THE CONDITIONS OF COLLECTIVE ACTION FOR LOCAL COMMONS MANAGEMENT: THE CASE OF IRRIGATION IN THE PHILIPPINES *

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Abstract

Using the cross-section survey data on the activities of irrigators' associations in the Philippines, regression analysis is conducted to identify factors underlying the success and failure in farmers' organizing collective actions for maintenance and operation of gravity irrigation systems. It is found that collective action is difficult to organize where: (a) water supply is uniformly abundant, (b) water supply is greatly different between upper and lower streams in lateral, (c) size of association is large, (d) population density is low, (e) the ratio of non-farm households is high, and (f) the history of irrigated farming is short. The possibility is also found that these difficulties can be overcome with adequate supports of state agencies to promote community-level cooperation. The findings call for government to play the active role of enhancing local communities' organizational capacity in the process of handing over to them the management of local commons.

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1. Introduction

This study aims to identify factors underlying success and failure in organizing collective action for the management of local commons in developing economies, using the case of irrigation in the Philippines.

The critical importance of irrigation in the development of rice-based agriculture in monsoon Asia has long been established (Ishikawa, 1967, ch. 1; Hayami and Ruttan, 1985, ch. 10). The need of mobilizing effective participation by farmer beneficiaries in the management of irrigation systems has increasingly been voiced in recent years (Small and Carruthers, 1991; World Bank, 1996). The voice has been raised from the two fronts.

In the academic sphere the accumulation of empirical studies has been sufficient to reverse Garret Harding's (1968) paradigm of "tragedy of commons" alarming the danger of over-exploitation of common-pool or common-property resources including irrigation water and thereby urging for the conversion of local commons from communal to either state or private management. A newly emerging paradigm is to recognize the ability of rural communities in conserving common pool resources adequately, while cautioning against the inefficiency of state bureaucracy in the use of local information and initiative as well as both the high cost and the inequitable distributional consequences of privatization (Ostrom, 1990, 1992; Bardhan, 1993; Baland and Platteau, 1996; Hayami, 1997, ch. 9). This paradigm has been serving as a theoretical support for the policy of "handing over" the management of irrigation systems from state agencies to the groups of local beneficiaries – commonly called "irrigators' associations."

However, the stronger force that has pressed developing countries to adopt the handing-over policy for the past two decades has been the financial crisis of state irrigation administrations. In the 1970s following the so-called "World Food Crisis" in 1973-74, the irrigation administrations enjoyed a large allocation of national budget as well as foreign aid to their activities. However, as international food markets turned into a low-price regime after the collapse in 1981 of the commodity boom, the flow of fund to agriculture, especially for irrigation, from both national treasuries and international aid agencies have been sharply curtailed. Handing-over of state agencies' operation and maintenance as well as irrigation fee collection to irrigators' association have been envisaged as a convenient means to compensate for their reduced revenue.

Results of the handing-over policy, however, have not been very encouraging. There have been some success cases but more failure cases. In many countries in Southeast Asia the service of national irrigation systems has deteriorated, because the reduction in state agencies' operation and maintenance activities has failed to be compensated for by the activities of irrigators' associations. As the result, countries such as Indonesia and the Philippines, which once achieved the status of net rice exporter in the late 1970s to the early 1980s, have slipped down into net importers.

The failure has been, to a large extent, based on hasty handing-over by state agencies under the rather suddenly emerged financial crisis in the 1980s. Typically, absent in designing the policy has been due knowledge in the side of bureaucracy on the capacity and mechanism of local communities to organize collective action for managing local commons. Appropriate policies to enhance the communities' organizational capacity have rarely been instituted. The difficulty here is that major constraints in organizing collective action for irrigation management are different across different communities with different environmental as well as economic and social conditions. It requires in depth case-by-case studies to identify what policy may be appropriate for each concrete case.

As a preparation for such case studies, this study tries to map out possible factors underlying differences in the performance of irrigators' association by means of regression analysis, based on data collected from a wide survey over national irrigation systems in the Philippines. Following this introduction, section 2 outlines the characteristics of irrigation systems under study. Section 3 develops quantitative measures of farmers' cooperation in collective action for the operation and maintenance activities organized by irrigators' association. Section 4 identifies the possible determinants of farmers' cooperation that can be used as explanatory variables in regression equations. Section 5 summarizes the results of the regression analysis. Finally, section 6 discusses on policy implications of the findings.

2. Irrigation Systems under Study

This study is based on our survey of 46 irrigators' associations (IAs) in 25 national irrigation systems under the command of the National Irrigation Administration (NIA), over six provinces in the Philippines – Batangas, Cavite, Laguna, Occidental Mindoro, Oriental Mindoro and Quezon. The survey consisted mainly of interviews with the leaders of IAs and the staff members of local NIA offices in charge of national systems' operation and maintenance. We tried as much as possible to check the reliability of their answers with farmer beneficiaries as well as knowledgeable people in each systems' service area. The pilot survey was conducted in February-March 1998 and the main survey conducted in August-September 1998.

