Institutional Design of Public Agencies and Coproduction: A Study of Irrigation Associations in Taiwan

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Summary. — The provision and production of many public goods and services involve the joint effort of government officials and citizen-users. This paper examines the successful experience of irrigation governance and management in Taiwan as a means of understanding how joint efforts can be established and sustained through institutional arrangements. Several principles for institutional design, including a careful definition of the scope of farmers' participation, complementarity of interests between individuals, reduction of asymmetries involved in the use of authority, and the existence of domains of autonomy are identified as instrumental to the success in Taiwan.

1. INTRODUCTION

Taiwan's irrigation systems are reportedly among the most effective in the world. In a study comparing the water delivery efficiency in different rice-growing systems in Asia, Levine (1977) estimated that the basic water requirement per crop in Taiwan was 1,000 mm, as compared to 2,500 mm in the Philippines and 1,400 mm in Malaysia. In the Tou Liu system in Taiwan (currently part of the Yunlin Irrigation Association), the requirement was even as low as 650 mm. The effectiveness, however, is not confined to the high levels of efficiency in water delivery. Water delivery and distribution in Taiwan's irrigation systems are generally organized in an orderly manner, and the physical structures are kept in relatively good condition (Moore, 1983, 1989).

One might be tempted to attribute this effectiveness to the heavy investment made by the Taiwanese government in irrigation development and to the sophisticated engineering infrastructure that is commonplace in Taiwan. A high level of infrastructural investment, however, does not tell the whole story. Even the most sophisticated structures must be operated by individuals. How these individuals work with one another significantly affects irrigation performance (Coward and Levine, 1987; E. Ostrom, 1992; Ambler, 1993; Lam, 1994; Lam, Lee, and E. Ostrom, 1995).

Productive patterns of relationships, however, do not just exist; they are constituted and sustained by a large array of rules relating individuals to each other. Some of these rules are considered formal in the sense

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that they are created and enforced by governmental authority, others are considered informal in that they are sustained by "private" actions of individuals. Some of these rules are crafted by conscious efforts; others evolve slowly through human interaction. How these rules work together to allow individuals to realize their productive potential is a question of importance in resource management in particular, and public administration in general. This paper addresses this question by studying the successful experience of irrigation management in Taiwan.

Taiwan's successful experience in irrigation management is of major policy relevance, not simply because it is in sharp contrast to the experience of irrigation development in much of the developing world where many high-cost and sophisticated irrigation systems have been nonsustainable due to inadequate operation and maintenance (Ascher and Healy, 1990; Chambers, 1988; E. Ostrom, Schroeder, and Wynne, 1993). The persistent underperformance of irrigation agencies in much of the developing world in the last several decades has raised serious doubts about the usefulness and feasibility of relying on government officials to manage irrigation and other public services. The viability of government agencies serving as the agent for development has come under serious challenge. Taiwan's experience, however, represents a rare case where irrigation agencies work.

Numerous calls for reforming the governance structure for development have been made (Israel, 1992; Kessides, 1993; World Bank, 1994). Research findings suggest that self-governance can work and, in many instances, outperform government agencies in the management of an infrastructure and resources such as irrigation systems (Ostrom, Schroeder, and Wynne, 1993; E. Ostrom, 1990, 1992; Tang, 1992; Lam, 1994). Unfortunately, that self-governance can work (in some instances) has been used by some policy makers and researchers in developing countries as the justification for a policy recommendation that aims at downsizing, if not getting rid of, the government. Parallel to such a bias in the policy circle is the prevalence in resource management in particular, and public administration in general. This paper addresses this question by studying the successful experience of irrigation management in Taiwan.

2. THE SETTING

(a) Physical environment

Although rainfall in Taiwan is abundant, its distribution is uneven in both space and time. While the annual average rainfall in the northeastern part of the country is about 6,500 mm, it is only 1,000 mm on the west coast where most of the cultivated land is located. Moreover, more than 80% of the total rainfall falls between June and October. In other months of the year, the monthly average rainfall is rarely more than 100 mm. During the winter season, areas on the west coast commonly have no rainfall. Thus, effective irrigation management is a major factor affecting the extent of agricultural potential that can be realized.2 The physical environment in Taiwan is hostile to irrigation. Rivers are short and with high gradients. This, together with the high concentration of rainfall in the rainy season, results in a high level of run-off flowing into the sea (Kuo, 1986).

(b) Socioeconomic context

Perhaps the most important event that fundamentally shaped the social landscape of Taiwan's rural areas was the Land Reforms conducted in the early 1950s.3 As a result of the Reforms, large landlords in Taiwan virtually disappeared. Since then, the country's agricultural sector has mainly comprised small family-owned farms. In 1952, the average farm size in Taiwan was 1.29 hectares. It dropped to 1.12 hectares in 1984, and to 1.1 hectares in 1992 (COA, 1993). Given the small size of farm households, effective irrigation management involves the collective action of a large number of irrigators that, in turn, requires a high degree of coordination and organization. A more intensive mode of irrigation management was deemed necessary. In addition, without large landlords who usually assume the traditional leadership role in the rural areas, farmers tend to organize themselves around scattered small groups. Such small group centricity, to a certain extent, explains why farmers in Taiwan do not stand out as having unusual levels of trust and solidarity. Earlier research indicates that
farmers in Taiwan did not hesitate to engage in water theft when water was scarce (VanderMeer, 1971).

(c) Institutional overview

The primary irrigation institutional arrangements in the country are the 17 Irrigation Associations (IAs), which have the responsibility of operating and maintaining irrigation systems located within one or more hydraulic regions. These IAs are parastatal agencies that are legally owned and formed by farmers and supervised by governments at higher levels. Their legal status as juristic entities entitles them to a high degree of de jure autonomy and also certain public authorities to levy water fees.

The activities of the IAs are primarily confined to main-system management. The IA staff at headquarters diverts water to a system and allocates water to different regions. Within a region, a management station coordinates water allocation to different areas. A working station is in place in each area to deliver water to various irrigation districts. Within an irrigation district, the tasks of operation and maintenance are presumably coordinated by a network of irrigation groups (IGs). The structure and operation of IGs vary, depending on specific local environment. Usually, an irrigation district is further divided into several irrigation blocks; in each of these blocks, farmers are presumably organized into irrigation teams (ITs) to carry out the tasks of operation and maintenance. While IGs and ITs are said to be farmers’ self-organizing units, they appear in organizational charts as subsidiaries to the IAs.

