Area Four Irrigation Watercourse

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1 Static Analysis - Collective action

Irrigation watercourse "Area Four" in Taiwan is 67,670 hectares, with 150,000 farm units that benefit from the irrigation services provided by an Irrigation Association maintaining 1,225 km long canal and 470 tubewells. Area Four was studied as part of a comparative case study of four irrigation projects by The World Bank. It was concluded that Area Four was performing well across all indicators evaluated due to its strong institutions even with the challenge of seasonal water scarcity.

1.1 The Commons Dilemma

While there was no urgent commons dilemma in this case due to strong institutions and collective action, there was evidence that environmental stability was precarious. Problems of flooding in the coastal plain, rapid decline of groundwater levels in the coastal areas with dangers of saline intrusion, and evidence of shorter seasonal water flows in hillstream areas as a result of deforestation in the upper catchments had led to the emergence of strong irrigation institutions.

1.2 Biophysical Context (IAD)

- **Natural Infrastructure** The irrigation area is 67,670 hectares of steeply sloping clay, loam, and sandy soil. The area receives 1,550 mm of rainfall per year of which 85 percent is in May through August and has water scarcity during the dry season. The main drainage is 1,125 km. The main crops grown are rice, sugarcane, sweet potatoes, and groundnuts at about 300 percent cropping intensity.
- **Hard Human-made Infrastructure** The canal headworks were largely constructed in 1927 and are run-of-river meaning there are numerous systems. Some of these subsystems were built before or after 1927. The 1,225 km of the main canal has a maximum discharge of 1.5-3.0 lit/sec/ha. All of the main canal and 10 percent of the watercourses are lined. The watercourses are 40 ha on average. The irrigation system has 2,431 control structures including the lifting gates and measurement structures at the watercourse outlets. The irrigation system also has many private wells and 470 public tubewells and 45 pumping stations that have an average capacity of 32 lit/sec. The canals are satisfactorily maintained by appropriately trained staff and an estimated annual investment per canal km of 2352 USD.

1.3 Attributes of the Community (IAD)

- **Soft Human-made Infrastructure** There are 150,000 farm units that are an average of 0.5 ha in the irrigation area. There is little skewness in the land distribution and 94 percent of the units are owners, 4 percent are part-owners, and 2 percent are tenants. 36.6 percent of the working population work in agriculture and there are few landless laborers. Farmers' choice of cropping pattern is controlled by the water distribution pattern due to the need to account for water scarcity and the need to prevent high rates of seepage or water-logging.

  There are on average 80 farmers per watercourse. The watercourses are organized as such: small groups at the 150 ha level, rotation area groups at the 50 ha level, rotation [cut off in report]. At the irrigation system level, there is one irrigation association plus Farmers' Associations in different areas. Area Four has separate cadres for water distribution and maintenance work, recognizing water distribution as a specialist activity of key importance. The irrigation association has 1-2 senior officials, 20 junior officials, 47 skilled field staff, 13 unskilled field staff, and 18 clerical office support staff. A junior qualified water-distribution official covers 350 ha/7.5 canal km. A junior maintenance person covers 7.5 canal km. There is one field assistant to 300 farmers or 150 ha.

  The organization of the project has a hierarchical shape of Headquarters - Management Offices - Working Stations - Small Groups (farmers' representatives). There are very detailed procedures for the planning, implementation and monitoring of water distribution based on high quality agricultural research previously carried out by research organizations. Initial plans are built up through the submission of plans from the 43 Working Stations. Programs for the supervision and training of farmers' Small Groups and for fee assessment and collection are also carefully planned with responsibilities at each level of the organization clearly defined. Farmers' representatives (Small Group leaders) are involved in regular discussions during the decision-making processes.

  In Area Four, the Irrigation Association is financed primarily by members' fees, which makes the management and staff accountable to their clients and pressures them to provide good service. As a result, managers in Area Four have the autonomy to recruit staff, offer periodic bonuses, and promote them within the organization. Moreover, the fee recovery rate depended highly on the efficiency and resourceful of the staff. Therefore, the staff were motivated to provide good-quality service. If they were not doing well, fees would be difficult to recover.