The area of our survey belongs to Region 4, one of 12 administrative regions of NIA. Our survey tried to cover all the 30 national irrigation systems within Region 4 but 5 systems were excluded, which were not functioning due to natural hazards or located too far away to reach.

All the systems that we surveyed are of the simple gravity type, based on surface flows of water diverted from river with no reservoir and no pump-up system being installed. Typically, a major canal runs from the diversion dam and is branched out into several laterals (and further into sub-laterals), which are connected to farm ditches for the distribution of water to individual fields. Usually one IA is formed over an area served by one lateral, hence several associations being organized within a large system. The national average of irrigation service areas under the command of NIA systems is just about 3000 hectares, while the average of the systems that we surveyed was 1553 hectares, reflecting the hilly topography in Region 4 that is characterized by relatively small rivers to tap water for irrigation; this contrasts to large flat plains such as Central Luzon. As common to all the gravity systems under NIA's auspice, the systems under our survey are solely intended to serve for the irrigation of ricefields.

As common in tropical monsoon Asia, most canals and laterals in the systems under study are embanked by mud, except for concrete structure to support water gates and water-gauging facilities at the junctures of laterals to the main canal and of sub-laterals to the laterals. There is no device of metering take-in of water into individual fields. In the absence of water-gauging devices, irrigation fees is not based on the quantity of water consumed but charged proportionally to area served at the rates of 100 kg per hectare in paddy for wet season and 150 kg for dry season.

As such, water supplied from those systems is endowed with the attributes of "local commons" which are allowed to use by the people in a local community but are exhaustible if used in excess of their reproductive capacity. Since water resource for a system is limited by the capacity of diversion from the river flow, it is exhaustible through over-exploitation. Thus, an abuse by farmers in upper streams has negative externality to downstream farmers. Yet, no incentive mechanism exists to prevent an individual user from abusing water, because water take-in to his field can not be metered and, hence, is not chargeable in proportion to his consumption. It is costly to organize actions to save water (by such means as rotating water supply among users) or to augment water supply (by such means as removing silts and cutting weeds in canals) because everyone is tempted to be a free rider on others' conservation activities. This problem is exacerbated in the case of gravity irrigation systems by an asymmetry in the distribution of means and benefits of the conservation activities; typically, farmers in the head end of the system can reduce abuse in their water use but receive no benefit from it, whereas those in the tail end receive benefits from the head-enders' water saving but are not in a position to reciprocate to them (Ostrom and Walker, 1994)[1]. Thus, deterioration in the quality of gravity irrigation systems is universal in developing economies (Chambers, 1988).

NIA, which is mandated to administer national irrigation systems in the Philippines, is a "government-owned and controlled corporation". Until the end of the 1970s, with generous subsidies from the national treasury based on foreign aid inflows, the operation and maintenance (O&M) of NIA systems had almost totally been carried out by the teams of water masters and ditch tenders formally employed at NIA's local offices (called "irrigation systems offices"). However, with the collapse of international rice market in the 1980s, NIA lost its financial base to maintain sufficient field staff. The receipt of foreign aid was reduced. It has been stipulated since 1981 that NIA should be autonomous in financing its current expenditures for O&M of existing systems from its revenue consisted mainly of irrigation fees collected from farmers[2]. However, as rice prices continued to fall, the monetary value of irrigation fees collected in paddy declined proportionally.

Pressed by the financial crisis, NIA prompted to set up IAs for handing over a part of the responsibility of O&M. NIA urged local community leaders to organize farmers into IAs through persuasion as well as some honorarium payments to the leaders. In order to enhance local participation and initiatives, NIA designed various incentive schemes for IAs. First, if an IA agrees to take the responsibility of cleaning canals within its territory, NIA pays 400 pesos per month (which is about equivalent to 3 person-days of farm work) per kilometer of canal length. For a repair work, which costs more than 500 pesos, NIA usually grants the contract to the IA. For a smaller repair costing less than 500 pesos, the IA is supposed to mobilize members' labor without pay but materials and machineries are supplied by NIA. The IA that takes charge of collecting irrigation fees is entitled to receive 2 percent of collected fees if it was able to collect more than 50 percent of total invoice and to receive 15 percent if the collection rate exceeds 90 percent.

How successful have such efforts of NIA been? What could have been the factors underlying success or failure in farmers' participation in O&M activities. These are the questions upon which we try to shed lights in this study, based on cross-section variations on the degree of farmers' participation in collective actions organized by IAs.

3. Measures of Farmers' Cooperation

Our analysis begins with developing a measurement on the degree of cooperation among farmers in their participation in collective actions organized by IAs. The cooperation is first measured in terms of success or failure in the organization of collective actions for specific O&M activities. These separate measures are aggregated into a composite index.