Government agencies at various jurisdictional levels are also involved in the governance and management of irrigation. At the local level, the interaction between the IAs and local organizations, such as the county governments, conditions the ways that irrigation systems are governed and managed. At the provincial level, the Provincial Water Conservancy Bureau is in place to formulate and implement water resource policies. The Bureau is also responsible for supervising the IAs. Every year, each IA is required to submit a report with details on very aspect of its operation during the last year to the Bureau for review; in addition, every year the Bureau sends a working team to the IAs to evaluate their operation and performance, and to audit their budgets. At the national level, the Council of Agriculture is the lead agency that formulates policies concerning irrigation in general and the operation of the IAs in particular.

3. TEAM PRODUCTION, COPRODUCTION, AND GOVERNANCE

An irrigation system is a common-pool resource (CPR) where the cost of excluding potential beneficiaries is nontrivial and benefits are subtractable (Gardner, Ostrom, and Walker 1990). If any farmer can take water from a system whether or not he or she has contributed to the operation and maintenance of the system, he or she sees few incentives to contribute. Furthermore, when the water supply is scarce and unpredictable, allocation of water is necessary to ensure that water is distributed equitably and used productively. The need to allocate water, however, implies that farmers are likely to obtain a smaller amount of water than they desire. Farmers usually want enough water to attain the highest possible returns by working their land to its full potential, they also want more water as insurance against risk and unexpected exigencies. Given the threat of a substantial crop loss, there are usually temptations for farmers to take more water than allowed or to take water out of turn.

(a) Team production and coproduction

The concept of team production is central to the understanding of the problem of motivation in irrigation agencies. Organization enables individuals to reap the benefits of team production. Many complex tasks in the public sector cannot be accomplished unless individuals put their efforts and resources together and work as a team. Team production, however, is rarely a simple process of pooling the efforts and resources of individuals. It is a process through which individual efforts and resources are structured in complementary ways that yield a higher level of joint productivity (Lachmann, 1978). This is why, in a team production process, the marginal productivity of an individual is a function of the efforts of the others (Alchian and Demsetz, 1972).

Coproduction is a form of team production. In a coproduction process, the efforts of the irrigation officials (the regular producers) and those of the farmers (the consumer producers) are largely interdependent; neither can totally substitute for the other (Parks et al., 1982). In the irrigation process, while officials might possess “scientific” knowledge concerning some physical aspects of irrigation systems, the farmers possess time-specific and place-specific local knowledge of the systems upon which their livelihood depends (Freeman, 1990). Only when both kinds of knowledge are utilized can effective operation and maintenance be attained.

The interdependence of efforts may give rise to the problem of shirking similar to the setting of team production. In many large-scale irrigation systems, irrigation officials assume that water allocation and maintenance are the responsibilities of the farmers because farmers are directly affected by the performance of operation and maintenance. From the farmers’ per-
productive working relationships with one another. Because the officials are the "managers," they are the ones who "should" be doing the operation and maintenance. Since both farmers and officials think that managing the system is the responsibility of the other, it is possible that neither of them invests much effort in irrigation management activities. If no one maintains the systems, they begin to operate less effectively. Such a problem is often exacerbated by the blurred boundary between those who constitute the members of the coproduction team.

For a coproduction process to succeed, incentives must be in place so that regular producers (the irrigation officials) are motivated to serve the interests of consumer producers (the farmers). If the payoffs to irrigation officials are somewhat dependent on how well they serve the farmers, the officials are more likely to take the interests of the farmers into consideration. Unfortunately, there are usually few intrinsic incentives in irrigation that could motivate irrigation officials to serve the interests of farmers. Irrigation officials are usually not the ones who have a stake in the efficient operation of the irrigation systems in which they work. Whether the officials take the interests of the farmers into consideration depends on how the relationships between the officials and the farmers are understood and structured in particular societies.

(b) Governance

Unlike irrigation construction that deals with the delivery of tangible goods such as dams and canals, irrigation management is mainly concerned with the provision of a less tangible good: rule-ordered relationships among farmers. This puts irrigation management in the policy domain where the patterns of relationships between individuals, as a way of life, are part of the situation that the agencies are meant to deal with. Policy outcomes, that is, the degree to which these problems are resolved, are inherently linked to how well individuals can work with one another.

In irrigation, effective water delivery largely hinges upon farmers following water allocation rules, taking care of their system in daily exigencies, and contributing their efforts to the maintenance of the structures whenever necessary. While these patterns of relationships are a major part of the outcomes of irrigation management, they cannot be "produced" directly by irrigation officials. Thus, assigning an irrigation agency to handle irrigation does not automatically solve the problems of collective action among farmers involved in irrigation operation and maintenance. What is essential is to design the governance structure in the way that rules are crafted, monitored, and enforced, so that they enable farmers to establish productive working relationships with one another.

How the agencies can fit in the governance structure is a question of major import in institutional design.

The problems of team production, coproduction, and governance can serve as the point of departure for understanding the operation and performance of irrigation institutions in Taiwan. In the following sections, I examine the design of Taiwan's irrigation institutions, and the mechanisms through which these institutions enable individuals to cope with the problems. The analysis proceeds from three angles: (i) the structures and incentives within the IA; (ii) the ways that water delivery is carried out in the field; and (iii) the interactions between farmers and officials.

4. INSIDE THE BUREAUCRACY: THE STRUCTURE AND PROCEDURES

Like a typical government agency in Taiwan, the structure of an IA is highly bureaucratic and centralized, and designed upon the principles of division of labor and hierarchical control. At the top of the bureaucracy is a chairman who, until 1994, was elected by farmer representatives who were in turn elected by farmers. The chairman appoints a general manager and a chief engineer, who assist the chairman in overseeing the operation of the association. The day-to-day operation is carried out by various divisions responsible for specialized functions. Within a particular division, the tasks are further divided and assigned to several sections.

The centralized image is also reflected in the relationships between the IA headquarters and its field offices (management stations and working stations). The field offices are perceived as the implementation arms of the headquarters. They collect information necessary for irrigation planning, and manage the implementation of irrigation plans and other tasks assigned by the headquarters. While the working stations assist the headquarters in making decisions concerning irrigation management, they do not participate in the decision-making process.

(a) Flexibility

The bureaucratic characteristics of the IAs in Taiwan seem to contradict the image portrayed by prior research. It is particularly interesting that while observers have often likened the IAs to street-level bureaucracies where coordination, discretion, and responsiveness are emphasized, officials in both the central government and the IAs have always emphasized the importance of hierarchy and control in the associations. The puzzle, then, is how the two seemingly contradictory images can be reconciled and geared toward enhancing the performance of the associations.

A possible answer to the puzzle is that the head-
quarters and the working stations operate on quite different principles, which allow them to deal with problems of different scopes and nature at different levels. The formal organization of the working stations is based upon the bureaucratic image of the headquarters. A station chief is assigned to oversee the operation of a station, and the station staff members are assigned to various sections with specific functions such as engineering and irrigation management. Unlike at the headquarters, however, the size of the working station staff is usually very small, with an average of eight persons. The small staff makes the division of labor by functions more a formality than a meaningful organizational feature. That every one of the staff sits in an open office space further shortens their social distance.