- **Human Infrastructure** The farmers are skilled in irrigation farming as they have long worked with rice and dry crops. The irrigation area has an 87 percent literacy rate. As farmers' management skills have developed over the past 50 years, an initial pattern of externally imposed supervision, control and discipline has evolved to one of increasing self-control and self-discipline by farmers' groups. Part of this is due to the operating agency's role in supervising farmers' activities, strengthening their capacity for communal decision-making and joint action, and extending the adoption of improved O and M techniques.

  The Manager, Engineer and Finance specialist divisions of the Irrigation Association collaborated closely. The majority of field staff and senior officials of the Irrigation

Association have Vocational Middle School educations. Many of the officials come from farming backgrounds and hence have a good rapport with farmers. The Chief Engineer, who is in charge of maintenance and operation, is an Agricultural Engineer. Junior officials have sufficient opportunities to obtain and practice the skills on their jobs, thanks to the participatory procedures for the planning, implementation and monitoring of water distribution.

1.4 Rules in Use (IAD)

1. **Position Rules:**
   - Farmers who run cultivation operations, purchase inputs other than water, and transport and marketing farm products.
   - Farmers' Associations who input supplies and credit, provide training through agricultural extension, and market farm products.
   - Manager (Irrigation Association) who oversee water distribution and supervise the construction of canals and tubewells.
   - Engineer (Irrigation Association) who design, construct and maintain canals and tubewells.
   - Finance (Irrigation Association) who plan, research, and monitor the irrigation association operations including fee assessment.
2. **Boundary Rules:** Not mentioned in the study.
3. **Choice Rules:**
   - Farmers may choose which crops to grow
   - Farmers may choose to pay their fee to the irrigation association
   - Managers may recruit staff, offer periodic bonuses, and promote them within the organization
4. **Aggregation Rules:**
   - Farmers Associations may vote on the level of fee payment
5. **Information Rules:**
   - Farmers Associations must provide O and M technique training to farmers
   - The annual budget is prepared participatively with farmer representatives and involves detailed consideration of alternative fund allocations.
6. **Payoff Rules:**
   - Farmers pay dues to the Irrigation Association that maintains the irrigation system, distribute water, and provides training to the farmers.
   - All the revenue raised from membership fees is retained by the Irrigation Association for reinvestment in the project area.
7. **Scope Rules:**
   - When water is scarce, farmers must choose less water-intensive cropping patterns.

1.5 Summary

This case explains the sophisticated organization of water distribution, infrastructure maintenance, and cultivation operations in a large area with 150,000 farming units. Area Four was the best-in-class example in comparison with three other irrigation systems. This success is largely attributed to the separation of water distribution and infrastructure management and the irrigation association being funded by the farmers leading to the accountability of the association to the farmers and flexibility of the association to organize itself in such a way to meet the farmers' needs.

2 Dynamic Analysis - Robustness

The success of the irrigation project is largely attributed to the structure of its management system. The interactions between the Resource Users and Public Infrastructure (i.e. engineers and operating staff of the Irrigation Association, as well as Public Infrastructure Providers, namely the manager) are intimate, since the farmers are involved in the discussions on planning, implementation and monitoring procedures of water distribution. The financial autonomy of the Irrigation Association is mentioned many times as one of the determining factors of the good performance of the system. The farmers' member fees is a key feedback mechanism strengthening the linkage between RU and PI/PIP. There are also clearly established maintenance procedures for the hard human-made public infrastructures, where both the PI and RU have responsibilities, meanwhile the former providing techniques to the latter. Moreover, with decades of accumulative agricultural experience, farmers in the region are able to make choices of the cropping patterns based on the feedback information on water supply (Resource System) and the supervision of the Irrigation Association. All the above interactions correspond to the linkages in the Robustness Framework that can help to stabilize the system.

Several potential challenges to the robustness of the system could be seen from the information available. First, the sanctions for breaking the rules, an important design principle for institutions, were not documented. Second, the link between PI and resource dynamics (link 5 in the Robustness Framework) was unclear, making it hard to predict how the system might evolve dynamically. Third, although not mentioned in the source document, exogenous drivers such as environmental changes could bring more instability and pressures on the public infrastructures and their adaptability, and therefore could possibly be a concern in the future.

3 Case Contributors

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