Individual activities for our measurement are: (a) collective work for cleaning canals and laterals, (b) coordination in rice cropping schedules, (c) practice of water rotation, and (d) organized monitoring on cropping schedule and/or water rotation. For each collective action, the case of successful implementation is measured as 1 and the case of failure as 0.

Needless to say, the cleaning of canals and laterals by cutting grass and removing silt is a critical component of regular O&M activities for ensuring efficient delivery of irrigation water to farmers' fields. One method to achieve efficient and equitable distribution of limited water supply is to coordinate rice planting (for which water demand is the highest) among farmers according to an agreed-upon schedule (which is commonly called the "cropping calendar"); for example, farmers in the head-end portion of a major lateral may be scheduled to plant rice in the first two weeks of a season, followed those in the middle-stream portion for the next two weeks and further followed by tail-end farmers. In this way, water supply tends to be *de facto* rotated across sections along the lateral. Alternatively or simultaneously, the rule of water rotation can be explicitly agreed upon and practiced. Further, both the rules of cropping coordination and water rotation rule can be enforced more strongly, if the system of monitoring against possible violators is established in the association, either by IA leaders' rotational patrolling or by employing a professional guard. In our sample of 46 IAs, those successfully organized collective canal cleaning, cropping coordination, water rotation rule and organized monitoring are 74, 57, 54 and 52 percent, respectively (Table 1). In our sample 13 IAs (28%) are successful in organizing all the four collective activities, while 9 IAs (20%) failed in all the four.

These collective actions can be both complementary and substitutionary to some extents. For example, the coordination of cropping schedules may be used as a substitute for the explicit water rotation rule, but they are highly complementary because the former makes the implementation of the latter much easier. Likewise, augmented water supply by means of collective canal cleaning may reduce the need of equitable water distribution by means of water rotation, but it can be complimentary with the implementation of water rotation as it mitigate conflicts between up-stream and down-stream farmers. Such intricate inter-relationships seem to be reflected in the correlation matrix across four variables, in which all the correlation coefficients are positive and significantly different from zero at conventional levels but none of them is dominantly large (Table 2).

Since the variables representing the four types of collective action are not orthogonal, the simple summation is not very appropriate to aggregate them into a composite index of farmers' cooperation. A better approach should be the principal component (PC) analyses. Application of the PC analysis to our four variables show that the first component dominates in terms of its eigen value as well as proportion (Table 3).

The PC vector of the first component is also economically meaningful because none of its coefficients is negative unlike other components' vectors. Thus, we use the PC score of the first component as the composite measure of cooperation or IAs' success in organizing farmers in collective action. This score is calculated as the sum of four variables weighted by coefficients in the PC vector, after normalizing each variable by subtracting its average from individual observations and dividing these differences by standard deviation with the result that the average is zero. For the sake of comparison, the "simple-sum score", which is the unweighted sum of four variables normalized in the same manner as the PC score, is also calculated.

If we classify irrigators' associations with their PC scores above 0 as "active" associations and those below 0 as "inactive associations", the former numbered 28 and the latter 18. Among active IAs the incidence of success in organizing either of the four collective actions was higher than 80 percent, whereas it is uncomparably lower among inactive IAs (Table 1).

4. Determinants of Cooperation

The major question is what factors may underlie differences in IA's performance in mobilizing farmers' participation. From data collected from our survey a list of variables are chosen as possible determinants on the degree of farmer participation, as summarized in Table 4.

Water supply conditions

The conditions of water supply are obviously a crucial determinant for inducing farmers to organize collective action. If water supply is abundant relative to demand by the extent that no water shortage possibly emerges, there should be no incentive for farmers to undertake collective action to augment the supply of water or to save its consumption, as elucidated by Robert Wade (1988) for the case of South India. On the other hand, if water shortage is very severe, conflicts among water users might become so large as to make cooperation difficult. As already discussed, in the case of gravity irrigation systems such as those under our study, differences in water supply between up-steam and down-steam farmers are critically important in determining lateral-wide cooperation within IA.

In terms of water supply conditions in the upper and the lower stream portions along lateral before the formation of IAs, our observations fall into the categories of following six combinations:

Upper	Lower
O	O
O	M
O	S
M	M
M	S
S	S

where O represents the case of no water shortage in that significant water shortage seldom occurred; M represents the moderate water shortage case in that water shortage often occurred but could be solved through coordination among farmers within a small district served by a common turn-out gate for taking in water from a major lateral or sub-lateral; and S represents the severe water shortage case in that significant crop damage was bound to occur without lateral-wide coordination.

Distribution of IAs according to the six combinations of water supply conditions between upper and lower streams shows that the number of inactive IAs is higher than that of active IAs only in the cases of O-O and O-S (Table 4).

It is reasonable to expect that no inducement to organize collective actions operates so long as all the farmers both in the upper stream and the lower stream sections need not fear about water shortage (O-O). On the other hand, it is possible that a major difference in water supply conditions between up-stream and down-stream farmers (O-S) makes it difficult to reach an agreement of their mutual satisfaction.