Instead of a division of labor by functions, the small size of the staff makes it necessary to have division of labor by irrigated areas. Each official at the working station, including the station chief, is assigned the responsibility of overseeing the irrigation management of a certain number of IGs and their irrigated areas. The official, then, serves as the contact person between the working station and farmers in particular areas. This type of division of labor facilitates communication between the IA officials and farmers, but more important, it affects the dynamic of interaction among officials within a working station.

First, a division of labor by irrigated areas, to a certain extent, enables individual officials to monopolize information on their particular areas. This area-specific information becomes a unique asset of individual officials. Since every piece of such area-specific information is essential to the effective operation of the working station, each official holds a key to the overall success of the station. Officials who feel they have something important to contribute to their organization are more likely to perceive their work as meaningful and to do a conscientious job. Moreover, since effective irrigation management in a particular area usually requires complementary actions of officials managing the adjacent areas, horizontal coordination among officials becomes necessary. Thus the working station staff is put in an interdependent situation of which they are well aware. Such awareness not only helps create collective identity among the staff but also signifies to them the importance of cooperation.

Second, assigning individual officials areas for which they are responsible implicitly holds them accountable to what might happen in the assigned areas. An official is likely to face much pressure from others in the station if his or her area faces persistent problems. In fact, assigning responsibilities in this way also applies to the working stations as a whole. By assigning each working station to oversee the irrigation management of a particular area, officials at the station are held collectively responsible for what might happen in the area. Such collective responsibility creates a sense of collective identity among officials, which transcends hierarchical relationships among them.

While work at the headquarters is basically a nine-to-five routine, work at the working stations requires much more flexibility. The need for such flexibility is well known, and has been consciously promoted through various institutional arrangements. A standard working station is a two-storied building. While the ground floor is used for office space, the upper floor is an apartment where the station chief and his family live. Living in the station, the chief is expected to stay alert 24 hours a day. This arrangement allows the working station to better deal with emergencies.

When emergencies come up, the chief alone is unlikely to be able to deal with them. Extra effort from other officials at the station is needed. These other officials, however, are not paid to make the extra effort. For these officials, giving their help to the chief in case of an emergency is doing the chief a favor; it would not be difficult for them to avoid making the extra effort if they chose. The subordinates' ability to do the chief a favor gives them bargaining power that, in turn, affects the way in which they interact with each other, vis-à-vis the chief. As a station chief succinctly puts it, "there will be many occasions when extra effort of the staff is required, whether the staff will offer the extra effort is purely a matter of goodwill. How can I offend them?" Under such a situation, the chief would find that command and control is unlikely to be an effective way to get things done.

Given that irrigation management involves many uncertainties, irrigation managers in almost every system in the world are expected to contribute extra effort when emergencies arise. What is special in the Taiwanese case, however, is that the station chief is locked into the task of dealing with emergencies by various kinds of institutional arrangements. He is targeted as the one who is given incentives and responsibilities to mobilize and coordinate necessary efforts for dealing with emergencies. Now compare this situation to that in many South Asian countries such as India and Nepal where irrigation officials managing the systems are also expected to deal with emergencies. There, with strict hierarchical control in place, subordinates do not have incentives to take any action before they are ordered to. Inflicting on the authority of superiors could be extremely detrimental to an official's career. Ironically, the requirement that the subordinates consult their superiors before they act provides a legitimate excuse for the subordinates to do nothing. So while every official knows that they, the officials as a whole, are expected to deal with emergencies effectively, which officials should be doing the job is not clear.
A more organic mode of organization at the working stations is possible only when the headquarters refrains from intervening. The low level of intervention, ironically, is made possible by the bureaucratic principle of strict division of labor across units at different levels. The headquarters is responsible for the overall planning, larger scale maintenance work, management of water sources, and water delivery at the system level. Once the water flows into laterals, it is the responsibility of the management stations to allocate water to different areas managed by different working stations. Usually the management stations only deal with the working station chiefs, but not farmers directly. It is clearly understood that the working stations are where the distribution of water to farmers' fields occurs, and where farmers interact with irrigation officials. Such an understanding is essential. It gives the working station chiefs leverage to make necessary adjustments in dealing with water allocation at the local level.

Such local autonomy is further enhanced in that the working stations are given the responsibility of facilitating, and communicating with, the IGs. Although the IGs are shown on the organizational chart as subsidiary units to the IAs, neither IA officials nor farmers see them as part of the associations. Irrigation officials often cite the respect for local democracy as a reason for their unwillingness to be involved in the IGs. But such a reason seems unlikely to be true, given that irrigation officials have never hesitated to intervene when necessary. Instead, several reasons might explain the officials' hesitancy. First, the IA staff see themselves largely as government agents (although they do not have civil service status) and irrigation professionals (even though most of them do not have professional qualifications). Organizing farmers in irrigation operations is not the kind of task that they see themselves fit to do. Second, the ambiguous nature of the IAs as parastatal organizations does not give the IA staff the legitimacy to intervene. While farmers as a whole might not actually play an active role in supervising the IAs, the image that farmers are the boss of the IAs is very clear in the mind of IA officials.

Third, from the perspective of the IA officials, being involved in the mushy business of water allocation at the field level is the last thing they want. It is especially the case in the areas where local factions do not get along with one another. Since it is clearly stipulated in regulations that water allocation at the field level is a responsibility of farmers, irrigation officials are glad to oblige. Finally, until very recently, the farmers' extra contributions (other than the water fees they were required to pay) in terms of voluntary labor and monetary chip-in were an important source of resources for irrigation management at the local level. These extra contributions were largely based upon farmers' goodwill as well as the calculus that they might enjoy payoffs from these contributions. Too much intervention from the IA could offend farmers and damage local goodwill. An unhappy farmer is unlikely to be willing to offer extra contributions.

Since the IAs do not see themselves in the position to be actively involved in the operation of the IGs, the headquarters maintains only limited formal interactions with the groups. The limited involvement of the headquarters in the IGs leaves a vacuum between the IA and farmers that the working stations are in the position to fill. Irrigation operation and maintenance at the local level requires cooperation and coordination between IA staff and farmers. As the officials at the working stations must deal with farmers in their work whether they want to or not, they must have de facto autonomy in dealing with the IGs. Such autonomy allows the working station staff and IGs to develop arrangements to cope with the local situations. For example, in systems where water mainly comes from natural springs and rivers, a water shortage might render rotation within an irrigation block necessary. The order of rotation is therefore arranged normally by farmers themselves. In many instances, farmers draw lots to determine the rotation order. Such an arrangement can be maintained, however, only when the working station is able to adjust water delivery to complement the agreed-upon order.

