IRRIGATION MANAGEMENT AND THE DEVELOPMENT PROCESS: TWO EXAMPLES FROM SRI LANKA

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The concept of an irrigation system refers not only to physical aspects such as channels and control structures — hut also to the management structure by which the physical system is planned. designed. constructed, and operated. These two aspects are functionally interdependent. and need to he understood as a whole. The choice of technology, the canal layout, and the cropping patterns all constrain the way the physical system can he managed; whereas the management skills of agency officials and farmers constrain the kinds of physical system which are feasible.

This paper discusses the role of social science in IIMI's cross-disciplinary research on two irrigation systems in Sri Lanka. The objective of the research is to identify constraints in the systems (*sensu lato*), to suggest improvements, and, in collaboration with relevant government agencies, to make interventions in the system and monitor the results. Each of the disciplines involved in the research — engineering, soil science. economics, and anthropology focuses on a particular aspect of the total irrigation system: water flows and water use, plant-water-soil relationships, inputs and returns, and organizational aspects. respectively. Following an overview of one rcscarch project. this paper describes the management practices of farmers and agency staff, examines ways to improve that management. and discusses how alternative management approaches can he evaluated with respect to the broader development process.

RESEARCH ON IRRIGATION INSTITUTIONS

Field research on two irrigation systems in Sri Lanka was initiated by IIMI staff in mid-1985 during the *yala* (dry season) to understand the effects of irrigation management on diversifying from rice to "other food crops" (OFCs) such as chilli, lentils, soybeans, and onions. Faced with imminent self-sufficiency in rice production hut continuing large-scale imports of non-rice food crops, the government is trying to promote the cultivation of OFCs, which require intermittent irrigation, in schemes designed for rice cultivation and more or less continuous water flows.

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Two IIMI research assistants, an agricultural engineer, and an economist, were posted at each system to collect data. They were joined by a sociologyl assistant in October, at the start of the *maha* (monsoon season). The role of the sociology component in research directed at crop diversification issues is to identify organizational constraints to the more careful management required for irrigating OFCs, to explain those constraints, and, during a later phase of action research,' to suggest or experiment with interventions.