Size of association

The classic study by Mancur Olson (1965) suggests that collective action is more difficult to organize in larger groups. An obvious indicator of the group size in the case of IAs is the number of irrigators, which is roughly equal to the number of farm households within the association's territory.

In the context of rural economies in Asia including the Philippines, village is a basic unit of people's life, endowed with both formal and informal self-governing mechanisms. Therefore, it is relatively easy to reach an agreement and enforce it within a village, while coordination across different villages is more difficult. Therefore, the number of villages (*barangays* in the case of the Philippines) within the territory of an IA can be an important determinant on the cost for IA leaders of organizing lateral-wide cooperation.

Further, the size of association as measured by irrigation service area within its territory is likely to be a significant determinant, because it is more difficult and costly to monitor over wider area if the rules of collective actions such as the schedules of the planting and water rotation are duly observed.

In our data the size of IA as measured by its service area is on the average about 50 percent larger in inactive than in active IAs. However, there is no significant difference in the number of farm households as well as in the number of villages.

Community characteristics

The group of rural people in developing economies bases its organization and enforcement of collective action on intense social interactions among people within a community, involving informal sanctions against free riders by means of malicious gossip, social opprobrium and eventual ostracism (Hayami and Kikuchi, 1981). Therefore the social structures and traditional norms of rural communities, along which IAs are organized, are critically important in determining the success of their collective action.

The characteristics of community in this regard are difficult to quantify. One possible measure on the intensity of social interactions may be population density. It is expected that social interactions among people tends to be more intense if they are concentrated within a smaller area. For this consideration, we use the number of farm households per hectare in the service area as a proxy to represent the degree of social interactions among irrigators.

Another characteristic of rural community, which may have a significant influence on the organization of collective action for irrigation management, should be the degree of exposure and access to market activities outside agriculture. If a rural community is largely self-sufficient with little exposure to urban market activities, the expectation should be strong for its members on the indefinite continuation of their collective action in the future; this is akin to the situation of infinitely repeating games for sustaining a positive-sum cooperative outcome along the Folk Theorem (Fudenberg and Maskin, 1986; Bardhan, 1993; Seabright, 1993; Ostrom and Walker., 1994). On the other hand, ready access of farmers to non-farm market activities means availability of the "exit option" for them from collective action within the farming community in the sense of Albert Hirschman (1970). If this option is available, it should be more difficult to enforce them to join collective action at the community level. In this study the ratio of non-farm households within the territory of one IA is calculated as a measure of farmers' access to market activities. Indeed, this ratio is more than twice higher in inactive than in active IAs.

A significant factor to facilitate the activities of IAs appears to be the past experience of collective action for the maintenance of communal irrigation systems. In about one-fifth of our sample IAs, communal irrigation systems tapping water from small streams in hilly areas by the collective work of farmers in a small group had been operating until large-scale national irrigation systems were built by NIA. It is naturally expected that, where communal systems existed previously, communities are better endowed with social skills and norms to mobilize collective efforts to maintain and operate irrigation systems. This expectation is consistent with the observation that the percentage of IAs in which communal systems had previously existed is twice higher among active IAs than among inactive ones.

Policy factors

According to our field observation, the intensity and quality of activities by local NIA offices for the promotion of IAs made significant differences. One way for local NIA offices to promote IAs is to give special incentives. Although such incentives as payments to associations for regular cleaning and repair of canals and dikes (as explained in Section 2) are uniformly applied to all the IAs, each local office has some discretions in deciding on priority among IAs in the allocation of public work for major renovations such as straight lining of lateral and widening of access road as well as on who should be chosen as contractors. It is also possible to exercise administrative guidance to contractors so as to employ farmers in a certain IA for the assigned public work project. Through the exercise of these discretions, a local office can induce activation of IAs. In fact, the percentage of IAs which received such special incentives was three-times higher among active than among inactive IAs. However, it must be cautioned that causal relationships are ambiguous because these incentives tends to be given as a reward to the IAs that achieved (or were expected to achieve) the high rate of irrigation fee collection.

It is noteworthy that some managers of NIA's local offices exerted exceptionally fine leadership for the promotion of IAs. Beyond the routines as instructed by the headquarter, these local officers devoted much of their time and energy in persuading local community leaders to develop cooperation and coordination within IA as well as among IAs, while assisting them not only on irrigation matters but often for solving their complications with other local government offices. The IAs that were favored by the service of the excellent local staff of NIA, as identified unanimously by IA leaders as well as farmers, were only 15 percent of our sample but all of them were able to achieve the status of active associations in our classification.

However, there is a little ambiguity about the causal relationship of this factor with the success in activating IAs, though likely less ambiguous than in the case of special incentives. The possibility cannot be ruled out that even the most capable and devoted NIA official might have failed to organize an effective IA under extremely unfavorable conditions with respect to water supply, association size and community characteristics and, hence, have not been recognized as an excellent official.