Earlier irrigation literature has pointed out the importance of a hand-over point between officials and farmers in irrigation management (Wade, 1987; Chambers, 1988). Yet the mere existence of a hand-over may not be enough, because whether the hand-over can be designed in a complementary manner depends on whether the two teams of individuals at the hand-over point are given liberty to work things out. The high degree of autonomy enjoyed by the working stations in dealing with irrigation groups has facilitated coordination between the two teams.

3. WORKING TOGETHER: THE ORGANIZATION OF WATER DELIVERY

While effective irrigation management involves close cooperation between officials and farmers, such cooperation cannot be taken for granted. A large array of rules must be in place to specify the division of work, to create positive incentives for the parties to contribute their efforts, and to help the parties maintain stable mutual expectations of each other. In this section, I decipher the "nuts and bolts" of the institutional arrangements in Taiwanese irrigation systems that relate the efforts of officials and farmers by examining the organization of water delivery — an activity that requires high levels of continual cooperation.

Given the diverse physical characteristics in dis-
parate locations in the country, there are diverse means by which water delivery is conducted. The following discussion deals mainly with water delivery in the Tainan area of the Chianan IA where the major water source for irrigation is two connected large-scale reservoirs, the Tsengwen Reservoir and the Wushantou Reservoir. These reservoirs make the practice of rotation irrigation possible.

(a) The formulation of the irrigation plan

The practice of rotation irrigation requires a relatively accurate and comprehensive irrigation plan. The process of working out the irrigation plan starts at the working stations. Every year before the first planting season, irrigation officials at the working station convene a meeting of IG leaders in the area to plan irrigation operations in the coming year. A major concern of discussion, of course, is the level of water demand for irrigation in the coming season.

Two factors are the basis upon which the water demand in a particular irrigation block is calculated. The first factor is the physical characteristics of the fields. These include soil type, the topography of the land, the rate of seepage of the soil, and the distance of the land from the gate to where water is diverted into the block. Information about all these physical characteristics is meticulously recorded and integrated in a formula used for the calculation of the amount and timing of water flow to particular fields. The second factor is the expected cropping patterns of the irrigated land.

It is obvious that variations in these two factors across time are minimal. On the one hand, the physical characteristics of the land are unlikely to change dramatically in the short run. The major source of change in physical characteristics is reduction in the size of irrigated areas due to changes in the patterns of land use. On the other hand, the expected cropping patterns are fixed and rarely adjusted. In fact, broad cropping categories such as “paddy” and “miscellaneous crops” used in the irrigation plan are meant to serve more as a yardstick in determining the amounts of water delivered to a particular area than to control what farmers grow in their fields. In other words, the so-called water demand is defined mainly with reference to the amount of water that a farmer is entitled to receive in a particular season.

Information on water demands provided by the IGs is gathered by the working station staff. The staff checks to see whether the information is reasonable, based upon the past records, and makes necessary adjustments. The information is then submitted to the headquarters. There, the management division staff first checks out the expected amount of water available in the coming year, based upon information about past years and weather forecasts. This estimate of water supplies is the most important variable that basically sets the constraints on the irrigation plan. If water is adequate to meet all the water demands, the management division staff can satisfy the demands (after making sure that the water demands are reasonable). If the expected water supply is inadequate, the management division decides which areas will receive water. Usually, areas that have the lowest rate of conveyance loss are given priority. In other words, upstream areas are usually given water during the period of water shortage. Areas that are not given water are left fallow. The central government (not the IA) will compensate farmers who own cultivated land in the fallow areas at a rate of NT 20,000 per hectare per season. Such an amount is about 50% of the revenue that would have been made had cultivation been possible. The IA’s freedom to decide how much land it is going to irrigate allows it to better balance water demand and water supply and, hence, to avoid overstretching its managerial capacity.

(b) Flexibility amid rigidity

The irrigation plan has a strong flavor of centralized control. Outside observers are frequently amazed, if not stunned, by how detailed the irrigation plan appears to be. The irrigation plan literally specifies the amount and the timing of water delivered to the fields of individual farmers; recently, such detailed calculation has been further facilitated by the use of computers. Obviously, if such a plan was strictly adhered to, it would require a very high level of managerial inputs on one hand, and would severely limit the flexibility of farmers on the other.

Such a possible pitfall of rigidity is coped with by the rule that water delivery within each irrigation block (i.e., below sublaterals) is taken care of by IGs organized by farmers themselves. Such an arrangement combines reliability and flexibility. On the one hand, farmers in a particular irrigation block, as a collective, are assured that they will receive a certain amount of irrigation water for the block. On the other hand, they are given much liberty in adjusting the distribution of water at the field level. In such a situation, the irrigation plan can serve three functions. First, it constitutes an implicit contract between IA officials and farmers — water demands are seen as entitlements of farmers rather than needs. Ironically, because these demands are fixed and rather stable, arbitrary actions on the part of officials are less likely. Such an implicit contract not only supports the farmers’ expectations of the reliability of water supplies, but also represents a plan of action, or a focal point, with reference to which farmers and officials work together.

Second, the plan can serve as a yardstick by which farmers evaluate officials’ performance. If farmers in an irrigation block have not received the amount of
water to which they are entitled, the IA officials are held responsible. Note that it is the IA who, based upon the expected water supplies, decides the size of area that will be delivered water. It would be impossible for them to blame the possible inefficiency in water delivery on the excessive demands of farmers.

Third, while the irrigation plan is not strictly implemented below the level of sublaterals, it does provide a framework with which water distribution among farmers is carried out. So while adjustments within an irrigation block are possible, outright inequality is likely to be prevented. It is a *de jure* right of a farmer who is not given the amount of water entitled to him to take the case to the working station for resolution. Furthermore, the entitlement nature of the irrigation plan implicitly creates water rights for farmers, which allow them to deal with one another more effectively.

As each farmer is entitled to receive a certain amount of water, each working station, then, has a claim for the amount of water equal to the summation of the amounts of water entitled to individual farmers in the area under its jurisdiction. Water claims at different levels set up a dynamic of backward monitoring in the process of water delivery. For an IG leader, being able to deliver the amount of water to which the farmers in his group are entitled requires that he insist on, if not fight for, their water allotment. By the same token, in order to have adequate water for irrigation groups in its jurisdiction, the working station also has the incentive to stick to its water claim. In other words, a unit at a particular level has the incentive to hold the unit from which it receives water accountable; or it will face problems from the unit to which it delivers water. Such a dynamic greatly enhances the mutual accountability between different units in the water delivery process.

