Multiple layers of rules: operational and collective choice rules
I4: Ease in enforcement of rules
I5: Graduated sanctions
I6: Availability of low-cost adjudication
I7: Accountability of monitors and other officials to users
I8: Contract aid rule (external monetary stimulus)

Institutional arrangements are the most important attributes in the action arena. They are rules that "are potentially linguistic entities that refer to prescriptions commonly known and used by a set of participants to order repetitive, interdependent relationship" (E. Ostrom, 1986; North, 1990; Eggertson, 1990). In regard to institutional arrangements or rules, seven propositions can be drawn for the evaluation of the 1st FSMDP. First, *the sustainable self-governing irrigation* *system will tend to have simple and understandable rules* **(Proposition I1). Second,** *the sustainable self-governing irrigation system will tend to have locally devised access and management rules* **(Proposition I2)**. Third, in general, there are multiple layers of rules for governing the resource system. The most important rules are operation rules and collective choice arrangements (rules). Operation rules define who can participate in the irrigation situation; what the farmers may, must not, or must not do; and how the farmers will be rewarded or punished. They are classified into one of seven categories; boundary, scope, position, authority, aggregation, information, and pay off (E. Ostrom, 1986: 468).[3] Operational rules are neither self-generating nor self-enforcing. In most cases, institutional arrangements must be established to adjudicate conflicts, enforce decisions, and formulate and modify operational rules. These are collective choice rules, which structure the processes by which disputes among participants can be settled. *The existence of operation rules and collective choice arrangements to be followed by farmers and officials may facilitate the sustainable self-governing irrigation systems* **(Proposition I3)**. Fourth, *the sustainable self-governing irrigation systems may make rules- enforcement easy among farmers and management officials* **(Proposition I4)**. Fifth, *graduated sanctions may enable farmers to have incentives to cooperate against rule-breakers and to facilitate a sustainable self-governing irrigation system* **(Proposition I5)**. Sixth, *sustainable self-governing irrigation systems will have the possibility of low-cost adjudication of conflict or law-suit through the indigenous conflict resolution mechanisms and reciprocal trust* **(Proposition I6)**. Seventh, *sustainable self-governing irrigation systems will have an accountability of monitors and other officials to farmers* **(Proposition I7).** Eight, *agency may use various external stimuli to change behavior of management officials and farmers in the sustainable self-governing irrigation system* **(Proposition I8).**

<Outcomes or Performance of Sustainable Self-governing Irrigation System>

These three sets of attributes combine together to create different incentives and constraints for farmers and agency managers in irrigation systems. However, instead of determining direct outcomes of irrigation systems, the three factors in the action situation affect the participants' incentives or disincentives and then determine the action outcomes of participants. In general, outcomes or performance in all types of irrigation systems can include several dimensions. Tang (1992) shows four measures of performance or outcomes based on the empirical study of 47 coded irrigation systems: water supply, physical maintenance, degree of rule conformance, and distribution of benefits and costs. Also Lam (1998) specifies three dimensions of performance through the empirical study of 120 Nepalese irrigation systems: physical condition, water delivery, and agricultural productivity. In particular, eight design principles[4] investigated by E.

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[3] Boundary rules define what requirements must be fulfilled before individuals are eligible to use irrigation water. Also, they are rules which determine who can become appropriators or actors in a given irrigation collective action situation. Authority rules define what appropriators must, must not, or may do at a particular stage of the appropriation stage in light of the actions taken by others and the conditions of the physical resource. They prescribe the actions, which are available to particular position. Scope rules specify the conditions in the world, which must, must not, or may be affected as a result of actions taken. They prescribe the domain within which water users or self-governing farmers in the system have effect. Position rules mean what positions there are in the system, how those positions are filled, and how tenure in those positions is controlled. There are position rules for actual users of the irrigation system. Aggregation rules are applicable when authority rules are assigned to multiple positions for partial control over the same action. They assign a weight to each appropriator and specify a formula to be used in adding up the contribution of each person's contribution to a final decision about action. Information rules define the manner in which information is distributed among actors. Finally, payoff rules specify the external rewards or sanctions that must, must not, or may be assigned to specific actions or outcomes. They delineate the consequences or of behaviors or actions, given the physical and community attributes. They are rules that determine the distribution of benefits (The definitions of each rule are drawn from the IU workshop coding manuals).

[4] Eight design principles include clearly defined boundaries, proportional equivalence between benefits and

Ostrom and Benjamin (1993) and E. Ostrom (1992) can be related to the performance of self-governing irrigation systems. As measures of such performance, they include water adequacy, equity, and timeliness (reliability and predictability) along with longevity.

The outcomes or performance during the period of 1st FSMDP include the following variables.

O1: Water supply (reliable and predictable supply and adequacy)
O2: Physical condition and maintenance of water delivery facilities
O3: Distribution of benefits and costs (equity)
O4: Degree of rule conformance
O5: Efficiency
O6: Agricultural productivity
O7: Sustainability and accountability

Performance evaluation criteria are applied to both the processes and outcomes of the 1st FSMDP implementation. Economic efficiency is a criterion for evaluating the relationship between the benefits and costs produced by a set of actions through the FSMDP policy process. To be minimally efficient, the benefits must be greater than the costs. Equity (distribution of benefits and costs) means fiscal equivalence or the relationship between farmers' contributions and the benefits they derive. Perceptions of fiscal equivalence can affect the incentives or disincentives of farmers to cooperate toward the development and maintenance of sustainable self-governing irrigation systems.) The degree of rule conformance is as to what extent farmers follow the rules in the irrigation systems. If rules seem unfair, such rules are not likely to be observed and followed for long. Water supply (reliable and predictable supply and adequacy) means whether reliable and predictable water is sufficiently supplied to irrigated area or not. Physical condition and maintenance of water delivery facilities represents the condition of physical infrastructure and the degree of maintaining water delivery devices. Agricultural productivity is the turnout and intensity of cropping. Sustainability pertains to the longevity of self-governing irrigation systems through the aid of pecuniary contract budget. Accountability can be related to sustainability. Farmers should be accountable to agency officials concerning the continuity of the FSMDP.

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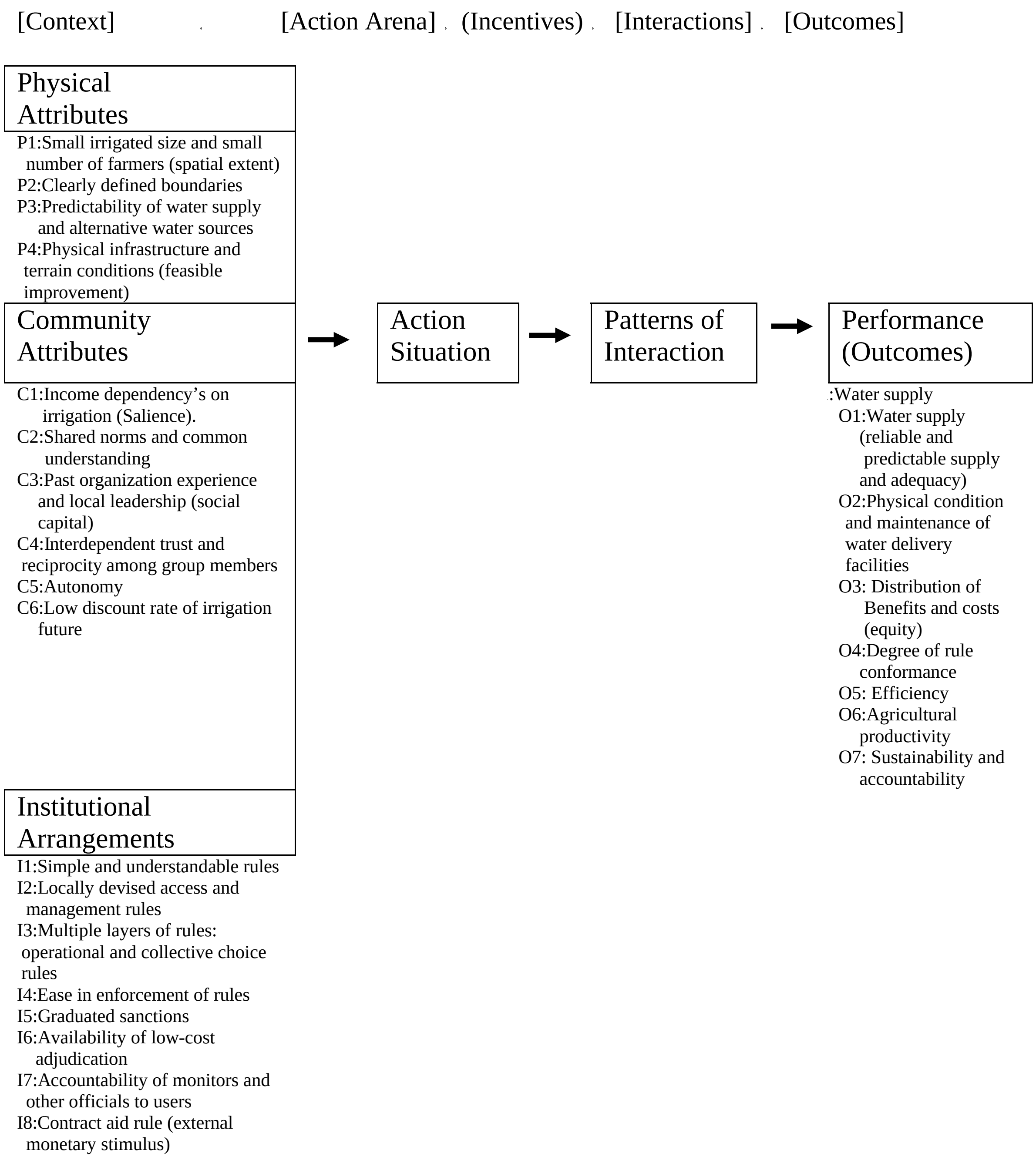
costs, collective choice arrangements, monitoring, gradual sanctions, conflict resolution mechanisms, minimal recognition of rights to organize and nested enterprises (E. Ostrom, 1992).