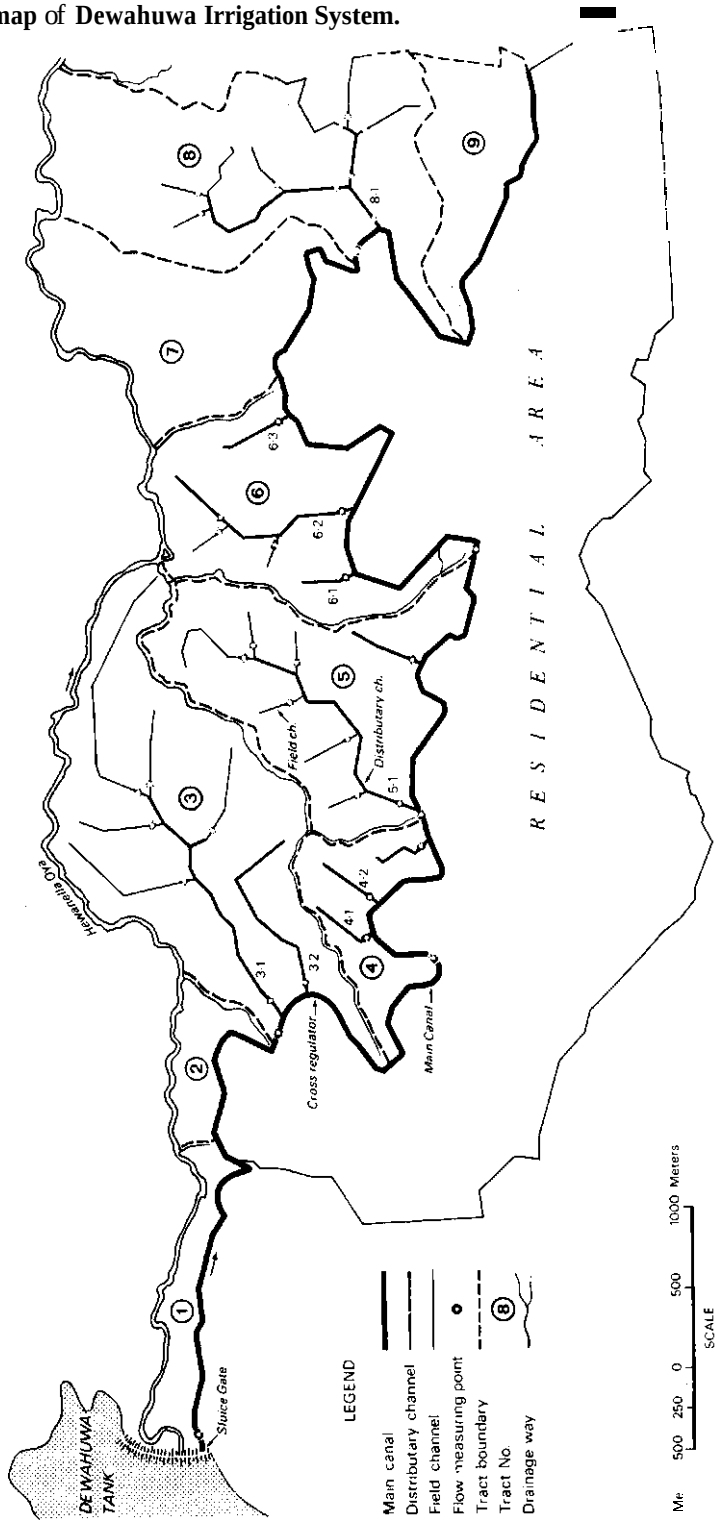
The two irrigation systems selected for the study represent two different kinds of irrigation systems and irrigation agencies: 1) Dewahuwa Scheme, a major tank commanding 1,200 hectares (ha) managed by the Irrigation Department; and 2) Mahaweli System H, a segment of the ongoing Mahaweli irrigation and settlement project which when completed will cover nearly 350,000 ha and is managed by a parastatal agency, the Mahaweli Authority of Sri Lanka.

Dewahuwa Tank

Dating to the 3rd century A.D., the ancient Dewahuwa Tank bad been abandoned for centuries when it was reconstructed in the 1950s. Farmers from the reservoir area, from surrounding villages, and from more distant regions were allotted 2 ha of irrigated land plus 1.2 ha of "highland" plots near the command area. By 1970, the new system had fallen into a state of disrepair and was rehabilitated under a Japanese aid project. Today the designed command area has been expanded nearly 20 percent by unauthorized encroachments; the original families who were allotted land have subdivided their plots several times. While most household economies remain primarily agricultural, many of the second and third generations rely on rain-fed agriculture outside the scheme, supplemented by off-farm employment. Land tenure is fluid, with about half the operators farming land which they do not own. Some nonowners are family members who may someday inherit the land they now lease: others who are classified as owners have taken mortgages and are actually tenants on their own land. Hidden tenancies are the norm because land transfers through either lease or sale are prohibited by law in Sri Lanka's settlement schemes.

The physical layout of the scheme comprises a large tank (reservoir) with a single main canal from which distributary (secondary) channels take off on one side, to serve the command area. The highland residential area extends along the right side of the canal (Figure 1). Each take-off point from the main canal to a distributary or from a distributary to a field channel (tertiary) is controlled by a gate which in theory is opened or closed only by an Irrigation Department worker. Distribution of water within the field channel, which may serve 3-15 allotments (and up to 50 operators), is the responsibility of the farmers themselves. In addition, some allotments are hydrologically independent, receiving water directly from a distributary.

Figure 1. A map of Dewahuwa Irrigation System.