(c) Water allocation at the field level

Prior research has noted that while the water distribution effort within an irrigation block is supposed to be organized by farmers, and rotation irrigation is supposed to be practiced, little is known about how it is actually carried out. The IT is supposed to be the farmers' organization that deals with water distribution within an irrigation block, but whether such an organization exists at all has been questioned by researchers. Since the IA has neither formal authority nor responsibility to manage water distribution within an irrigation block, farmers in different locales have been able to develop their own ways of coping with the problems.

IG and IT are most active in areas where rotation is seriously practiced and the amount and timing of water flows are specified. Neither IG nor IT exists in that their names suggest. Since farmers who are served by the IA are automatically members of the IG and IT, they have a right (or an obligation) to participate in the IG meetings before the planting seasons, and a right to vote in the election of the IG leader every four years (IT leaders are appointed by IG leaders). Yet unlike what many Taiwanese officials and earlier research have suggested, farmers in general are not actively involved in water delivery. In most instances, the IG leader and a few IT leaders are the only farmers involved in the operation of irrigation in particular areas.

The IG leaders, however, perform many important functions in facilitating irrigation management in Taiwan. One of these functions is to hire water guards to carry out water distribution as well as minor repair works. Usually, one to two water guards will be hired for each irrigation block. These are part-time positions and the salaries are paid by the IG. Water guards are the ones who actually operate the system and allocate water to individual farmers' fields. Conflict resolution is another function of IG leaders. As many of them are local notables who have many local social and political ties, they are respected by both farmers and IA officials. Thus, on one hand, their reputations give them "moral power" to serve as arbiters in resolving conflicts. On the other, their political and social resources enable them to interact with IA officials effectively.

Water guards are supposed to allocate water based upon the irrigation plan. In reality, however, they have a relatively high degree of autonomy in making necessary adjustments. Their high degree of autonomy generally comes from two sources. The first is their seniority in the local community. The water guards are usually local farmers. Obviously, as they are members of the local community, any acts that are perceived by farmers as unfair might place them under pressure of social ostracism. Second, a majority of the water guards are elderly men who have been serving as water guards for many years. As both IA officials and farmers are well aware, the task of allocating the water is not easy by any means. One has to know the physical as well as social landscapes really well to carry out the task effectively. Such knowledge cannot be taught but has to be learned by doing. The experience and local knowledge of water guards allows them to establish authority on matters concerning water allocation, and to gain confidence from farmers. Since the experience and local knowledge is highly specific, water guards cannot be easily replaced. As a result, threatening to quit becomes an effective leverage for the water guards to deal with farmers and IA officials. Such a threat is made even more credible by the low salary received by the guards. Although the salary varies across different IGs, it is normally about NT 400–500 per day. For many water guards, giving up such a small amount of money; if necessary, is not a hard choice to make. From the perspective of many irrigation officials and farmers, the job of the water guards is more like a community service than a way of earn-
ing money. By taking up the job, the water guards actually are doing the community a big favor. So unlike patrollers in many irrigation systems in South Asia who commend no respect either from their superiors or from farmers, water guards in Taiwan are seen as individuals who not only know irrigation and the local situation well, but are also willing to contribute to the local community.

6. INTERACTION BETWEEN IA OFFICIALS AND FARMERS

Discussion in the last section suggests that farmers and IA officials are able to develop complementary relationships in water delivery. While it is generally agreed that such complementary relationships are embedded in the broader pattern of cooperative relationships, how such a pattern of relationships is maintained is subject to less agreement. Earlier research argued that elections and water fee payments are the two major mechanisms that sustain the cooperative relationships. Recent research disputed the importance of these mechanisms and focused on the more subtle means that farmers use to hold IA officials accountable, such as signaling their dissatisfaction by delaying payments and social ostracism.

(a) Elections, water fees, and social embeddedness

Interviews with officials and farmers indicate that the elected farmer representatives have never played an important role in controlling the IA. These representatives might give some suggestions concerning the budget of the IA at the annual meeting, or stop by the headquarters once in a while to convey farmers’ concerns, and that is the extent of their involvement. Given that farmers in Taiwan are generally subservient and many of them are part-time farmers, it is not surprising that the representatives did not exercise effective control over the IA. More important, the election of farmer representatives was more of an extension of local politics than irrigation politics per se. The representatives were unlikely to pay as much attention to irrigation as warranted.

To most IA officials and farmers, water fees were similar to taxes that farmers had to pay. The government was effective in enforcing fee payment. Defaults in water fee payments happened from time to time, but in most of these instances, it was only because farmers did not receive water at all. Withholding payment of water fees was rarely used by the farmers as leverage to have their voices heard. In fact, the water fees have long ceased to be essential to the survival of the IAs. In most IAs, the water fees are not even enough to pay for the salaries of the IA officials. That the central government has been paying water fees on the farmers’ behalf since the early 1990s further breaks the link between the water fee payments and control by farmers.

While these formal mechanisms might not have carried the control functions that they were supposed to, they were not totally irrelevant. First of all, as some officials and farmers eagerly pointed out, the process of collecting water fees provided opportunities for officials to talk to farmers. These conversations were not necessarily about irrigation only, but also issues concerning the local community. In other words, these conversations were not formal communication between officials and farmers, but casual discussions between acquaintances. Such conversations might not help improve irrigation management directly, but they allow farmers and officials to gain a better understanding of each other’s views.

Second, the officials at the working stations were responsible for collecting water fees. Given the small size of the station staff, the help from the IG leaders was extremely important. As mentioned earlier, the IG leaders are mostly local notables who are respected by the local community; many of them are also representatives to various local government functionaries. Their help could make the process of water fee collection much easier and create incentives for the officials at the local level to maintain a close relationship with the IG leaders. To a large extent, it was just such a close relationship between the working station staff and the IG leaders that mediated the interaction between the IAs and farmers.

Third, although the farmer representatives did not perform the control functions that they were supposed to, their existence was essential to constituting the farmers’ perception of their relationship with the IA. As long as farmers saw their representatives in place to supervise the IA, they felt it was legitimate to speak out when they faced problems. According to IA officials, a result of the recent reform that replaced the elected representatives with appointed committee members has been a decrease in the number of farmers’ complaints. While such a decrease could be due to a better job done by the appointed members, it could also be due to a change in the farmers’ perception on their relationship with the IAs.

Recent research has argued that the embeddedness of local IA officials in the local community is a more important reason for the close relationship between officials and farmers. Irrigation officials are frequently residents of the local community. Their daily interactions with local people in the community can provide them with information on different issues concerning irrigation as well as the community. Since they are part of the community, any wrongdoing on their part that causes harm to the local community could put them under much social pressure or even social ostracism. Moreover, irrigation officials serving at the working stations tend to serve in particular
working stations for a long period of time. Knowing that they will have to deal with the same group of local farmers for a long time makes building a good relationship with them a good strategy.