Figure 2-1. IAD Framework for Identifying Sustainable Self-Governing Irrigation System under the FSMDP



Notes: Adopted from Kiser and Ostrom, 1982; Tang, 1992; E. Ostrom et al., 2002a; E. Ostrom et al., 2002b: Agrawal (2000).

RESEARCH METHOD AND DATA COLLECTION

Creating Structural Korean Irrigation Data Base for Data Collection

• ***KORIS DB Coding Manual***.

To test the propositions on the irrigation systems concluded under the 1st FSMDP, Korean irrigation system data base (KORIS DB) was created. It is adopted from the original Indiana University Workshop coding manual with seven coding forms (E. Ostrom, Benjamin, Shivakoti, 1994). They are Location Form, Appropriation Resource Form, Operational Level Form, Subgroup Form, Operational Rules Form, Organizational Inventory form, and Organizational Structure and Process Form. Location Form is designed to obtain general physical, economic, and institutional characteristics of the area in which an irrigation system is located. Appropriation Resource Form is designed to collect the important physical attributes of the resource system, delineate the boundary of the irrigation system, and describe how the appropriation resource is related to the relevant organization for producing, distributing, and using the resource unit. The form includes the type of headworks (temporary or permanent), length and number of canals, degree of lining of canals, and the predictability of irrigation water. In the process of delivery, three different stages can be shown: production, distribution, and appropriation or use.[5]

Operational Level Form contains the information about the attributes of community, the action situations that individuals face, and their patterns of interactions and outcomes achieved. The Form includes the information about the stakes of individuals, about their patterns of communication, the types of actions they are taking, and information about their various performance characteristics. For irrigation systems where there are few differences among the individuals using the system in regards to their water rights, the Subgroup Form is a continuation of the Operational Level Form. Subgroup Form includes the information the number of households, their landholding patterns, their regular patterns of exchange, and the information that farmers have about their system. A subgroup can be defined as those who have the same rights to water. The Operational Rules Coding Form intends to collect information about the operational level rules particular to a subgroup that appropriate from the irrigation system. Operational level rules are prescriptions and proscriptions that outline what actions are forbidden, required, or permitted. Major operational rules are boundary rules, authority and scope rules, information rules, payoff rules, and aggregation rules. Boundary rules define the requirements that must be fulfilled before individuals are eligible to withdraw units (water) from the appropriation resource (irrigation system). Authority and scope rules define what farmers must, must not, or may do at a particular stage of the appropriation process. Information rules define what kind of information must be communicated and recorded. Payoff rules define the external rewards or sanctions that must, must not, or may be assigned to specific actions or outcomes. Finally, aggregation rules are authority rules that are assigned to multiple positions for partial control over the same action. Finally, Organizational Structure and Process Form is designed to collect the information on attributes of the irrigator organization or the government agency that directly manages the irrigation system. For example, the Form includes type of leader, how the leader is chosen, and how others supervise him.

[5] The production resource in an irrigation system is the set of engineering works that divert or hold back a water course and thus produce water for the irrigation users. So the production resource is a kind of permanent or temporary headworks. A distribution resource is the main canal. It is a part of main canal which is located after the headworks and before the command or service area. The appropriation resource is the area where the irrigation water is appropriated by the farmers (command area, service area). This form also tells who operates and maintains each resource (AMIS, FMIS).

In addition, for testing the propositions and answering research questions, we added 16 variables to the KORIS DB, which are farmers' perception responses of the 1st FMSDP

• *Coding Manual Variables for Evaluating the 62 irrigation systems under the 1st FSMDP*

From the KORIS DB, about 60 variables are drawn for evaluating the 62 irrigation systems under the 1st FSMDP (see Tables 4-1 and 4-2). Of them, important variables of three attributes and performance of the FSMDP in the IAD framework can be explained to test the propositions.[6]

Table 4-1. Survey Variables for Farmers' Perceptions on the 1st FSMDP for Propositions Testing

Variable Name	Label	Variable Name	Label	Variable Name	Label
A4	System name	A14	governing drought and flood by district	A63	design principle 4: monitoring
A5	communication with farmers	A15	labor mobilization	A64	design principle 5: graduated sanctions
A6	Understanding of FSMDP	A16	allowance of the head farmer	A65	design principle 6: conflict resolution
A7	benefits of FSMDP	A17	added cost support of drought or flood	A66	design principle 7: right to organize
A8	satisfaction of FSMDP	A18	bookkeeping status	A67	design principle 8: nested enterprise
A9	clear task scope	A19	rational decision of head position, duties, and authority	A68	design principle: overall
A10	support performance by KARICO	A20	Continuity of FSMDO	A69	established year
A11	fairness of contract agreement	A60	design principle 1: clearly defined boundaries	A70	amount of contract budget
A12	Well supervision	A61	design principle 2: proper equivalence between B and C	A2	system jurisdiction
A13	canal management by FSMDP district	A62	design principle 3: collective choice	A3	Type of Headworks (Production resources)

Table 4-2. Survey Variables in the KORIS DB on the 1st FSMDP for Propositions Testing

Variable Name	Label	Variable Name	Label	Variable Name	Label
A21	System condition	A34	Reliability	A47	entrepreneurial activities
A22	Short-run economic technical efficiency	A35	Cropping turnout	A48	knowledge of system resources
A23	adequacy –summer headend	A36	productivity –head intensity	A49	Existence of overall rules of monitoring and sanctioning
A24	adequacy –summer tailend	A37	productivity –tail intensity	A50	information rules on water appropriation
A25	adequacy –autumn headend	A38	type of governance	A51	information rules on resource

[6] Most of explanations rely on heavily the Workshop coding manual.

					mobilization
A26	adequacy –autumn tailend	A39	headworks status	A52	penalty rules for violation
A27	adequacy –spring headend	A40	canal lining	A53	water appropriation rights
A28	adequacy –spring tailend	A41	alternatives	A54	monitoring by each other
A29	adequacy(overall proxy: a23-a28)	A42	variance of annual family income	A55	variations of sanctioning level
A30	Consistently disadvantaged	A43	terrain	A56	degree of rule conformance
A31	deprived of their benefits	A44	canal length	A57	degree of rule violation
A32	gab of least and most advantaged	A45	system area	A58	trust among farmers
A33	equity (overall proxy a30-a32)	A46	number of appropriators		

Data Collection

To get the data of 62 irrigation systems contracted in the FSMDP, the KORIS DB coding manual (in Korean) was constructed and it was designed as a relational database by SPSS. Omitting some variables not applied to Korean context based on the original CPR coding manual made the KORIS DB. The original CPR coding manual has been constructed through a series of research project conducted by the Workshop in Political Theory and Policy Analysis at Indiana University.

We collected the data of the KORIS DB by conducting both fieldworks and telephone interview survey. From March to August 2001, the fieldwork survey was conducted in 20 districts with structure coding manual including southern provinces. Also, telephone interview survey was successfully made with the responsible self-governing head of 62 irrigations systems from April to May 2002. In particular, the telephone interview survey was preferred to farmers because they were very old and reluctant to reading questionnaire. The statistical data in the KORIS DB were obtained from KARICO materials. The profiles of 62 cases are represented in Table 4-3.

Finally, the performance results conducted by the KARIO in charge of the FSMDP were also employed in the propositions testing.

Table 4-3. Profile on 62 Irrigation systems contracted in the 1st FSMDP (2001)

	Name of the Irrigation system(A4)	Type of Headworks (A3)	Benefited Area(A45) (Unit: ha)	No. of Farmer (A46)	Contract Budget (A70)	Established Year(A69)
1	Songra	Reservoir	76.0	247	$3,797	1974
2	Hwangdun	Reservoir	87.0	191	$3,650	1974
3	Miroji	Reservoir	51.5	185	$2,204	1966
4	Gigogji	Reservoir	31.4	36	$2,204	1973
5	Bagrogje	Reservoir	140.0	259	$5,275	1981
6	Baggog	Reservoir	92.0	230	$3,120	1959
7	Inpyung	Reservoir	69.0	101	$2,898	1960
8	Sayang	Reservoir	62.0	48	$2,000	1975
9	Seongdae	Reservoir	59.0	50	$1,800	1984

10	Neungchon	Pumping Station	44.0	86	$2,464	1980
11	Samyongbo	Weirs	34.3	97	$1,333	1983
12	Hangokje	Reservoir	68.0	160	$2,725	1987
13	Balsanji	Reservoir	11.0	53	-	1955
14	Hwaam	Reservoir	68.0	152	$2,200	1945
15	Hoam	Pumping Station	55.0	141	$4,828	
16	Juhang	Reservoir	169.0	355	$6,788	1945
17	Zeungsan	Pumping Station	141.0	155	$3,520	
18	Sinjungje	Reservoir	32.0	60	$1,212	1960
19	Cheoncheonje	Reservoir	180.0	554	$5,391	1996
20	Zoogjeon	Reservoir	15.0	120	-	1960
21	Seogpoje	Reservoir	78.3	113	$3,587	1998
22	Bodug	Pumping Station	172.0	155	$9,487	1959
23	Youcheon	Pumping Station	85.3	98	$4,722	1991
24	Bagamje	Reservoir	29.0	80	$903	1960
25	Bongyangje	Reservoir	148.7	165	$5,822	1993
26	Gwangdaeje	Reservoir	121.8	210	$4,616	1981
27	Gagogje	Reservoir	36.0	65	$1,516	1959
28	Dangchonje	Reservoir	33.2	87	$1,390	1945
29	Ohidongje	Reservoir	106.4	249	$4,245	1962
30	whirlseongje	Reservoir	101.6	233	$4,111	1991
31	Geumgaeje	Reservoir	76.0	116	$3,398	1956
32	Chimgyeoje	Reservoir	151.6	140	$6,364	1990
33	Haepyungje	Reservoir	43.0	96	$1,358	1999