Mahaweli System H

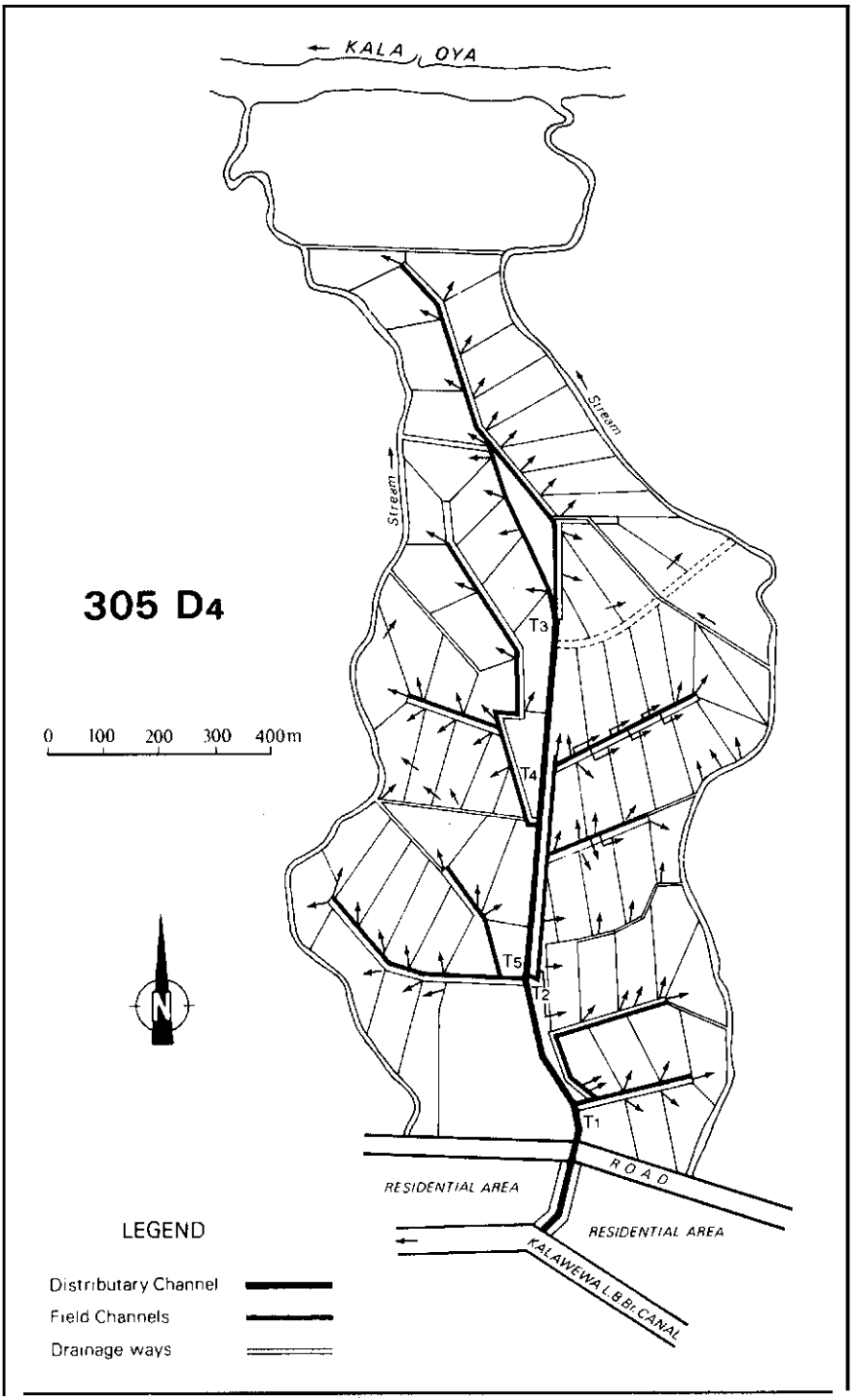
Most of the country's largest irrigated settlement scheme is still under construction. System H was completed in 1983, and is the oldest of five separate units of the scheme, all fed by the Mahaweli River, as well as by smaller streams in each locality. Prior to construction. much of the **24,000** ha which comprise the irrigated area of System H was irrigated by village-owned and managed small tanks. Village economies were based on a mix of irrigated (rice) cultivation and upland swidden. The new canal system and associated land development obliterated many of these tanks, and incorporated others into on-line reservoirs fed by the main system. Settler families from the area, as well as from outside the region, were alloted 1.0 ha of irrigated land and ***0.2*** ha for house plots and gardens. Following the precedent of other settlement schemes, the government constructed all irrigation facilities and cleared and leveled the fields.