(b) Local politics and social embeddedness

While IA staffs, farmers, and officials at the central government are fond of referring the IAs as organizations owned by, and representing, farmers and local communities, they generally take a dim view of local politics and tend to downplay its importance in the operation of the IAs. The ambiguous attitude toward local politics is reflected in the continual debate on the importance of elections, compared with control and guidance from the central government, in the operation of the IAs. There is no doubt that some IA officials play an active role in the elections of local public offices, and that local factions are to a certain extent involved in the elections of IA offices. To examine the effects of activities on the IAs, however, requires a detailed analysis of Taiwan’s local politics, which is beyond the scope of this paper. Several observations and conjectures on the way that local politics plays out, however, might shed light on how cooperative relationships between farmers and officials are sustained.

Many researchers and government officials have tended to understand the linkage between local politics and the IAs by focusing on the formal arenas such as the election of the farmer representatives and the IA chairman. They have thus often come to the conclusion that, notwithstanding the potential for rent-seeking activities, local politics has only minimal direct effects on the IAs’ day-to-day operations. What has not been given as much attention is the possibility that local politics might be instrumental in sustaining, if not facilitating, the embeddedness of the IAs in the local community. Space constraints, however, do not allow a detailed discussion of local politics in the country.

To understand how the embeddedness works out, however, several features of Taiwan’s local factional politics, as laid out by Bosco (1992), might be relevant. (i) In all local elections, factions provide the core of support to particular candidates. On average about two-thirds of the voters are estimated to be divided between two factions and the remaining one-third are the free voters to whom the factions try to appeal. (ii) Taiwan’s local factions are held together not by common ideology or class but by social ties such as kinship, patron-client relations, friendship, etc. They arose because although power and authority are concentrated in the hands of the Kuomintang (KMT) in which mainlanders dominate, the central authorities have to deal with local Taiwanese politicians in order to keep local order. (iii) Factions are usually visible only during elections. Outside of elections, most villagers maintain social relationships without consideration for faction.

The existence of local political factions, to a certain extent, provides essential glue to the rural society where the multitude of small farmers could have made any organizing efforts difficult. The competition among the factions, with their emphasis on bringing favors to constituents as an appeal to voters, can bring the farmers’ attention to public interests that pertain to their well-being. The competition, then, serves an interest-articulation purpose in a political system where, until the last several years, there was only one political party. Moreover, the factions that do not control the IAs have the incentive to monitor the ones who do. This creates a system of checks and balances in the operation of the IAs. As the factions usually overlap with various social ties at different levels, such a checks-and-balances mechanism has a rather comprehensive scope. It is the mutual reinforcement between local factions and social ties that makes embeddedness possible.

The competition between factions does not necessarily operate in a benign way. Yet the fluid structure of factions, the limited scope of factional activities, the need to appeal to the middle votes, and the overlap between factions and various social ties, all prevent the competition from getting out of hand. Furthermore, in maneuvering to keep factions under control, the ruling KMT government not only gears the operation of factional activities toward enhancing local governance, but also uses factions to help it control the countryside in which mainlanders have few social or political ties.

7. THE ROLE OF THE CENTRAL GOVERNMENT IN IRRIGATION GOVERNANCE

Political economists that are interested in the developmental state of Taiwan and other East Asian newly industrializing countries (NICs) often wonder at the seemingly paradoxical coexistence of an authoritarian state on the one hand, and space for self-organized activities in the society on the other. An important question, then, is what is the role of the central government in creating, or sustaining, the patterns of relationships described above. In particular, how do the actions of the government allow, or encourage, irrigation officials to make adjustments and to acquiesce to some self-organized activities by farmers?

(a) Government as epistemic leader

The central government plays an important role in setting the tone of what irrigation management is sup-
posed to be and how it should be conducted. By advocating ideas such as “serving the farmers comes first,” the government serves as an epistemic leader. The government not only promulgates ideas but actively carries out activities that promote and sustain them. For example, model IG leaders are selected and honored by the president of Taiwan every year; there is also an irrigation festival every year that highlights the importance of irrigation.

These ideas are extremely important in the governance of irrigation in Taiwan. First, they help constitute motivations faced by officials and farmers. A chance at being honored by the president, for example, has been a primary motivating force for many IG leaders to take up their jobs. Second, these ideas constitute the major part of the conceptualization of farmer-IA relationships commonly shared by farmers and officials. The way individuals see the game significantly affects how they are to play the game. Third, the activities that enhance these ideas can serve to signal the government’s commitment to irrigation development that is essential to hacking the bargaining power of farmers vis-à-vis IA officials.

(b) Government as arbiter

The shadow of the government also poses the fundamental constraints within which IA officials and farmers interact. Maintaining effective coproductive relationships requires a certain degree of reciprocity between officials and farmers. The sustenance of reciprocity involves, among other things, a relatively symmetric relationship, complementarity, and credibility. Government actions might help create and sustain these elements.

The farmers’ contribution to operating and maintaining field-level channels is substantial. IAs have neither the necessary resources nor the capability to micromanage water allocation and maintain farm-ditches. How much and how well farmers organize themselves and mobilize adequate resources for operation and maintenance affects the overall performance of irrigation systems. Note that those ultimately affected most by the overall performance are farmers themselves. IA officials have few intrinsic incentives to see to it that a certain level of performance is attained. Under such a situation, the interests of officials and farmers are in an asymmetric relationship.

Such asymmetry can be somewhat ameliorated if payoffs to officials are linked to the performance of the irrigation systems. If the government, which is capable to reward and punish the IA, is committed to satisfying the irrigation needs of farmers, farmers’ complaints represent a credible threat to IA officials. The dynamic of the situation changes in that the contributions of farmers are essential for officials to get their jobs done. It implies not only that officials would be more sensitive to farmers’ needs, but that fostering the self-organization of farmers is also in the interests of the officials. Government commitment, in other words, reduces the asymmetry on the one hand, and turns farmers self-organization into a complementary activity on the other.

(c) Government as a source of finance

Another of the central government’s role is as the major source of financial resources for the IAs. This was the case even before the government started paying water fees on behalf of farmers’ in the 1990s. The amount of financial support and the way that it is channeled to the IAs affect the capability as well as the management practices of the IAs.

The amount of financial support poses a constraint with which the IAs have to cope. Before the reform in recent years, for example, the government mainly provided financial support to engineering work, but not to the operation of the systems. It created a need for IAs to try to extract resources from farmers for operation and maintenance activities. Such a need may have had positive effects on the overall provision of irrigation services, for officials had incentives to maintain good relationships with farmers to make sure that the farmers’ contribution was forthcoming.