It must be noted that the list of possible determinants in Table 4 is not exhaustive. Such variables as farming systems, especially with respect to the share of non-rice crops, and distributions in farm size as well as land tenure relationships may have significant influences[3]. Our choice of explanatory variables is limited by the narrow coverage of our survey questionnaire used for a rather quick survey over a wide area.

5. Regression Analysis

In order to measure the net contributions of possible determinants selected in the previous section, multiple regression analysis is conducted. The principle dependent variable is the PC score as measured in Section 3, but the analysis using the simple-sum score is also tried for the sake of comparison. The regression analysis is conducted using the observations of 42 associations for which data are available for all the explanatory variables[4].

Six combinations of water supply conditions between the upstream and the downstream sections are represented by five dummy variables using the S-S case as the base, namely assigning 0 to S-S and 1 for each of other combinations. The irrigation service area, the number of farm households and the number of villages to represent the size of IA are tried interchangeably in order to avoid multicollinearity.

The number of farm households per hectare and the ratio of non-farm households are parametric variables, but the prior existence of communal irrigation systems (abbreviated as "communal irrigation"), the provision of special incentives from NIA ("NIA’s special incentive") and the excellent local staff of NIA ("NIA's staff quality"), are the 1-0 dummies.

Results of the regression analysis using all those variables are as summarized in Table 5. Estimation is based on the method of ordinary least squares (OLS). Among the five dummy variables representing water supply conditions, the coefficients of O – O and O-S alone are negative and statistically significant, while the others are non-significant. These results are consistent with the hypotheses: (a) collective action for irrigation O&M activities is difficult to organize where water supply is abundant over all the system of irrigation and, hence, returns to such collective actions are low, and (b) collective action is difficult to organize where water supply conditions are very different across sections of a lateral, so that the conflicts of interest between upstream and downstream farmers are difficult to resolve. Implicit in those results is the implication that collective action is relatively easy to organize under conditions in which water shortage occurs uniformly across sections of an IA's territory.

The coefficients of service area and the number of farm households in regressions (1) and (2) are both negative and significant, reflecting the high cost to organize collective action for the IA that encompasses a wide territory and the large number of farmer beneficiaries. It is somewhat anomalous, however, that the number of villages turns out to be not statistically significant at a conventional level in regression (3). It appears that more indepth investigation is necessary to identify the role of villages in the organization of IAs.

The coefficients of three variables representing community characteristics have expected signs and are statistically significant at conventional levels. The positive coefficient of the number of households per hectare is consistent with the hypothesis that the high density of farm population strengthens social interactions as the basis of organizing community-wide collective action. The negative coefficient of the non-farm household ratio implies that availability of the exit option for farm workers to non-farm employment weakens their cooperation for improving agricultural production infrastructure such as irrigation. The highly significant positive coefficient of communal irrigation shows clearly that the prior experience of small-group cooperation in managing small-scale indigenous systems becomes an important basis of organizing collective action for the operation and maintenance of large-scale modern system, representing a case of historical path dependency in the evolution of social systems.

Finally, the coefficients of two policy variables are all positive and significant. The results suggest that a large room exists for NIA to achieve greater participation of farmers in the management of national systems by means of designing greater incentives to irrigators' association as well as upgrading of NIA's staff quality.

On the whole, the results of regression analysis as reported in Table 5 are reasonable in terms of both signs and statistical significance of the coefficients as well as the values of R-square adjusted for the degree of freedom. These regressions using the PC score as the dependent variable may be compared with those using the simple-sum score as reported in Table 6. Reflecting relatively homogeneous PC weights for calculating PC scores (Table 3), the results based on simple-sum scores are not greatly different from those based on PC scores. Yet, adjusted R-squares in the regressions based on PC scores are about 15 percent higher than the counterpart regressions based on simple-sum scores. Also, several regression coefficients become non-significant at conventional levels with the use of simple-sum scores, such as those of the number of households per hectare and NIA's staff quality. These comparisons seem to support the hypothesis that the PC score is a superior index in measuring the degree of farmers' cooperation in collective actions organized by IAs.

In order to guard against the possibility of two-way casual relationships between two policy factors and IAs' success in organizing collective action to disturb the results of estimation, regressions based on PC scores are re-estimated after deleting the policy factors from explanatory variables. Estimation is made both with the whole sample of 42 associations (regressions no. 7-9 in Table 7) and with the sample of 32 associations which were not favored by the two policy factors (regressions no. 10-12).

With the deletion of two policy variables, adjusted R-squares of regressions (7) – (9) based on the whole sample become smaller by about 20 percent than those of regressions (1)–(3). However, estimation based on 32 observations after removing policy-affected IAs produces about 10-percent higher adjusted R-squares for regressions (10)-(11) than for regressions (1)-(3). In both cases, the signs and statistical significance of regression coefficients are largely the same as those of regressions (1)-(3). Such results show the strong robustness of our regression estimates with respect to the variables representing environmental and community characteristics.