Operational management of the Mahaweli Systems is carried out through a separate administrative structure which supplants the normal line agencies, such as the departments of agriculture and irrigation. In System **H,** three resident project managers, are the chief administrators, each supervising about a dozen block managers, with unit managers at the next level. From the farmer's perspective, it is the unit manager, with jurisdiction over about **250** farm allotments, who is the most significant representative of the government. For problems ranging from child care to agricultural credit to irrigation water, the unit manager serves as a patron to the farmer and as a liaison to specialized government services.

The physical layout of the residential plots and the irrigation canals in System H reveals a highly regular pattern. The main canal serving the research area feeds **20** distributaries, which take water to field channels. From these, water flows through four-inch concrete pipes into the individual one-hectare plots. Unlike the case in Dewahuwa Tank, there are no fields fed directly from the main canal or from the distributaries. Each field and each farmer is part of a larger irrigated unit defined by the field channel whose water supply is controlled by a "turnout gate" (Figure **2).**

Each field channel provides water for between 7-15 allotments, and because the scheme is a very new one, most (68 percent) allotments are farmed by the original allottees or close kin.[2] The nominal leader of each field channel unit is a "turnout leader" selected by the farmers or the unit manager or both. At the distributary level, which consists of **74** allotments, there is a distributary leader. Both levels of farmer representatives are intended to mobilize labor within their respective units to clean the water channels and enforce water rotations as needed. Neither the distributary leader nor the turnout leader is given any remuneration, nor does either carry any real authority. The actual role of these farmer leaders centers on reporting to the unit manager about conditions in the field rather than taking direct management action. One-third of the operators sampled did not even know who the farmer representative was and half were not aware of the distributary leader.

Figure 2. Map showing Distributary Channel-4 in Block 305 in Kalankuttiya Block of Mahaweli System H.



MANAGEMENT PRACTICES

In both irrigation schemes, the turnout gate from which water flows from the distributary to the field channel demarcates the management division between the government agency (Irrigation Department or Mahaweli Authority) and farmers. In general, the agency controls the turnout, and the agency employee who makes adjustments to the gate is responding to orders from above, not from farmers. The administrative structure of farmer representatives serves to channel information up the system to the agency level, with the management decisions flowing down the system to the turnout.

Below the turnout. farmers control the distribution of water and are expected to follow rotations to ensure that each operator receives an equitable share. The role of the farmer representative is to provide leadership in organizing water rotations, and in maintaining the channels. During the rainy season when rice is the only crop, rotations are not normally needed. Each farmer prefers to keep his pipe outlet (taking water from the field channel to an individual allotment) open all the time. This results in a small volume of water flowing continuously into his allotment. Even a trickle of water is useful, because the standing water in the rice fields serves as an irrigation reservoir for that field, which is replenished whenever water flows into the field. Excess water flows into drainage channels.

Tail-end farmers receive significantly reduced water flows when the head-end outlets are open. When tail enders need more water, they block the field channel pipe outlets going into the head-end allotments, thus increasing the **flow** to the tail. If the head-end farmer have enough water in their fields, this action is tolerated. If the head enders are not satiated, however, the tail enders are forced to wait until night, when all farmers prefer not to irrigate and when tail enders face the least competition for water supplies.