(continued)

	Name of the Irrigation system	Type of Headworks	Benefitted Area (Unit: ha)	No of farmers	Contract Cost	Established Year
34	Songdanje	Reservoir	224.6	643	$9,427	1983
35	Soonheungje	Reservoir	31.8	62	$1,327	1945
36	Donghaeje	Reservoir	203.3	288	$5,240	1999
37	Ipseogje	Reservoir	274.4	549	$11,122	1966
38	Chilseongje	Reservoir	64.2	89	$2,467	1945
39	Wallgaje	Reservoir	117	319	$5,226	1963
40	Gawangeum	Pumping Station	26	96	$700	1969
41	Gagsanji	Reservoir	20	46	$840	1976
42	Mooeulji	Reservoir	231.0	393	$9,732	1970
43	Zoogan	Pumping Station	188	506	$7,896	1967
44	Yeongyeongje	Reservoir	47	117	$3,442	1979
45	Gomaeje	Reservoir	110	148	$3,465	2000
46	Wallsongbo	Weirs	80	287	$3,360	1991

47	Yongjeonji	Reservoir	66	152	$2,772	1963
48	Mimangji	Pumping Station	65	93	$1,950	1963
49	Daesan	Reservoir	84	301	$3,528	1945
50	Yongdam	Pumping Station	137	204	$2,500	1945
51	Woonsan	Reservoir	26	55	$977	1974
52	Nagsangbo	Weirs	52	68	$2,175	1956
53	Hyunribo	Weirs	37	130	$2,869	1969
54	Zinrae	Reservoir	244	531	$10,230	1978
55	Imgeeje	Reservoir	31	103	$1,120	1958
56	Sajeong	Pumping Station	190	323	$2,000	
57	Yogoje	Reservoir	122	252	$5,140	1976
58	Seotagji	Reservoir	69	250	$2,889	1945
59	Shinchonje	Reservoir	50	103	$2,100	1977
60	Gangseonji	Reservoir	86	413	$3,626	1997
61	Samhwaji	Reservoir	86	366	$3,613	1997
62	Geogryangji	Reservoir	147	649	$6,113	1994

Note: A# stands for variables in the coding data.
Sources: KORIS DB data

EMPIRICAL RESULTS AND DISCUSSION

Designing the 1st FSMDP for Sustainable Self-governing Irrigation Systems

National Design Directions of the Program

First of all, the FSMDP was established to find stable regularities for farmers' self-governance under the AMIS under the basic mid and long run planning. It can be operated over one irrigation district based on the KARICO branch office size. Second, the KARICO supports necessary budget in accordance with the analysis of the proper operating cost. While the program is being conducted by sharing the roles of both farmers and the KARIO, the management budget (cost) should be distributed to the farmers in the self-governing district within the direct cost (water supply cost). Third, the KARICO branch director chooses the proper irrigation district and concludes the contract with the responsible head of self-governing model district. Fourth, the continuous related laws and regulations are revised to cope with the reality or various context-specific problems. Finally, the operating performance of the FSMDP is reflected on the overall evaluation of water management of the KARICO branch district by the KARICO headquarter (Main Office).

In short, uniform design directions at the national level are considering the local circumstances and incentives of both local agency and farmers so that they can cooperate to increase the performance of the irrigation systems. In particular, in the design directions, three types of attributes (physical, community, institutions) were considered in choosing the irrigation systems under the FSMDP.

Physical and Community Attributes: Before and After KARICO

In terms of physical and community attributes in the 62 irrigation systems, there was no big change before and after KARICO. All propositions of physical and community attributes specified in the IAD framework were positively tested in the 62 irrigation systems under the FSMDP as follows. The reason is that under the FSMDP, KARICO has contracted with 62 sustainable self-governing irrigation systems that had had the indigenous physical and community attributes for self-governance.

<Physical attributes>

In terms of physical attributes in the sustainable self-governing systems, first, 62 district irrigation systems cover the irrigated area of 5,782 hectares (average 93 hectares per district). The size of 62 irrigation systems is relatively small. Also the number of irrigated farmers is relatively small. While 20 irrigation systems have less than 100 farmers and 32 irrigation systems have about 100 to 200 farmers, only 10 irrigation systems have 300 ~650 farmers(see Table 4-3) (Proposition P1). Second, 62 Korean irrigation systems have traditionally had their own clearly designated boundaries for a long time (Proposition P2). Third, 62 irrigation systems have had enough water supply and some alternative water sources. So they have traditionally had the incentives to organize the self-governing association. Also irrigation systems have 2 or 3 alternative supplementary water sources and thus irrigators' incentives to cooperate (Proposition P3). Fourth, 62 irrigation systems concluded with the FSMDP have had good field terrain and irrigation system facilities. Thus, farmers have shown more incentives to cooperate during the operation of FSMDP. Before the contract, the ratio of lining canal was 45% (KARCIO district-> 32%) and the length of irrigated and drainage canals was 15.9km per 100 hectares (KARICO district-> 18.6km). Also the number of irrigation facilities was 36 per 100 hectares (KARICO district-> 55). Most of the headworks have been reservoirs (81%), while pumping and weir has been 11% and 8% respectively. Each district has one or two alternative water sources. Many farmers have preferred reservoirs to other headworks for a long time (Proposition P4).

<Community Attributes>

In terms of community attributes in the sustainable self-governing systems, first, most of farmers in the FSMDP have depended on their irrigation systems as a source of income and have cooperated each other in governing the systems for better cropping (A42) (Proposition C1). Second, most of 62 irrigation system farmers have traditionally had shared norm and common understanding for a long time, which does still share a cohesive community recognition. Oftentimes, KARICO officials communicate with farmers to explain the FSMDP (A5). Most of 62 irrigation systems have had mutual trust among farmers themselves before the KARICO (A58) (Proposition C2). Third, 62 irrigation systems have experienced sustainable self-governing skills through the local leaderships of organization and management for a long time before the KARICO. Farmers have understood the knowledge of FSMDP operation rules (A6). Most of farmer heads have assumed leadership or entrepreneurial activity for the sustainable self-governing irrigation system (A47). Many farmers have had a well-developed understanding of the characteristics of irrigation resource before the KARICO (A48) (Proposition C3). Fourth, the KARICO considered the interdependent trust and reciprocity among group farmers in choosing the candidates in the FSMDP. Most of 62 irrigation systems have traditionally had mutual trust among their own district farmers (A58) (Proposition C4). Fifth, the previous self-autonomy district was operated by the self-autonomy district establishment regulations (article 6) of the former Farmland Improvement Association (FIA). Therefore, under the governance of KARICO, 62 irrigation systems have had the autonomy for sustainable self-governing. Farmer head of each district has autonomous authority with some duties (A19) (Proposition C5). Sixth, farmers had a favor of FSMDP based on its benefits (A7) and satisfaction (A8). Most of irrigation system farmers wanted to continue the FSMDP (A20) (Proposition C6).

Institutional Arrangement or rules

When we review the design of the FSMDP, it is very important to understand institutional arrangements or rules along with physical and community attributes. The rules can be existed both formal written rules (de jure rules) and informal rules in use (de facto rules). However, as E. Ostrom emphasized, "researcher cannot just assume that individuals are following a set of written rules or it is easy to discover the rules in use." (E. Ostrom, 1986: 466). The combination of these two sets of rules (de jure and de facto) and consequent behavior patterns determine the full set of incentives within a given institutional context. Discrepancies between the formal rules and those in use could be huge. Therefore in designing the FMSDP, it should be taken into account how to reduce discrepancies to increase the performance of irrigation systems. Rules should be internally consistent and understood by all participants in the irrigation system.

KARICO stipulated a new rule (de jure) called as "Self-governing District Establishment and Management Regulation. Based on the regulation, Management Reform Team in the KARICO made a field trip to gather the local issues before implanting the Farmers' Self-governing Model District Program. In 2001, KARICO designed the principles for the 1st FSMDP. In particular, most of design principles by E. Ostrom (1996) are nested in the operational and collective choice rules of the FSMDP. Major rules in the FSMDO are explained as follows.

· ***Grand De Jure Operational Rules of the FSMDP***

The grand formal (de jure) operational rules were crafted for sustainable self-governing irrigation systems (Propositions I3). Aforementioned physical and community attributes were interactively affected by these operation rules.

(a) Boundary rules: contract qualifications for FSMDP

First, the model district should have unique headwork as a KARICO governing district (not local government) and should not affect the agricultural farming of other regions. Second, the consignment management should be easily conducted under the good conditions and capacity of headworks and irrigation & drainage facilities located in the district. Third, the district should be located far away from the branch office of the KARICO and management cost cutback should be available through the consignment management. Fourth, the qualifying model district must be the region where water users and community residents can easily lead to an agreement on irrigation issues and have governing capacity. Finally, water users in the district must want to voluntarily apply for self-governing program. The program is aimed at the bottom-up approach for the qualifications (Propositions I1, I3, I4)

(b) Scope rules (1): major tasks by farmers for self-governing in the FSMDP**.**

First, farmers within the district must maintain and repair irrigation facilities. Second, farmers must manage supply and drain water within the district. Third, farmers must remove weeds in the irrigation and drainage canals. Fourth, farmers must manage all administrative tasks on implementing water supply cost of O&M budget on emergency disaster remedies (Propositions I2, I3, I7).