Finally, probit regressions are estimated to explain the success in organizing individual collective actions (Table 8). Some of explanatory variables in the 1-0 dummy form have to be dropped from probit regressions because they have perfect correlations with dependent variables. Only the case of using the service area is reported. However, similar results are obtained from the use of the number of farm households.

Estimated coefficients in probit regressions have expected signs, except for NIA's special incentive in regression (15) for water rotation. However, only a few of them are statistically significant at conventional levels. Moreover, it is difficult to explain why certain variables are significant in regressions on certain collective actions and not significant in others. The relatively poor statistical results of probit regressions on individual collective actions seem to reflect substitutionary relationships in addition to complementary relationships among the four collective actions, as discussed in section 2. If the substitutionary relationships are significant, it should not be a surprise to obtain inferior results from regressions on individual collective actions as compared with those on their composite score.

6. Conclusion

Results of our cross-section analysis over national irrigation systems in the Philippines are consistent with the hypothesis that collective action by water users for the operation and maintenance of irrigation systems is difficult to organize (a) where the water shortage rarely occurs, (b) where the difference in water supply is large between up-stream and down-stream farmers, (c) where irrigators' association is large in terms of service area and the number of farmer beneficiaries within its territory, (d) where the local community is sparsely populated, involving low social interactions, (e) where farm workers have the option of ready exit from farm to non-farm economic activities, and (f) where farmers had traditionally practiced rainfed farming with no previous experience in managing communal irrigation systems. The results also suggest that collective action can be promoted by adequate incentives granted by the national irrigation agency and that the promotion of associations' activities is especially effective when handled by capable and devoted personnels in the agency's field staff.

Policy implications of our findings are obvious. Promotion of irrigators' associations is hardly sufficient just to hand over the responsibility of operation and maintenance by granting them a standard package of incentives. Where water supply conditions, sizes of associations, and community characteristics are unfavorable against the organization of collection action, the national agency must increase supports by such means as providing special incentives for associations' activities. However, granting discretion to the agency's local staff on the provision of special incentives can be a source of inefficiency as well as corruption, unless properly handled by competent and devoted personnels. The difficulty is that needed supports and incentives are likely different for different combinations of environmental and community characteristics under which associations operate; this makes it ineffective or even counter-productive to apply a standard manual designed by central bureacracy.

What is required for a personnel in the state agency to be an effective promoter is the ability and devotion to learn about farmers' needs under their specific settings and to work out with the potential beneficiaries how to resolve their problems, possibly with the clever use of incentives under his discretion. This is the rare talent to find in bureacracy, not only in the developing but also in the developed world. In fact, the task of the field staff in state irrigation agencies to promote farmers' collective action is more difficult in economies like the Philippines where rainfed rice farming had been dominant until recently under the abundant endowment of land relative to population than economies like Japan where farmers had traditionally practiced communal irrigation management under land scarcity. There have been a few cases, even in our sample, in which the state agency's personnels succeeded in promoting farmers' collective action by overcoming obviously adverse conditions. However, such cases have so far been sheer exceptions in the absence of adequate incentives, education and training as well as logistical supports for the agency's field staff.

The new policy orientation to delegate the management of local commons from state agencies to rural communities has a high potential to increase both efficiency and equity. However, if it is promoted for the motive of saving government resources alone without recognizing the severe constraint in organizing rural people, positive consequences are unlikely to be forthcoming. A major public support is called for to overcome local communities' organizational capacity limit. Similar to the advocacy for the market-enhancing role of government (Aoki,et.al.,1997), the community-enhancing activities should have to be borne by government either directly or, perhaps, through NGOs.

Needless to say, the concrete policies that will really enhance communities' capacity can only be designed on in-depth investigations into highly elusive norms and organizations of the rural communities as well as environmental and technical conditions. Especially important is to trace out the processes by which interactions among community leaders and government workers were either successful or unsuccessful in overcoming constraints against collective action.

This study that tried to map out possible determinants of collective action for irrigation management in the Philippines is by itself of little value as a guide for concrete policy design. Instead, the broad mapping, as attempted in this study, is hoped to serve as a guide for the indepth case studies that will become the real basis of effective policy making.

NOTES

1. The tendency for the head-enders to abuse water is enhanced by the nature of rice plants which are relatively tolerant to excess water application but tolerant to drought.
2. NIA's capital expenditures for the construction of new systems and major rehabiliation of existing systems are still financed by the national treasury that channels foreign aid money. For more detail about NIA, see Kikuchi, et. al. (1999).
3. Local communities in the area under our study are predominantly inhabited by Tagalogs, involving few ethnic conflicts. Unlike Central Luzon where large estate farms (*hacienda*) had prevailed until land reform, this area had traditionally been farmed by smallholders, mostly under sharecropping arrangements with relatively small-scale landlords living in local towns. With the implementation of land reform programs in the 1970s under President Marcos Martial Law regime, most farmers established their status either as leasehold tenants paying low fixed rents controlled by government or "amortizing owners" who expect to become owner farmers upon finishing amortization payments to Land Bank which purchased lands from landlords in lieu of the tenants. Since both the controlled rents and the amortization payments are fixed at about the same level, work incentives and farm incomes per hectare are largely the same between the leaseholders and the amortizing owners. For more detail, see Hayami and Kikuchi (1981, ch. 4; 1989, ch.4).
4. The observations of four IAs are dropped from the regression analysis, because both the IA leaders and the local NIA offices were not able to keep reliable records on the number of households as well as their farm-nonfarm classifications at the time point of our survey due to rapid progress in urbanization in their territories.