During the dry season, slightly more than half the commandable area **is** cropped (depending on reservoir supplies). About half of this is given to non-rice crops, which require less water and risk waterlogging if grown during the rainy season. **As** mentioned earlier, the government is encouraging farmers to grow more non-rice crops because of the low-economic returns to rice. Thus, the primary focus of IIMI's field investigations is to determine how irrigation management can promote that objective. While non-rice crops require less water, they require more carefully managed supplies. Waterlogging will result if too much water is delivered. Water stress will occur if the deliveries are too sparse. lnstead of a steady trickle of water, non-rice crops need relatively high volumes delivered in a short period **of** time.

Irrigation rotations are imposed on farmers at the distributary level through management of the main system. During the 1986 yala, cycles of four days "on"

and three days "off" were adopted in Mahaweli-H. In Dewahuwa, the average was about two days "on" and five days "off." The Irrigation Department rotated water among field channels in Dewahuwa, but within the field channels, the farmers did not follow formal rotations. Because the flow to each turnout gate was concentrated during one or two of the few days when water was in the distributary, most of the farmers were able to obtain adequate supplies without resorting to rotations among field allotments. The tail-end farmers within the tail-end field channel, however, relied on night irrigation when they could block the head-end outlets within their channel, and block the turnouts serving the head-end field channels.

In Dewahuwa. where a single distributary serving six field channels was selected as the study area. adjustment of the turnout gates is controlled by two farmer representatives and one irrigator. The irrigator is a full-time employee of the Irrigation Department who controls the water flowing into the distributaries, and in some cases, turnout gates within the distributary. Under the Dewahuwa management structure, the farmer representatives fill an official, part-time administrative role and are paid in-kind' by the farmers in their turnout. On an average, there are about 50 operators for each leader. His services include relaying farmer complaints to the project manager, and conveying information about water schedules from the project management to the farmers. He is also responsible for mobilizing farmers to clean channels and to comply with the field channel rotations. Other than the farmer representative, there are no formalized positions of irrigation-related leadership among farmers.

In Mahaweli-H. the agency does not normally rotate field channels within a distributary; all the turnout gates are generally kept open. However, within the field channel, farmers are expected to rotate water in six-hour turns. Of five field channels in one distributary studied, the six-hour schedule was adhered to in two cases, even though this required certain farmers to irrigate at night. In the two field channels toward the head end of the distributary, the rotational schedule was not followed because there was enough water available without resorting to formal rotations. In the tail-end field channel, some farmers tried to organize rotations, but the procedure broke down over scarce day-time supplies. As in Dewahuwa, these farmers resorted to a primarily night-time schedule when farmers in the head-end were not using the water.

Under the Mahaweli system, there is a much more intensive administrative structure involving two levels of unpaid farmer leaders who are either elected hy farmers, or. more usually. are appointed by the unit manager. Turnout gates are adjusted by a field assistant, a full-time employee attached to the unit manager. The farmer leaders (a distributary leader and a turnout leader), do not control water flows at any level. Their function is to convey information between farmers and the unit manager, and to mobilize the cooperation of farmers in cleaning channels. They also encourage farmer compliance in adhering to rotational schedules within the turnout. Neither the turnout leaders nor the unit manager can enforce farmers' cooperation except through informal persuasion.

IMPLICATIONS FOR MANAGEMENT

In both irrigation systems the general prescription for improved water use efficiency within the distributary is the same: equitable water deliveries to the field channels, equitable rotational schedules (taking into account variations in conveyance efficiencies and soil characteristics), and tighter adherence to rotational schedules. If these measures were carried out, the demand for water within the distributary would fall, and supplies could be reduced. Ascertaining the amount of water that could be saved is an intermediary objective of IIMI's research which must await final analysis of the water data. The long-term objective is to develop new management approaches to support more efficient water use to increase dry season cultivated area, and to increase the production of dry season (and in particular, non-rice) crops.