(c) Scope rules (2): support duties by the agency (KARICO branch office)

KARICO officials should conduct survey, design, works supervision, and defect maintenance, which are required of technology. Also they must do all administrative tasks on implementing repairing cost of O & M budget such as rebuilding / repairing projects and natural disaster recovery project (Propositions I2, I3, I7).

(d) Payoff rules for incentives of farmers' participation: budget estimation and supply for self-governing by the agency (KARICO)

Required budget for self-governing is estimated based on the FSMDP project proposal which the responsible head farmer of the district submits within the "Optimal Operation Cost for Self-governing by Headworks" recommended by the agency (KARICO). Estimated budget for self-governing is supplied in installment three times per year (after contract conclusion, July, after completion of exact calculation of the allotted budget) (Propositions I3, I5, I7).

(e) Authority rules (1): the rules for monitoring and supervision of the operation of FSMDP

The branch head of KARIO supervises the operation progress of FSMDP. He should check the status of FSMDP over once per month, while checking very oftentimes the operating status in accordance with the anti-natural disaster plan in the case of special weather report. The responsible farmer head of self-governing district should report the operating results including budget implementation to the KARICO branch office within one month after terminating the contract period of the FSMDP (PropositionsI3, I7).

(f) Authority rules (2): duties and authorities of a responsible farmer head in the district

First, the farmer head should write a project proposal for the FSMDP and conclude agreement with KARICO as a representative of the self-governing district. Second, the head should charge overall maintenance and management works. More specifically, the works are as follows: 1) daily management and supervision of headworks, 2) water supply and drainage management tasks within the district, 3) operation status of headworks (daily report on storage rate in the reservoir, amount of electric power for pumping stations), 4) removing weeds in the irrigation and drainage canals, dredging, and repairing (over two times), 5) cleaning up the facilities area, 6) removal of various useless trees, 7) maintenance management tasks like anti-corroding, and 8) report on operation results (writing a report on operation performance) (Propositions I3, I7).

(g) FSMDP operation period rule

Most of irrigation systems operate the FSMDP for about 6 months (180 days: April 1~September 30). However, some districts can choose 4 or 5 months based on their own situations.

· **Collective Choice Mechanisms**

The grand formal (de jure) collective choice rules were crafted for sustainable self-governing irrigation systems (Propositions I3).

(a) Collective choice mechanism for contract (agreement) conclusion and choosing a responsible farmer head for FSMDP

For the available self-governing district, the KARICO branch head concludes agreement (contract) with the responsible farmer head of self-governing district through the written formal format after the review of the Operation Committee. The result will be announced on the branch bulletin board over 5 days and notified to the water users (farmers) of irrigation system within the district.

Also, to operate the FSMDP, one responsible head of water users (farmers) in the district should be chosen. The responsible head in the self-governing district should take the education training over one day on maintenance and management from the jurisdictional branch. The term limit for the head position is during the contract period (Proposition I3)

(b) Collaborative labor-division rules between KARICO and Farmers
The KARICO's Operation Committee and branch office decide the collaborative work rules between KARICO and the farmers in the FSMDP (A9) (Proposition I2)

(c) Cancellation Decision Rules (1): Authority and penalty rules for use purpose of irrigation facilities
Self-governing farmers are not allowed to use irrigation facilities and canals in the district for other purposes. If the farmers happen to use the irrigation facilities in the program for other purposes, the tasks of self-governing would be transferred directly to the KARICO (Propositions I3, I4, I5).

(d) Cancellation Decision Rules: Aggregation, boundary, and penalty (2) rules for cancellation of the FSMDP agreement
If the district in the FSMDP happens to fall under the following items, the KARICO may terminate the self-governing contract with the district farmers and directly govern the irrigation systems in its own district after the review of the Operation Committee. Then the farmers' self-governing district should be taken over the management of the KARICO (Proposition I3, I5).

• when the self-governing district violates the agreement rules of the FSMDP or does not perform self-governing duties
• when facilities and water management is seriously in bad conditions.
• when the KARICO could judge that the district cannot attain the expected goal agreed in the FSMDP until the expiration of contract period
• when many farmers in the self-governing district request to terminate the SMDP

(e) Aid amount decision rule: external monetary stimulus
KARICO's Operation Committee and branch office determine the amount of contract aid budget and allowance of district farmer head based on his and system overall performance (Proposition I3).

Performance (Outcomes) of the 1st FSMDP

· ***Farmers' Perceptions of the FSMDP***
Based on case studies of 62 irrigation systems, overall, farmers' perceptions are very positive of the implementation of the FSMDP. However, some pitfalls of the 1st FSMDP make the farmers unsatisfactory. Figure 1 represents the response of 62 responsible head farmers. "0" means the negative response of each question item, while "1" means the positive response.[7]

(1) Legitimacy and preference of farmers on FSMDP

KARICO is well communicating with farmers regarding the FSMDP (A5) and farmers understand well the FSMDP (A6). Task scope between farmers and agency managers is clearly specified (A9) and the contract conclusion of FSMDP is very fair (A11). Also, the supervision of FSMDP operation is well conducted (A12) (Figure 4-1).
However, the satisfaction degree of FSMDP is somewhat negative. 50 percent of the respondents show the negative perceptions of satisfaction (A8). In the same context, 41.9 percent

[7] In the KORIS DB, 3 or 4 response categories of each question were constructed. But they were recoded into two dichotomous categories for statistical analysis.

of respondents show the negative perception of support performance by KARICO (A10) (Figure 4-1. In the field survey interview, the farmers were complaining that the number of visits of agency managers in the previous FIA to irrigation field was reduced after the abolition of water tax. The reason is that farmers missed the chances to complain irrigation issues because of water tax abolition, while agency managers felt there is no need to support actively farmers because they do not collect water tax. Institutional change of water tax brought about the change of incentives of both farmers and agency managers, which resulted in unsatisfactory response of the FSMDP.

In short, despite the ambiguous average satisfaction (50%) of the FSMDP, the overall legitimacy and preference of the FSMDP is positive at the 1st experimental stage.

(2) Management status of irrigation and drainage facilities (Outcome O2: Physical condition and maintenance of water delivery facilities)

Canal management for irrigation and drainage is well conducted by the FSMDP district (A13). Also the remedies on drought and flood disaster are significantly (71%) governed by FSMDP district (A14). However, labor mobilization is not well executed (35.5%) (A15) (Figure 4-1).

(3) Implementation of operation cost budget and bookkeeping (O5: Efficiency)

The allowance of a responsible head farmer is not sufficient (A16). 85.5 percent of respondents show negative response. In the field interview, head farmers did not pay attention to the amount of allowance. They were doing their roles with service spirit for a long time and holding their irrigation systems as the whole life assets. The actual expenditure of head allowance amounts to $8,552 ($143 per month) in the only head task, while $67,139 ($280 per month) in the case of dual task with water inspector task) (Table 4-1).

During the contract period, there were few drought and flood. So farmers did not need additional damage cost of drought and flood and thus the district office did not support additional cost (A17) (Figure 4-1).

Table 4-1. Actual allowance amount of self-governing head (Unit: $, number)

	Total	Head task only	Add water inspector task
Number of Self-governing head	50	10	40
Amount	$75,691	$8,552	$67,139

Source: KARICO internal data of FSMDP (2002).

The bookkeeping for the operation of FSMDP is well being kept (A18) (Figure 4-1). 72.6 percent of respondents show the positive status of bookkeeping including budget implementation. The total amount of operating cost of FSMDP is $0.2 millions ($37 per ha). In the case of reservoir, the actual cost was reduced by 14% from the planned $42 per ha. The cost of self-governing head and water inspector takes 69% of total cost.

Table 4-2. Implementation status of operating cost (Unit: $)

Type	System area (ha)	Contract Amount (per ha)	Actual Amount (per ha)	Decrease (-)
Total	5,782	$222,347 ($38)	$210,532($37)	$11,815
Reservoir	4,728	$185,975 ($39)	$174,836($37)	$11,139
Pumping	714	$ 25,205 ($35)	$ 24,325($34)	$ 880

station				

Source: KARICO internal data of FSMDP (2002).

Actual expenditure costs by items are represented in Table 4-3. The costs of self-governing and water inspector takes great portion of 35% and 32.8% respectively.

Table 4-3. Implementation status of operating cost by item (Unit: $, %)

Item	Total	electric	Oil	Weeds removal	Canal dredge	Water inspector	Facilities Check	Governing Head	Other
Amount (Ratio)	$210,532 (100%)	6,953 (3.3)	334 (0.1)	22,384 (10.6)	27,940 (13.3)	69,094 (32.8)	7,583 (3.6)	75,691 (36.0)	553 (0.3)

(4) Rational decision of farmer head position, duties, and authorities: position and authority rules

77.4 percent of respondents represent the positive response of how the responsible farmer is rationally chosen and what duties and authorities on them are properly assigned (A19). In the FSMDP, two representative positions exist: the responsible self-governing farmer head (self-governing head) and water inspector. Most of self-governing heads (69%) are doing dual roles with water inspector. 60 percent of self-governing head have O&M experiences over 5 years. By farmers' organizer career, town head experience is majority. 77% of head have farmers' organizer experience. Also, the age structure of self-governing gets older. 79 percent of head is over 51. Finally, the district with water inspector takes 58 percent. The age structure of water inspector is similar to that of self-governing head (Table 4-4) (Figure 4-1).