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Table 1. Average characteristics of sample irrigators' associations about collective actions

	Total	Active (PC score >0)	Inactive (PC score <0)
No. of associations	46	28	18
Percent of associations practicing:			
Collective canal cleaning	74	89	50
Cropping coordination	57	86	11
Water rotation	54	89	0
Organized monitoring	52	82	6
Total score of cooperation			
Principal-component (PC) score	0	1.1	-1 8
Simple-sum score	0	0.7	-1.1

Table 2. Correlation matrix of collective actions across irrigators' associations.

	Collective canal cleaning	Cropping coordination	Water rotation	Organized monitoring
Collective canal cleaning	1.00	0.38	0.35	0.32
Cropping coordination		1.00	0.60	0.48
Water rotation			1.00	0.61
Organized monitoring				1.00

Table 3. Principal components of collective actions by irrigators' associations.

	1st	2nd	3rd	4th
Eigen value	2.39	0.75	0.52	0.35
Proportion (%)	60	18	13	9
PC Vector:				
Collective canal cleaning	0.40	0.90	0.15	-0.05
Cropping coordination	0.52	-0.09	-0.73	0.44
Water rotation	0.55	-0.28	-0.04	-0.79
Organized monitoring	0.51	-0.32	0.67	0.44

Table 4. Average characteristics of sample irrigators' associations about the determinants of collective action.

	Total	Active (PC score >0)	Inactive (PC score <0)
No. of associations	46	28	18
Water supply conditions: (no. of associations)			
O - O	5	1	4
O - M	16	11	5
O - S	7	2	5
M – M	3	3	0
M – S	12	9	3
S - S	3	2	1
Size of association:			
Service area (ha)	494	421	608
No. of farm households[a]	374	371	379
No. of villages	5.1	4.9	5.1
Community characteristics:			
No. of farm household per ha[a]	1.0	1.1	0.9
Ratio of non-farm household (%)[a]	22	16	34
Prior existence of communal systems (%)	20	25	11
Policy factors:			
Provision of special incentive from NIA (%)	13	18	6
Excellent local staff of NIA (%)	15	25	0

Note: [a] Average of 42 associations for which data are available, of which 28 are active and 14 are inactive.

Table 5. Results of OLS regressions to explain the degree of cooperation by irrigator's association as measured by principal-component score, based on the observations of 42 associations.

Regression No.	(1)	(2)	(3)
Intercept	0.62	0.034	-0.24
	(1.02)	(0.064)	(0.44)
Water supply conditions:			
O – O	-2.58***	-2.15***	-2.77***
	(3.19)	(2.63)	(2.59)
O – M	0.050	0.28	0.36
	(0.083)	(0.47)	(0.56)
O – S	-1.50**	-1.28**	-1.48**
	(2.35)	(1.90)	(1.96)
M – M	0.064	0.24	0.50
	(0.084)	(0.32)	(0.64)
M – S	-0.26	0.52	0.60
	(0.43)	(0.85)	(0.91)
Size of association:			
Service area	-0.00086**		
	(2.36)		
No. of farm households		-0.0012**	
		(1.79)	
No. of villages			0.011
			(0.24)
No. of farm households per ha	0.34*	059**	0.45**
	(1.53)	(2.27)	(1.72)
Non-farm household ratio	-0.018**	-0.017**	-0.019**
	(2.14)	(1.93)	(1.80)
Communal irrigation	1.37***	1.34***	1.24***
	(3.55)	(3.36)	(2.93)
NIA's special incentive	0.78**	0.88**	0.87**
	(1.95)	(2.11)	(1.92)
NIA's staff quality	1.08**	1.31**	0.83*
	(2.23)	(2.38)	(1.58)
Adjusted R^2	0.64	0.61	0.56

Note: Shown inside parenthesis are t-values, significant at: *** 1%; ** 5%; * 10%

Table 6. Results of OLS regressions to explain the degree of cooperation in collective action by irrigator's association as measured by simple-sum score, based on the observations of 42 associations.