As the IAs are receiving a large amount of financial support from the government, their relations with the government have been a contentious issue. The core concern is that while the IAs are spending government money government control is minimal. How to make sure that the IAs spend the money in a responsible manner has become an important concern. Government subsidies, however, do not necessarily imply direct government control. While the government’s control at the constitutional level is significant, its involvement in collective-choice rules is minimal. This is where the IAs can exercise their autonomy in deciding how they operate, and how to raise and spend their money. The reason for the government’s restraint from intervening too much at this level is unclear. Given that the government has never hesitated to change the structure of the IAs when necessary, it is unlikely that the government avoids intervening simply to uphold local democracy. A more plausible reason is that the government finds itself incapable of micromanaging. But no matter what the reasons are, the government’s restraint allows the IAs to formulate policies and management practices that fit local situations.

7. CONCLUSION: INSTITUTIONAL DESIGN AND IRRIGATION GOVERNANCE

The provision and production of many public
goods and services involve the joint effort of government officials and citizen-users. This paper examines the successful experience of irrigation governance and management in Taiwan as a way of understanding how joint efforts can be established and sustained through institutional arrangements. Cognizant of a large array of institutions involved, I have focused in this paper on the institutional design and operation of irrigation associations (IAs) in Taiwan, and on the mechanisms by which institutions create incentives to irrigation officials to do a conscientious job and to relate their efforts to farmers.

Several features of the institutional design of IAs are instrumental in coping with these problems. One of them is the multiple arenas at different levels of the IAs in which farmers can work things out, communicate with one another, and resolve conflicts. These arenas provide public space where the "benign" activities can be played out. Moreover, to reduce the cost of participation to farmers and the potential for conflicts due to excessive participation, the scope of farmers' participation is carefully defined. While generally farmers' participation is encouraged, conducting the "technical" tasks such as formulating water plans and conducting major maintenance work is the responsibility of the IAs. Note that these "technical" tasks often set the parameters within which the farmers' participation operates. For instance, while farmers have much leverage in deciding water allocation within an irrigation block, the amounts of water allocated to particular blocks are determined by the IAs. The effectiveness of the IAs in conducting these "technical" tasks can reduce the farmers' need for active participation. Furthermore, monitoring mechanisms are in place that reduce the possibility of rent-seeking activities. For instance, while IGs might decide on what maintenance works are to be done, the signature of the working station chief is required for payments made to the contractors, even though the farmers raise the money themselves.

Various rules are in place that enhance the complementarity of interests between individuals. At the most general level is the relationship between the IAs and farmers. Institutional arrangements, such as farmer representatives, the payment of water fees, and the status of IAs as juristic entities formed and owned by farmer members, all help create and sustain a conceptualization that emphasizes the mutually dependent relationship between the IAs and the farmers. Such conceptualization provides the basis upon which the officials and farmers develop productive relationships.

A high degree of complementarity of interests can also be found among the IA officials. The prevalence of lifetime careers, as a result of the IAs personnel system, for example, aligns the careers (not only jobs) of the officials with the fate of the association as a whole. Stable membership of the organization allows the officials to adopt a longer time horizon in their relationships with each other. The resultant low discount rates of officials are more conducive to their investing time and effort in developing productive relationships with each other. Such an awareness of mutual dependence and low discount rates are further reinforced by the signaling of the IA that emphasizes the close relationship between the officials and the association. The practice of delivering an annual bonus is one of the ways by which the IAs signal their commitment and goodwill to their staffs. Although, some IAs are currently facing serious financial problems, they still manage to deliver the bonus. The emphasis on mutual interests and long-term cooperation is consistent with the observation of prior research that many incentives in the IAs are designed to be "group-oriented" (Wade, 1982, 1987).

Like irrigation bureaucracies in other Asian countries, authority is an essential component in the institutional design of the IAs. Through a structure of hierarchy, and also a tight control process in irrigation planning, authority is used rather extensively in the operation of the bureaucracy as well as in the process of water delivery. While authority might enhance coordination, reduce transaction costs associated with negotiating the terms of cooperation in spot markets, and extract contributions from individuals by metering and sanctioning (Coase, 1937; Alchian and Demsetz, 1972; Williamson, 1985), it comes with many potential disadvantages (e.g., Lindblom, 1977; V. Ostrom, 1989; Tullock, 1987; Nicholson, 1994). Among these potential disadvantages the most serious is the asymmetries of interests and power between those who exercise authority and who are supposed to obey. Such asymmetries potentially provide opportunities and incentives for the abuse of authority, and might also hinder communication and learning. More important, they dampen the incentives of those in the subordinate position.

What is peculiar about the institutional design of the IAs in Taiwan is its ability to cope with the possible asymmetries brought by the use of authority. First, authority is closely aligned with responsibility. For instance, while a working station chief has much authority in handling water allocation within the areas under his jurisdiction, he is also responsible for what might happen in the areas. Saying that the alignment of authority and responsibility is important is a truism, is it not a major design principle of irrigation bureaucracies in many other countries? What makes the Taiwanese case different, however, is that the alignment is supported not simply by bureaucratic rules but also by norms and social sanctions. As mentioned above, while a working station official has much discretion in managing the irrigated areas assigned to him, he is likely to be subject to much pressure from colleagues if his areas are facing problems persistently. Similarly, while the working station has a rela-
tively high degree of discretion in handling water delivery and irrigation maintenance, the lengthy stay of station officials in the local community ensures that they will be held responsible for their actions.

Second, institutions are designed so that authority is checked and balanced. Perhaps the most obvious check-and-balance designs can be found in the personnel system. The loose alignment between the rank system and the position system, and the frequent reshuffling of leadership positions, make it less likely that those in leadership positions will abuse their authority. Less conspicuous designs involve the establishment of symbiotic relationships among individuals in which each possesses resources that are essential to the well-being of the others. For example, while the working station staff is evaluated by whether irrigation in the areas assigned to them is well managed, the staff alone usually does not have adequate resources to handle water delivery and system maintenance. Farmers’ contributions are essential to the staff to do the job. It is especially the case in systems where rotation irrigation is seriously practiced.

Another major characteristic of the institutional design of the IAs is the various domains of autonomy. Such autonomy is essential for individuals at different levels to exercise their problem-solving capabilities. Within the IA, for example, the working stations are given the liberty of working out arrangements of water delivery and distribution with local farmers. At the field level, the irrigation groups (IGs) also retain a certain level of autonomy in deciding how water delivery is conducted within irrigation blocks. In systems where rotation irrigation is seriously practiced and, hence, farmers’ efforts are even more essential, the IGs are given the liberty of deciding how to finance the operation and maintenance activities at the local level. In terms of water delivery, perhaps the most important autonomy is that given to the water guards. As noted by prior researchers, the water guards, rather than the working station staff, are the ones who make decisions about, and actually conduct, the allocation of water to farmers’ fields (Moore, 1983). The water guards’ autonomy is the lubricant between the rigid irrigation plans and the diverse local environments.