Table 4-4. Status of self-governing manpower resources: self-governing head and water inspector

<Roles of Self-governing head>

	Total	Only head role	Dual roles of head and water inspector
Number of head (ratio, %)	62 (100%)	19 (31)	43 (69)

<Experiences of O&M of Self-governing head>

Years	Total	No experience	1-4 years	5-9	10-19	Over 20
Number (ratio, %)	62 (100%)	10 (16)	15 (24)	14 (23)	15 (24)	8 (13)

<Farmers' organizer experience of self-governing head >

By career	Total	No experience	Farmland Management committee	Town head	Operating Committee	Rice Cultivator
Number (ratio, %)	91 * (100%)	14 (15)	17 (19)	42 (46)	5 (5)	13 (14)

< Age structure of self-governing head >

By age	Total	Below 40	41-50	51-60	61-70	Over 71
Number (ratio, %)	62 (100%)	1 (2)	12 (19)	16 (25)	30 (48)	3 (5)

< status of water inspector >

Total	No inspector	1	2	3	4	5

62 (100 %)	26 (42)	23 (37)	6 (10)	4 (6)	2 (3)	1 (2)

Source: KARICO internal data of FSMDP (2002)
Note: * 13 persons with 2 kinds of experience and 8 persons with 3 kinds of experience are twice calculated.

Figure 4-1. Perceptions of the 1st FSMDP by the Responsible Farmer Head

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A5 Frequency Percentage Bar Chart (A5=communication with farmers)
0      3         4.8    ••
1      59       95.2    ••••••••••••••••••••••••••••••••••••••••
A6 Frequency Percentage Bar Chart(A6=understanding of farmers)
0      2         3.2    ••
1      60       96.8    •••••••••••••••••••••••••••••••••••••••
A7 Frequency Percentage Bar Chart(A7=communication with farmers)
0      23       37.1    •••••••••••••••••••••••
1      39       62.9    •••••••••••••••••••••••••••••••••••••••
A8 Frequency Percentage Bar Chart(A8=communication with farmers)
0      31       50.0    •••••••••••••••••••••••••••••••
1      31       50.0    •••••••••••••••••••••••••••••••
A9 Frequency Percentage Bar Chart(A9=clear task scope)
0      5         8.1    ••••
1      57       91.9    ••••••••••••••••••••••••••••••••••••••••••••••
A10 Frequency Percentage Bar Chart(A10=support performance by KARICO)
0      26       41.9    ••••••••••••••••••••••••••
1      36       58.1    ••••••••••••••••••••••••••••••••••••
A11 Frequency Percentage Bar Chart(A11=fairness of contract)
0      4         6.5    •••
1      58       93.5    ••••••••••••••••••••••••••••••••••••••••••••••
A12 Frequency Percentage Bar Chart(A12=well supervision)
0      6         9.7    •••••
1      56       90.3    ••••••••••••••••••••••••••••••••••••••••••••••
A13 Frequency Percentage Bar Chart(A13=canal management by FSMDP district)
0      2         3.2    ••
1      60       96.8    ••••••••••••••••••••••••••••••••••••••••••••••
A14 Frequency Percentage Bar Chart(A14=governing drought and flood by district)
0      18       29.0    ••••••••••••••••••
1      44       71.0    ••••••••••••••••••••••••••••••••••••••••••••
A15 Frequency Percentage Bar Chart(A15=labor mobilization)
0      40       64.5    ••••••••••••••••••••••••••••••••••••••••
1      22       35.5    ••••••••••••••••••••••
A16 Frequency Percentage Bar Chart(A16=allowance of the head farmer)
0      53       85.5    ••••••••••••••••••••••••••••••••••••••••••••••
1      9        14.5    ••••••••
A17 Frequency Percentage Bar Chart(A17=added cost support of drought and flood)
0      53       85.5    ••••••••••••••••••••••••••••••••••••••••••••••
1      9        14.5    ••••••••
A18 Frequency Percentage Bar Chart(A18=record/book keeping status)
0      17       27.4    •••••••••••••••••
1      45       72.6    •••••••••••••••••••••••••••••••••••••••••••••
A19 Frequency Percentage Bar Chart(A19=rational decision of farmer position, duties,auth.
0      14       22.6    ••••••••••••••
1      48       77.4    ••••••••••••••••••••••••••••••••••••••••••••••
A20 Frequency Percentage Bar Chart(A20=continuity of the FSMDP)
0      12       19.4    •••••••••••
1      50       80.6    ••••••••••••••••••••••••••••••••••••••••••••••
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· *Operating Results of the 1st FSMDP by KARICO's Evaluation*

First, compared to the direct management by KARICO (2000), FSMDP (2001) reduced the direct cost (water delivery cost basis) by 20 %. The total reduction cost amounts $60,441 over 65,000 ha (estimation value). $10 per hectare decreased from $50 by direct KARICO management to $40 by self-governing (Table 4-5).

Table 4-5. Budget cutback management effect by the 1st FSMDP

Item	Direct Management by KARICO (2000)	FSMDP (2001)			Decrease (-) Increase(+)
		Sub-total	Self-governing Operation cost	KARICO expenditure	
Total (Per hectare)	$289,330 (50)	$228,889 (40)	$210,532 (37)	$18,357 (3)	(-)$60,441 (10)
Electricity fare	$13,087	$13,905	$6,953	$6,952	(+)$818
Oil fare	$52	$494	$334	$160	(+)$442
Weeds removal fee	$21,096	$23,412	$22,384	$1,028	(+)$2,316
Canal dredging					
Labor cost by water	$38,132	$31,913	$27,940	$3,973	(-)$6,219
inspector	$ 163,876	$71,789	$69,094	$2,695	(-)$92,087
Facilities improvement	$53,087	$11,132	$7,583	$3,549	(-)$41,955
Self-governing head		$75,691	$75,691	-	(+)$75,691
	-				
Others					

Source: KARICO internal data of FSMDP (2002).

Second, manpower of water management was annually reduced by 51% (2,058 persons) in the operation of FSMDP compared to the direct management by KARICO. Management area per one person increased from 105 hectares (direct management) to 209 hectares (FSMDP) (Table 4-6).

Table 4-6. Manpower reduction during water delivery period (Unit: annual number, ha, %)

Analysis district		Direct Management (A) [Per person]	FSMDP (B) [Per person]	Decrease (-) (B-A) [Reduction Rate]
No. of District	Area	(22) [105 ha]	(11) [209 ha]	(11) [51%]
29	2,299ha	4,001 persons	1,943 persons	2,058 persons

Source: KARICO internal data of FSMDP (2002).
Note: The number of the parenthesis is required manpower by calculating (annual personnels/180days).

Third, the progress performance of maintenance works increased by 77 percent per ha in weeds removal from 13 meters (direct management) to 23 meters (self-governance). Also the progress performance of canal dredging increased by 91% from 11meters (direct management by KARICO) to 21meters (self-governance) (Outcome O2: Physical condition and maintenance of water delivery facilities).

Fourth, the performance of farmers' participation increased by 105 percent compared to direct management by KARICO from 22 regions (direct management) to 45 regions (FSMDP). The number of participants increased by 3 to 13 times (i.e., 6 times in weeds removal, 7 times in canal dredging) (Outcome 4: Degree of rule conformance; Outcome O7: Sustainability).

Fifth, compared to the direct management, the frequency of public discontent was reduced by 20 percent from 101 cases in 15 districts (direct management) to 89 cases in 12 districts (FSMDP).

Finally, the grand de jure rules of task allocation between FSDMDP and KARICO were transformed into three types of rules during the operation of FSMDP. The institutional changes in authority rules were happened in the field. Many types of tasks were implemented by collaborative management. The 1st FSMDP was not conducted by only farmers themselves as expected in the grand de jure rules. (Table 4-7) (Outcome 4: Degree of rule conformance).

Table 4-7. Changes of Task (Labor) Division Rules between FSMDP and KARICO: change of authority rules

Type of Irrigation Tasks	Grand De Jure rules: Original Arrangement (Who governs?)	Operation Results		
		Self-governance	Direct Mgt	Co-Mgt
• check and management of agricultural infra facilities	-	-	-	-
- daily check of irrigation facilities	Self	37	23	2
- regular check of irrigation facilities	Direct by KARICO	4	58	0
- cleaning facilities, painting etc.	Self	48	8	6
- weeds removal in irrigation canal	Self	58	1	3
- dredge in irrigation and drain. Canal	Self	54	5	3
- safety check of facilities	Direct	6	56	0
- repair of facilities	Direct	35 +4	25+58	2 +0
- other facilities check and management	Direct	19	40	3
• water delivery and drainage mgt task	-	-	-	-
- gathering and directing water inspector	Self	30	30	2
- field patrol and delivery management	Self	54	8	0
- public discontent resolution	Self	26	30	6
- manipulation of headworks	Self	60	2	0
- water gate opening and closing	Self	62	0	0
- notice of water delivery such as storage	Self	42	18	2
- inspection of water quality pollution	Self	40	12	10
- other water delivery and drainage tasks	Self	52	7	3
• delivery & drainage tasks of calamity	-	-	-	-
- prevention tasks of calamity	Self	20	36	6
- early emergency treatment of calamity	Self	42	17	3
- reporting calamity status	Direct	33	22	7
- emergency recovery	Self	36	18	8
- permanent recovery	Direct	3	58	1
- cooperation of emergency and perman.	Self	42	18	2
- other delivery & drainage of calamity	Direct	43	16	3
• General administrative activity	-	-	-	-
- planning of water delivery and drainage	Direct	12	46	4
- planning of facilities check	Direct	8	51	3
- check of various daily record book	Self	33	28	1
- management of drought and flood	Direct	5	54	3
- operation & Management of FSMDP	Direct	31	29	2
- public discontent resolution	Direct	15	42	5
-other general administrative tasks	Direct	11	45	2

Relationship of Design Principles and Performance of the Irrigation Systems under the 1st FMSDP

62 Korea irrigation systems under the FSMDP retain most of design principles even under the AMIS. The reason is that traditionally the irrigation systems had been operated through the

previous farmers' organization (FIA) until 2000. They have a lot of self-governing skills by crafting their own institutions unlike the de jure rules.