Regression No.	(4)	(5)	(6)
Intercept	0.49	0.026	-0.14
	(1.12)	(0.068)	(0.36)
Water supply conditions:			
O – O	-1.67***	-1.33**	-1.42**
	(2.91)	(2.29)	(2.31)
O – M	0.87	0.15	0.20
	(0.20)	(0.35)	(0.45)
O – S	-1.00**	-0.83**	-0.94**
	(2.21)	(1.73)	(1.83)
M – M	0.14	0.11	0.27
	(0.27)	(0.20)	(0.50)
M – S	0.025	0.25	0.32
	(0.057)	(0.56)	(0.67)
Size of association:			
Service area	-0.00063**		
	(2.35)		
No. of farm households		-0.00073*	
		(1.49)	
No. of villages			0.067
			(0.22)
No. of farm households per ha	0.21*	0.39**	0.31*
	(1.31)	(2.08)	(1.66)
Non-farm household ratio	-0.010*	-0.0096*	-0.011*
	(1.65)	(1.48)	(1.46)
Communal irrigation	0.76***	0.75***	0.74**
	(2.69)	(2.52)	(2.38)
NIA's special incentive	0.78**	0.78**	0.45
	(2.17)	(1.93)	(1.17)
NIA's staff quality	0.39*	0.48*	0.47*
	(1.39)	(1.62)	(1.53)
Adjusted R^2	0.57	0.53	0.48

Note: Shown inside parenthesis are t-values, significant at: *** 1%; ** 5%; * 10%

Table 7. Results of OLS regressions using principal-component score as the explanatory variable, after deleting policy factors.

	Using the whole sample (n=42)			Deleting policy-affected observations (n=32)		
Regression No.	(7)	(8)	(9)	(10)	(11)	(12)
Intercept	0.43 (0.63)	0.21 (0.35)	-0.37 (0.61)	0.79* (1.39)	0.24 (0.50)	-0.19 (0.35)
Water supply conditions:						
O – O	-2.03** (2.25)	-1.67** (1.80)	-1.80** (1.93)	-1.91** (2.42)	-1.50** (1.94)	-1.56* (1.70)
O – M	0.10 (0.15)	0.46 (0.67)	0.46 (0.50)	-0.11 (0.18)	0.30 (0.54)	0.48 (0.74)
O – S	-1.01* (1.43)	-0.99 (1.28)	-1.28* (1.58)	-1.64*** (2.78)	-1.23** (1.99)	-1.57** (1.96)
M – M	-0.088 (0.10)	0.38 (0.44)	0.38 (0.44)	-0.25 (0.36)	0.0049 (0.0072)	0.53 (0.69)
M – S	0.70 (1.04)	0.91* (1.31)	0.92 (0.19)	0.63 (1.03)	0.99* (1.66)	1.11* (1.55)
Size of Association:						
Service area	-0.00074** (1.80)			-0.0011*** (2.94)		
No. of farm households		-0.00027 (0.39)			-0.0022*** (2.93)	
No. of villages			0.045 (0.90)			-0.01 (0.23)
No. of farm households per ha	0.57*** (2.49)	0.63** (2.13)	0.60** (2.26)	0.43** (1.73)	0.78*** (2.79)	0.52* (1.66)
Non-farm household ratio	-0.026*** (2.81)	-0.023** (2.32)	-0.027** (2.45)	-0.025*** (2.92)	-0.024*** (2.80)	-0.23** (2.09)
Communal irrigation	1.59*** (3.70)	1.53*** (3.37)	1.43*** (3.16)	0.95** (2.11)	0.90** (2.02)	0.63 (1.19)
Adjusted R^2	0.53	0.48	0.48	0.70	0.72	0.62

Note: Shown inside parenthesis are t-values, significant at: *** 1%; ** 5%; * 10%.

Table 8. Results of probit regressions to explain individual collective actions, based on the observations of 42 associations.

Regression No.	Collective canal cleaning (13)	Cropping condition (14)	Water rotation (15)	Organized monitoring (16)
Intercept	1.32**	-0.29	1.57***	0.45
	(1.98)	(0.49)	(2.73)	(0.95)
Water supply conditions				
O-O	-1.33	-14.02		-1.52*
	(-1.29)	(-0.0019)		(1.49)
O-S	-1.41**	-6.36	-0.89	-0.94
	(1.98)	(0.0013)	(1.08)	(1.27)
Association's service area	-0.00044	-0.00021	-0.0011**	-0.00028
	(0.70)	(0.35)	(1.77)	(0.54)
No. of farm households per ha	0.28	1.08**	0.044	0.39
	(0.61)	(1.93)	(0.13)	(1.25)
Non-farm household ratio	-0.87	-0.0072	-0.044***	-0.023*
	(0.55)	(0.37)	(2.63)	(1.60)
Communal irrigation	1.28	11.99	0.90	1.24**
	(1.39)	(-0.0016)	(1.19)	(1.92)
NIA's special incentive		0.55	-0.28	
		(0.72)	(0.45)	
NIA's staff quality			1.19	
			(1.28)	
Log Likelihood	-15.2	-13.9	-18.3	-22.5
Pseudo R^2	0.27	0.50	0.41	0.29

Note: Shown inside parenthesis are t-values, significant at: *** 1%; ** 5%; * 10%.