The domains of autonomy allow individuals in different settings to develop (informal) rules to cope with various problems that they might face. Autonomy, however, is not equivalent to a hands-off mode of management. Instead, the exercise of autonomy at different domains is supported and facilitated by various mechanisms. First, the boundary of the autonomy is clearly understood. The autonomy of units at different levels within the IAs is based upon the bureaucratic principle of the vertical division of labor; the autonomy of IGs from the IAs, on the other hand, is supported by the understanding, strongly fostered by the national government, that emphasizes the dominant position of farmers vis-à-vis the IAs. Second, the autonomy at lower levels is nested within institutions at higher levels, that is, institutions at higher levels can serve various supportive functions. Prior research, for example, notes that the operation of the IAs, or more generally of irrigation management, is in a default upward mode, in which those problems which cannot be handled effectively at the lower level are transmitted to the next higher level (Levine, 1978b; Moore, 1983). Thus, while individuals at different levels are given opportunities to exercise problem-solving capabilities, they are provided with backup by higher levels.

In sum, Taiwan’s Irrigation Associations are not only examples of efficient water delivery, they also illustrate a number of interesting features of organizational design that should have broad relevance to other public sector organizations. In this analysis of the IAs, I identified several important principles for designing effective institutions. In particular, I highlighted the problems of team production and coproduction involved in irrigation management and analyzed how these problems can be coped with by various institutional mechanisms. As many goods and services provided or produced in the public sector share similar characteristics of irrigation systems, lessons learned from the experience of irrigation management in Taiwan can be drawn upon to inform institutional reforms in other public sector contexts.

NOTES

1. My observations during my fieldtrips to Taiwan in 1993 and 1994 were largely consistent with what had been said about the good working order of water delivery and well-maintained infrastructures in irrigation systems in the country.

2. Earlier research has suggested that the high potentials of irrigation might be a reason why the governments in Taiwan, the colonial government before 1945 and the Nationalist government afterward, have made significant investments in irrigation development. It might also explain why irrigation institutions and management procedures have been developed into a high level of sophistication (Levine 1977, 1978a, 1978b).

3. For more detailed discussion of the Land Reform in Taiwan, see Kuo, Ranis, and Fei (1981), Kuo (1983), Gold (1986).

4. Note that unlike in irrigation agencies in many South Asian countries such as India and Nepal, the construction of irrigation facilities is not a responsibility of the IAs. The limited scope of responsibilities of the IAs might avoid the tension between the engineering-oriented function of construc-
dition, and the management-oriented function of operation and maintenance often observed in South Asian irrigation bureaucracies (Wade, 1987; Chambers, 1988).

5. Only IAs with a large service area have the management stations. On smaller IAs, the working stations report to the headquarters directly.

6. The county or city governments, for example, can determine the amount of water earmarked for domestic uses. As irrigation is given relatively low priority in water uses, IAs frequently have to adjust their irrigation plans to cope with the demands from these governments.

7. In this study, the term “irrigation agency” is used to denote an aggregate of irrigation staff who are given a set of tasks pertaining to the governance and management of irrigation systems. The term “organization” is used to refer not to the “formal” structures of an agency, but to the patterns of actions and interactions of individuals within an agency as a result of an organizing process, which is defined as changing the situation from one in which individuals act independently to one in which they act in a coordinated manner in an effort to accomplish collective benefits (E. Ostrom, 1990; Miller, 1992).

8. A typical IA includes: an engineering division, a management division, an administrative division, an accounting division, a personnel division, and a security division.

9. When I mentioned to senior IA officials during interviews that many observers had found rather equitable patterns of relationships among IA officials, the officials were eager to explain to me, somewhat apologetically, why such a “leakage of authority” had happened. To them, the IA should operate like a bureaucracy in which authority is respected. The equitable relationships were viewed very negatively.

10. Although there are female staff working in the IAs, and some of them are in leadership positions, the posts of working station chiefs are almost always taken by a male staff member. For simplification, I use “he” to refer to a working station chief in this study.

11. The irrigated area managed by the Chianan IA is in the western part of Taiwan, located within Chiayi City, Chiayi County, Tainan City, and Tainan County. As of 1994, the total irrigated area is about 78,113 hectares. The climate of the area is subtropical with an average temperature of 21–24 degrees Celsius and annual average rainfall of 1,600 mm. About 80% of the rainfall occurs in the wet season from May to September. Paddy rice and sugarcane are the two major crops in the area.

The major source of water is from reservoirs. There are a total of 33 reservoirs of various sizes. The largest are the Tsengwen and Wushantou reservoirs that provide water to a service area of more than 57,000 hectares. Besides reservoirs, surface water from rivers, springs, and urban sewage systems are other major sources of water. Generally speaking, cultivated lands located in the Chiayi area rely mainly on surface water, whereas those in the Tainan area rely on reservoirs. While the construction of the large-scale reservoirs has significantly expanded the area of cultivation, water is still so scarce that crop rotation is practiced in most of the Tainan area. In addition, rotation irrigation is encouraged at the field level. Although rotation irrigation is supposedly practiced in most of the irrigated lands in the Chianan area, it is seriously practiced only in the Tainan areas where reservoirs are the major source of irrigation water.

The Chianan IA is the largest IA in Taiwan in terms of the size of irrigated area, budget size, and the number of officials. As of 1993, the Chianan IA had 678 employees, more than 20% of the total number of IA officials in Taiwan. About 30% of the staff work at the headquarters, and the other 70% at the field offices. Chianan IA is said to be one of the best managed IAs in Taiwan.

12. Of the total irrigated area of 78,113 hectares the distribution of irrigated areas under various patterns of cropping is as follows: three years-two crops district: 36,534 hectares; double rice crop district: 73,276 hectares; single rice crop district: 9,515; simple rotation district: 360 hectares; and sugar cane district: 8,428 hectares.

13. Although women actively participate in agricultural activities in many places in Taiwan, major decisions in a farming household related to irrigation are usually made by the head of the household who is almost always a man. As a result, irrigation group leaders are almost always men. In this paper, I use “he” to refer to an irrigation group leader.

14. In some areas in the Pingtung IA where abundant underground water makes irrigation organization less necessary, the only function of the irrigation groups is to help the IA collect irrigation fees.

15. For a more detailed discussion of local politics in Taiwan, see Bosco (1992), Stavis (1994), and Gallin (1966).

16. Presently the chairmen of all 17 IAs in Taiwan are members of the KMT.

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