E. Ostrom (1996) and E. Ostrom & Benjamin (1993) investigate 8 design principles and their relationship with performance of farmer-managed irrigation systems in Nepal. Figure 6-1 shows that 62 irrigation systems under the system have principles (rules) of clearly defined boundaries, proportional equivalence between benefits and costs, collective choice arrangements, monitoring, graduated sanctions, minimal recognition of the right to organize, and conflict-resolution mechanisms, except nested enterprises. "0" means "have no principle," and "1" means "have principle" except variable A68 (overall). When one system has over 5 principles, we recode it as "1" and less than 3 as "0".

Design principles in the FSMDP can be identified in the physical, community, and institutional attributes. They are P2(well defined boundaries) (A60), P4(Physical infrastructure and terrain conditions), C2(Shared norms and common understanding) (A5, A6, A58), C3(Past organization experience and local leadership/social capital) (A47, A48), C5(Autonomy), C6(Low discount rate of irrigation future) (A7, A20), I1(Simple and understandable rules)(A49), I2(Locally devised access and management rules) (A49), I3(Multiple layers of rules: operational and collective choice rules) (A60~A68), and I5(Graduated sanctions)(A52, A55).

These design principles produce the positive performance and outcomes of irrigation systems under the FSMDO based on the perceptions survey of farmers, KORIS DB, and KARICO data. First, water supply is reliable, predictable, and adequate (A23-A29, A34). Second, physical condition and maintenance of water delivery facilities are well maintained (A21). Third, distribution of benefits and costs to farmers are equitable (A33, A31, A32). Fourth, rule conformance is well conducted among farmers themselves (A56). Fifth, short run economic technical efficiency is high (A22). Sixth, agricultural productivity is high. Cropping turnout is good (A35), cropping intensity between head end and tail end ranges from 100 percent to 200 percent (A36, A37). Finally, most of 62 irrigation systems are sustainable with self-governing. However, the limitation of self-governance in those systems is still being complemented by the accountability KARICO agency (A9, A11, A12, A14, A17, A20) (see Figure 4-1, 4-2, 4-3).

Figure 4-2. The degree of maintaining design principles of 62 irrigation systems under the FSMDP

```
A60 Frequency Percentage Bar Chart (A60=clearly defined boundaries)
0       6          9.7    •••••
1      56         90.3    ••••••••••••••••••••••••••••••••••••••••••••••
A61 Frequency Percentage Bar Chart (A61=proportional equivalence betw. B/C)
0       6          9.7    •••••
1      56         90.3    ••••••••••••••••••••••••••••••••••••••••••••••
A62 Frequency Percentage Bar Chart (A62=collective choice arrangements)
0       6          9.7    •••••
1      56         90.3    ••••••••••••••••••••••••••••••••••••••••••••••
A63 Frequency Percentage Bar Chart (A63=monitoring)
0       6          9.7    •••••
1      56         90.3    ••••••••••••••••••••••••••••••••••••••••••••••
A64 Frequency Percentage Bar Chart (A64=graduated sanctions)
0       3          4.8    ••
1      59         95.2    ••••••••••••••••••••••••••••••••••••••••••••••
A65 Frequency Percentage Bar Chart (A65=conflict resolution mechanisms)
0       2          3.2    ••
1      60         96.8    ••••••••••••••••••••••••••••••••••••••••••••••
A66 Frequency Percentage Bar Chart (A66=the right to organize)
0       6          9.7    •••••
1      56         90.3    ••••••••••••••••••••••••••••••••••••••••••••••
A67 Frequency Percentage Bar Chart (A67=nested enterprises).
0      57         91.9    ••••••••••••••••••••••••••••••••••••••••••••••
1       5          8.1    ••••
A68 Frequency Percentage Bar Chart (A68=overall)
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0       5         8.1    ••••
1      57        91.9    ••••••••••••••••••••••••••••••••••••••••••••••
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Three Observed Attributes and Performance(Outcomes) of 62 Irrigation Systems under the 1st FSMDP in the KORIS DB

Overall survey results of 62 irrigation systems show the positive performance of each variable as shown in Figure 4-3 and Figure 4-4. Most of irrigation systems in the FSMDP are physically in good condition (a21). Economic efficiency is good and water adequacy is enough (A22 and A29). By combining three variables (consistently disadvantaged A30, deprived of their benefits A31, gap of least and most advantaged A32), many farmers use water very equitably (A33). Tailend farmers withdraw the water reliably like the headend farmers (A36, A37). Cropping intensity ranges from 100% to 200%.

Types of governance are almost AMIS (A38). But in reality all systems are being operated by JMIS. Most of headworks (production resources) are permanent and 90 percent of main canals are lined (A40). There are few variances and constant in annual family income (A42) and most of irrigation systems are located in the flat terai (A43). Many farmers are doing entrepreneurial activities in governing the system (A47). Traditionally due to the long experience of the system, most of farmers are familiar with system resources (A48). Also many systems have rules-in-use of monitoring and sanctioning like the de jure rules (A49-A55). Most of farmers are following the rules and the degree of violation is very low. Also farmers trust each other among farmers (A57 and A58).

In short, based on the outcomes in the IAD framework (see Figure 2-1), O1(Water supply/reliable and predictable supply and adequacy), O2(Physical condition and maintenance of water delivery facilities), O3(Distribution of benefits and costs/equity), O4(Degree of rule conformance), O5(Economic Efficiency), O6(Agricultural productivity), and O7(Sustainability and accountability) variables of irrigation systems under the FSMDP show a positive performance for sustainable self-governance due to the implementation of the 1st FSMDP.

Reflecting on the propositions and three attributes in the IAD framework (see Table 2-2, Figure 2-1), most of 62 irrigation systems satisfy positively the propositions (4 propositions in physical attributes, 6 propositions in community attributes, 8 propositions in institutional arrangements). In other words, three attributes (physical, community, institutional) for sustainable self-governing systems affect very positively the performance or outcomes of 62 irrigation systems under the 1st FSMDP (Figure 4-4).

In conclusion, most of irrigation systems under the 1st FSMDP are being operated with de jure and de facto rules under greater sustainable self-governance. These results come from the indigenous and traditional cooperation of KARIO officials and farmers before the KARICO reform. During the filed trip, we can see KARIO managers play major roles as co-producers. In fact, they were members in the previous farmers' WUO organization operated by Farmland Improvement Association before the KARICO.

Figure 4-3. The observed variables (three attributes and performance) of 62 irrigation systems under the 1st FSMDP in the KORIS DB

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A21 Frequency Percentage Bar Chart (A21=system condition)
1       7        11.3    •••••••
2       5         8.1    •••••
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3      50        80.6    ••••••••••••••••••••••••••••••••••••••••••••••
A22 Frequency Percentage Bar Chart (A22=short-run econo.& tech. Efficiency)
3      37        59.7    •••••••••••••••••••••••••••••••••••••
4      25        40.3    •••••••••••••••••••••••••
A23 Frequency Percentage Bar Chart (A23=adequacy- summer headend)
0       1         1.6    •
1      61        98.4    ••••••••••••••••••••••••••••••••••••••••••••••
A24 Frequency Percentage Bar Chart (A24=adequacy –summer tailend)
0       1         1.6    •
1      61        98.4    ••••••••••••••••••••••••••••••••••••••••••••••
A26 Frequency Percentage Bar Chart  (A26=adequacy-autumn tailend)
0       5         8.1    ••••
1      57        91.9   •••••••••••••••••••••••••••••••••••••••••••••••
A27 Frequency Percentage Bar Chart  (A27=adequacy-spring headend)
0      16        25.8    ••••••••••••••••
1      46        74.2    ••••••••••••••••••••••••••••••••••••••••••••••
A28 Frequency Percentage Bar Chart  (A28=adequacy-spring tailend)
0      53        85.5    ••••••••••••••••••••••••••••••••••••••••••••••
1       9        14.5    ••••••••
A29 Frequency Percentage Bar Chart (A29=adequacy-overall proxy)
1       8        12.9    ••••••••
2      40        64.5    ••••••••••••••••••••••••••••••••••••••••
3       9        14.5    •••••••••
4       5         8.1    •••••
A30 Frequency Percentage Bar Chart (A30=consistently disadvantaged)
0       5         8.1    ••••
1      57        91.9    ••••••••••••••••••••••••••••••••••••••••••••••
A31 Frequency Percentage Bar Chart (A31=deprived of their benefits)
0       1         1.6    •
1      61        98.4    ••••••••••••••••••••••••••••••••••••••••••••••
A32 Frequency Percentage Bar Chart (A32=gab of least and most advantaged)
0       2         3.2    ••
1      60        96.8    •••••••••••••••••••••••••••••••••••••••••••••
A33 Frequency Percentage Bar Chart  (A33=equity- overall proxy a30-a32)
3       5         8.1    ••••
4      57        91.9    ••••••••••••••••••••••••••••••••••••••••••••••
A34 Frequency Percentage Bar Chart (A34=reliability)
2      57        91.9    ••••••••••••••••••••••••••••••••••••••••••••••
3       5         8.1    ••••
A35 Frequency Percentage Bar Chart (A35=cropping turnout)
4.6       1         1.6    •
4.8       4         6.5    ••••
4.9      11        17.7    •••••••••••
5        22        35.5    ••••••••••••••••••••••
5.2       1         1.6    •
5.2       4         6.5    ••••
5.4       1         1.6    •
5.5      16        25.8    ••••••••••••••••
5.6       1         1.6    •
6         1         1.6    •
A36=A37 Frequency Percentage Bar Chart(A36=productivity head/tail intensity
100      36        58.1    ••••••••••••••••••••••••••••••••••••
120       1         1.6    •
130       1         1.6    •
150      10        16.1    ••••••••••
170       8        12.9    ••••••••
180       2         3.2    ••
200       4         6.5    ••••
A38 Frequency Percentage Bar Chart (A38=type of governance)
0       3         4.8    ••
1      59        95.2    ••••••••••••••••••••••••••••••••••••••••••••••
A39 Frequency Percentage Bar Chart (A39=headworks status)
0       3         4.8    ••
1      59        95.2    ••••••••••••••••••••••••••••••••••••••••••••••
A40 Frequency Percentage Bar Chart (A40=canal lining)
0       5         8.1    ••••
1      57        91.9    ••••••••••••••••••••••••••••••••••••••••••••••
A41 Frequency Percentage Bar Chart (A41=alternatives)
0      18        29.0    ••••••••••••••••••
1      44        71.0    ••••••••••••••••••••••••••••••••••••••••••••
A42 Frequency Percentage Bar Chart (A42=variance of annual family income)
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0      57        91.9    •••••••••••••••••••••••••••••••••••••••••••••••••
1       5         8.1    ••••
A43 Frequency Percentage Bar Chart (A43=terrain)
0      13        21.0    •••••••••••••
1      49        79.0    •••••••••••••••••••••••••••••••••••••••••••••••••
A47 Frequency Percentage Bar Chart (A47=entrepreneurial activities)
0       1         1.6    •
1      61        98.4    •••••••••••••••••••••••••••••••••••••••••••••••••
A49 Frequency Percentage Bar Chart (A49=overall rules of moni. & sanct.)
0       2         3.2    ••
1      60        96.8    •••••••••••••••••••••••••••••••••••••••••••••••••
A50 Frequency Percentage Bar Chart (A50=information rules on water use)
0       2         3.2    ••
1      60        96.8    •••••••••••••••••••••••••••••••••••••••••••••••••
A51 Frequency Percentage Bar Chart (A51=information rules on resource mob.)
0       2         3.2    ••
1      60        96.8    •••••••••••••••••••••••••••••••••••••••••••••••••
A52 Frequency Percentage Bar Chart (A52=penalty rules for violation)
0       4         6.5    •••
1      58        93.5    •••••••••••••••••••••••••••••••••••••••••••••••••
A53 Frequency Percentage Bar Chart (A53=water appropriation rights)
0      61        98.4    •••••••••••••••••••••••••••••••••••••••••••••••••
1       1         1.6    •
A54 Frequency Percentage Bar Chart (A54=monitoring by each other)
0       2         3.2    ••
1      60        96.8    •••••••••••••••••••••••••••••••••••••••••••••••••
A55 Frequency Percentage Bar Chart (A55=variations of sanctioning level)
0       2         3.2    ••
1      60        96.8    •••••••••••••••••••••••••••••••••••••••••••••••••
A56 Frequency Percentage Bar Chart (A56=degree of rule conformance)
0       1         1.6    •
1      61        98.4    •••••••••••••••••••••••••••••••••••••••••••••••••
A57 Frequency Percentage Bar Chart (A57=degree of rule violation)
0      44        71.0    •••••••••••••••••••••••••••••••••••••••••••••••
1      18        29.0    •••••••••••••••••••
A58 Frequency Percentage Bar Chart (A58=trust among farmers)
0      10        16.1    ••••••••••
1      52        83.9    •••••••••••••••••••••••••••••••••••••••••••••••••
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Figure 4-4. Relationship Testing between Propositions with Three Attributes Variables and Performance of the Irrigation Systems under the FSMDP: IAD framework

Physical

Attributes		
Proposition P1(Small irrigated size and small number of farmers) Proposition P2(Clearly defined boundaries) Proposition P3(Predictability of water supply and alternative water sources) Proposition P4(Physical infrastructure and terrain conditions (feasible improvement)	Prop. P1 ? (+) Outcome O1, O2, O3 , O5, O6 Prop. P2 ? (+) Outcome O2, O4, O6, O7 Prop. P3 ? (+) Outcome O1,O5, O6, O7 Prop. P4 ? (+) Outcome O1,O2, O5, O6, O7	
Community Attributes	→	Performance (Outcomes)
C1:Income dependency's on irrigation (Salience). C2:Shared norms and common understanding C3:Past organization experience and local leadership (social capital) C4:Interdependent trust and reciprocity among group members C5:Autonomy C6:Low discount rate of irrigation future	Prop. C1 ? (+) Outcome O1, O2, O3, O4, O5, O6, O7 Prop. C2 ? (+) Outcome O1, O2, O3, O4, O5, O6, O7, Prop. C3 ? (+) Outcome O1, O2, O3, O4, O5, O6, O7, Prop. C4 ? (+) Outcome O1, O2, O3, O4,O5, O6, O7 Prop. C5 ? (+) Outcome O1, O2, O4, O5, O7 Prop. C6 ? (+) Outcome O1, O2, O3, O4, O5, O6, O7	:Water supply O1:Water supply (reliable and predictable supply and adequacy) O2:Physical condition and maintenance of water delivery facilities O3: Distribution of Benefits and costs (equity) O4:Degree of rule conformance O5: Efficiency O6:Agricultural productivity O7: Sustainability and accountability
Institutional Arrangements		
I1:Simple and understandable rules I2:Locally devised access and management rules I3:Multiple layers of rules: operational and collective choice rules I4:Ease in enforcement of rules I5:Graduated sanctions I6:Availability of low-cost adjudication I7:Accountability of monitors and other officials to users I8:Contract aid rule (external monetary stimulus)	Prop. I1 ? (+) Outcome O1, O2, O4, O5, O6, O7 Prop. I2 ? (+) Outcome O1, O2, O4, O5, O6, O7, Prop. I3 ? (+) Outcome O1, O2, O3, O4, O5, O6, O7, Prop. I4 ? (+) Outcome O1, O2, O4, O6, O7 Prop. I5 ? (+) Outcome O1, O2, O4, O6, O7 Prop. I6 ? (+) Outcome O1, O2, O3, O4, O5, O6, O7 Prop. I7 ? (+) Outcome O1, O2, O4, O5, O6, O7 Prop. I8 ? (+) Outcome O1, O2, O3, O4, O5, O6, O7	

CONCLUSION AND POLICY IMPLICATIONS

Until now, we raised three research questions (what factors of sustainable self-governing irrigation systems are; to what extent the 1st FSMDP has such factors with several propositions; how the performance of 1st FSMDP is) and tested them with 62 Korean irrigation systems in the

IAD framework. Research method and data collection were conducted by creating KORIS DB and farmers' perception survey case studies. When we reflect the worldwide issue of farmers' non-cooperative role in relation to participation in governing AMIS, the 1st FSMDP is very important.

Based on the evaluation results of the 1st FSMDP, first of all, the 1st FSMDP has been designed with profound sustainable self-governing factors. In terms of physical attributes, they are P1 (small irrigated size and small number of farmers/spatial extent), P2 (clearly defined boundaries), P3 (predictability of water supply and alternative water sources), and P4 (physical infrastructure and terrain conditions/feasible improvement). In terms of community attributes, they are C1 (income dependency's on irrigation/Salience), C2 (shared norms and common understanding), C3 (past organization experience and local leadership/social capital), C4 (interdependent trust and reciprocity among group members), C5 (autonomy), and C6 (low discount rate of irrigation future). Also, sustainable self-governing factors in institutional arrangements include I1 (simple and understandable rules), I2 (locally devised access and management rules), I3 (multiple layers of rules: operational and collective choice rules), I4 (ease in enforcement of rules), I5 (graduated sanctions), I6 (availability of low-cost adjudication), I7 (accountability of monitors and other officials to users), and I8 (contract aid rule/external monetary stimulus).

Second, reflecting on the propositions and three attributes in the IAD framework, most of 62 irrigation systems satisfy positively the propositions (4 propositions in physical attributes, 6 propositions in community attributes, 8 propositions in institutional arrangements). In other words, three attributes (physical, community, institutional) for sustainable self-governing systems affect very positively the performance or outcomes of 62 irrigation systems under the 1st FSMDP. Also, design principles emphasized by E. Ostrom are identified in the FSMDP, which produce the positive performance and outcomes of irrigation systems under the FSMDP.

In conclusion, most of irrigation systems under the 1st FSMDP are being operated with de jure and de facto rules under greater sustainable self-governance. These results come from the indigenous and traditional cooperation of KARIO officials and farmers before the KARICO reform. Also, such outcomes are due to the traditional experience of organizing farmers' self-organization (Farmland Improvement Association) even under the AMIS. In fact, current KARICO officials and farmers were members in the previous farmers' organization (WUO) operated by Farmland Improvement Association before the KARICO.

However, the farmers under the FSMDP are not still satisfied with the operation of FSMDP based on survey perceptions. So the Korean KARICO should understand the incentives of farmers in governing AMIS. Several prior works (Shivakoti and E. Ostrom, 2002; E. Ostrom et al., 2002b; Tang, 1992; E. Ostorm, 1992) deal with the incentives of FMIS. They will be helpful for the continuous FSMDP.[8] Through the works, we need to examine how institutional arrangements affect the incentives of government officials and farmers to perceive long-term costs and benefits realistically and to make efficient investments in irrigation facilities and in the governance and management of irrigation systems. The issues are of substantial importance for the Korean FSMDP.

Aside from the incentives faced by officials in government irrigation systems, first of all, the incentives faced by farmers on AMIS can be adopted from the incentives faced by farmers on self-organized systems (E.Ostrom, 1992; Tang, 1992; Lam 1998). They are as follows: 1) Secure land tenure so they can presume they will reap the longer –term benefits of their collective action; 2) The capacity to relate and communicate with one another repeatedly on a face-to-face; 3) A common understanding that they would each be able to increase their agricultural yields enough through the provision of an irrigation system potentially to compensate each of them, depending

[8] Hugh Turral (1995) gives five basic reasons for the substantial underperformance occurring in the irrigation sector, substandard construction or design, poor system and service provision, and poor understanding of farmer priorities and inadequate markets for produce (E. Ostrom, 2002).

on the sharing formula agreed upon, for the costs of their immediate and long-term investments; 4) A common understanding that they would have to enforce their own rules on a day-to-day basis but could count on external authorities not to interfere in their rule-making, rule-following, and rule-enforcement activities; 5)A common understanding of a repertoire of rules that, if enforced, can effectively counteract perverse, short-term incentives; 6) A common understanding that if they agree to a set of rules and follow accepted procedures to signify their agreement that each participant would be pre-committed to follow these rules or be sanctioned by the others for nonconformance; and 7) Trust that most of the farmers, who agreed to a set of rules and denoted their agreement in an accepted way, would actually follow these rules most of the time so that the effort to monitor and enforce these rules would not be itself extremely costly.[9] In particular, Tang (1992) emphasizes the issue of how to coordinate bureaucratic agencies to local, self-governing organizations and suggests enhancing the local self-governing organization

Second, participatory management has been advocated as a distinct policy for irrigation development and management in many Asian countries. This policy comes from growing recognition the importance of local knowledge and experience. So we need to educate and inform the significance of participatory irrigation management (PIM). Most of FMISs in Nepal are practicing the good lessons of PIM (Shukla, 2002). In Nepal, there was growing realization of users' participation in the implementation, operation, and maintenance of irrigation projects. The bottom-line is to maximize the involvement and participation of users so as to decrease the government responsibilities in development and management of irrigation system and thereby promoting local resources mobilizing and self-reliance.[10]

Third, as Lam (1998) emphasized, rules-in-use regulating the activities and relationships among the individuals should be flexible and responsive enough to cope with ever-changing situations. The bottom line is that farmers in the FSMDP are able to engage in rule-crafting activities to make corresponding adjustments in institutional arrangements.

Fourth, for the successful FSMDP, proper financing, legal issues of irrigation organization, association of farmers' organization, and PIM should be continuously considered. In particular, water charges (taxes) abolished in 2000 should be reconsidered for co-production or team production between farmers and KARICO.

Finally, based on the results of KARICO evaluation of the 1st FSMDP, some grand de jure rules should be changed as follows. Boundary rules for FSMDP application qualifications should be limited with over 50 hectares. The reason is that the operation budget of systems below the 50 hectares may be wasted. Contract aid rule of operating cost assistance on the basis of system area should be changed. That is, within the budget of district, farmers should voluntarily decide the cost. The incentives of positive participation of farmers should be developed. For example,

[9] For rational farmers to contribute to the collective effort of operating and maintaining irrigations systems, institutional arrangements should be designed so that they 1) allow farmers to develop common conceptions of what could be achieved by working with one another, and how they could work with one another. 2) Enhance farmers' expectations that the collective action for O&M is doable, and that they will reap the long-term benefits of the collective action, though some farmers might enjoy a larger share than the others. 3) Can reduce the uncertainties faced by farmers by inducing information and by counteracting opportunistic behavior 4) Provide mechanisms for conflict resolution, monitoring, and sanctioning to enhance farmers' confidence that the rules are followed and enforced. 4) Are commonly understood and agreed upon by a community of farmers. 5) Are responsive to changing environments. 6) Sustain farmers' belief of the advantages and viability of the rules by continuously reinforcing farmers' common understanding and common agreement (E. Ostrom, 1994)

[10] In Nepal, two action plans have been implemented: Turnover Program and Joint Management Program. The former means that operation and management of irrigation systems constructed and managed by the DOI are to be turned over to the organized group of water users. The latter deals with shared operation and management responsibility between DOI and water users (Shukla, 2002).

farmers may participate actively in the Water Management Committee established in 2002. The contract period should be extended by one year for the responsibility of facilities management. [11]

REFERENCES

Agrawal, Arun. 2002. "Common Resources and Institutional Sustainability." In The *Drama of the Commons*, eds. Elinor Ostrom et al., 41-85. Washington, DC: National Academy Press.

Anderson, Terry L.1983. *Water Crisis: Ending the Policy Drought*, Washington, D.C.: Cato Institute.

Coase, R.H. 1988. *The Firm, the Market, and the Law,* Chicago: University of Chicago Press.

Demsetz, Harold. 1967. "Toward A Theory of Property Rights." *American Economic Review*, Vol. 62, No. 2, 347-359.

Eggertson, T. 1990. *Economic Behavior and Institutions*, Cambridge: Cambridge University Press.

Hardin, Garrett. 1968. The Tragedy of the Commons. *Science*, Vol. 162(December), 1, 243-1, 248.

Hilton, Rita. 2002. "Institutional Incentives for Resource Mobilization in Farmer-Managed and Agency-Managed Irrigation Systems." In Improving *Irrigation Governance and Management in Nepal*, eds. Ganesh Shivakoti and Elinor Ostrom, 150-178. Oakland, California: Institute for Contemporary Studies.

Joo, Seuk-Hun. 1998. "Republic of Korea." *Irrigation Association for Participatory Management in Asia.*100-113. Asian Productivity Organization.

KARICO (2000, 2002), White Paper and Internal Data of the FSMDP.

Kiser, L. and E. Ostrom. 1982. "The Three World of Action: A Metatheoretical Synthesis of Institutional Approaches." In *Strategies of Political Inquiry*, Elinor Ostrm, ed. 179-222. London: Sage Publication.

Lam, Wai Fung. 1998. *Governing Irrigation Systems in Nepal: Institutions, Infrastructure, and Collective Action.* Oakland, California: Institute for Contemporary Studies.

North, Douglas. 1990. *Institutions, Institutional Change, and Economic Performance*. Cambridge: Cambridge University Press.

Olson, Mancur. 1965. *The Logic of Collective Action: Public Goods and the Theory of Groups*. Cambridge: Cambridge University Press.

Ostrom. Elinor. 1986. "An Agenda for the Study of Institutions." *Public Choice* 48: 3-25.

Ostrom. Elinor. 1990. *Governing the Commons: The Evolution of Institutions for Collective Action*. New York, NY: Cambridge University Press.

Ostrom, Elinor. 1992. *Crafting Institutions for Self-Governing Irrigation Systems*. San Franscico, California: ICS Press.

Ostrom, Elinor and Paul Benjamin. 1993. "Design Principles and the Performance of Farmer-Managed Irrigation Systems in Nepal." In *Performance Measurement in Farmer-Managed Irrigation Systems*, ed. Shaul Manor and Jorge Chambouleyron, 53-62. International Irrigation Management Institute.

Ostrom, Elinor, Paul Benjamin, and Ganesh shivakoti (1994). "Use of Case Studies and

[11] The limitation of this study does not provide the in-depth discussion of specific biophysical (i.e., regions of Korea, the impact of being hilly or not hilly, types of canal) and community attributes of district irrigation systems beyond the table, which will be conducted in the future research.

Structural Coding in a Relational Detabase for Storage and Analysis of Irrigation Institutions and Systems in Nepal." R94-13.
Ostrom, Elinor, Gardner, Roy, and James Walker. 1994. *Rules, Games, and Common-Pool Resources.* Ann Arbor, Michigan: The University of Michigan Press.
Ostrom. Elinor. 1998. "Reforming the Commons." Working Paper W98-28, Center for the Study of Institutions, Population, and Environmental Change. Indiana University.
Ostrom, Elinor. 2002. "The Challenge of Underperformance." In Improving *Irrigation Governance and Management in Nepal*, eds. Ganesh Shivakoti and Elinor Ostrom, 3-33. Oakland, California: Institute for Contemporary Studies.
Ostrom, Elinor et al. 2002a (eds). *The Drama of the Commons*. Washington, DC: National Academy Press.
Ostrom, Elinor et al. 2002b. *Aid, Incentives, and Sustainability: An Institutional Analysis of Development Cooperation.* Sida Studies in Evaluation #02/01, Stockholm, Sweden: Swedish International Development Cooperation Agency.

Shivakoti, Ganesh and Elinor Ostrom. Eds. 2002. *Improving Irrigation Governance and Management in Nepal.* Oakland, California: Institute for Contemporary Studies.
Shukla, Ashutosh. 2002. "Policies, Processes, and Performance of Management Turnover and Agency- Initiated Interventions." In Improving *Irrigation Governance and Management in Nepal*, eds. Ganesh Shivakoti and Elinor Ostrom, 75-102. Oakland, California: Institute for Contemporary Studies.
Tang, Shui Yan. 1992. *Institutions and Collective Action: Self-governance in Irrigation*. Oakland, California: Institute for Contemporary Studies.
Tang, Shui Yan. 1991. "Institutional Arrangements and the Management of Common-Pool Resources." *Public Administration Review*, Vol.51, No.1. pp: 42-51.
Vermillion, Douglas and Juan Sagardoy. 1999. *Transfer of Irrigation Management Services: Guidelines*. FAO Irrigation and Drainage Paper.
Williamson, Oliver. 1975. *Markets and Hierarchies*. New York: Free Press.
Williamson, Oliver. 1985. *The Economic Institutions of Capitalism.* New York: Free Press.