Using less water can be effected either by decreasing supply (induced scarcity) or by decreasing demand. Though this point may appear to be obvious, supply and demand are very much related: abundant water supplies create their own demand as farmers and agency staff fit their management practices accordingly. The current levels of water delivered to the distributaries are excessive from a technical standpoint. With better management, the same crops could be grown with less water. Given the present management arrangements, however, it is problematic whether water supplies could be reduced without suffering yield losses.

There is a circular relationship between improved management and reduced water supplies. Unless water supplies are reduced, there may be little incentive to improve irrigation management. Yet, existing management practices cannot cope with supply reductions. Incentives that can break this cycle and result in a more efficient irrigation system overall, are unlikely to originate from the beneficiaries of poor management: agency staff who enjoy a comfortable margin of error in calculating water deliveries, and farmers who are receiving all the water they need. Rather it is the senior-level agency staff concerned with agricultural production, along with those farmers unable to cultivate during the dry season, who form a potential lobby for management improvements that can save water.

The Sri Lankan custom of *bethma* (whereby water supplies which are not adequate for the full command area are allocated to part of the area, and all landowners are given proportional land shares in the irrigated part)[4] appears to placate farmers on the management issue, since each farmer can be assured of the same proportion of imgated land during the dry season as all the other farmers in the scheme. Unless the disparities in water availability between head-end and tail-end farmers are severe (which in the two examples cited here, they are not), there is little incentive for farmers to seek change. The incentive for improved management must come from above, where it is more clearly felt. Targeting middle- and high-level officials within the irrigation agencies has been an explicit strategy of IIMI's program, as this is the level where change is most likely to originate.

No matter how management improvements are initiated, an organizational structure that could effectively sustain tighter water control would require either an expanded role for agency staff, or greater involvement by farmers, or both. The choice of management strategy — the mix between agency control and farmer control — depends upon the development objectives: Is farmer management participation considered important for reasons of social development? Or is agricultural production of over-ridiiig concern regardless of management structure?

Improved Management by the Agency

Steps to strengthen the agency's administrative control over irrigation management could involve training existing staff, replacing them with better qualified staff, hiring additional staff, or modifying the administrative structure to enhance the effectiveness of staff. In Dewahuwa, all of these steps are being tried to some extent. The post of project manager (created in 1984) is intended to strengthen the role of farmer representatives and to facilitate communication between the Irrigation Department's engineers and farmers.

One important function of the project manager is to supervise the collection of irrigation maintenance fees which are used for repairs suggested by the farmer representatives. The practice of linking Dewahuwa's maintenance budget to fee collection within the scheme, rather than from central allocations at a regional level, is a potentially powerful incentive to farmers to pay their fees and to perform minor maintenance tasks themselves in exchange for reduced fees. However, there are also incentives for irrigation staff to keep the maintenance function and associated funds within the agency, and there is a complementary incentive to elected politicians to absolve farmers in their constituencies from paying unpopular maintenance fees.

In Mahaweli-H the current administrative structure dates from 1981 when the position of Unit Manager was created (Jayewardene 1984). Formalized leadership roles extend further down the scale than in Dewahuwa, with a dual-level of distributary leaders and turnout leaders, the latter covering about 12 ha and perhaps 15 farmers. One-day training programs have been instituted for some of these leaders. As in Dewahuwa, an irrigation maintenance lee is levied. Senior agency officials have encouraged several different approaches to the recurring maintenance task of cleaning the distributary canals. For several years, the agency gave annual contracts to clean the distributaries. An innovation was to award the contract to the distributary leader. effectively providing a payment to him because the contracts were quite generous. More recently, the agency has ceased providing this function on the expectation that farmers themselves will clean the distributaries. There is. however. no provision for farmers to do so.

In both irrigation systems. recent attempts to improve the administrative control of the agency have focused on the distributary level and (though not discussed here) at higher levels within the project. The next logical step might be to introduce incentives to farmers at the field channel level. Including turnout leaders as

shareholders in maintenance contracts could be one such approach in Mahaweli. In Dewahuwa where there is no field channel organization, partly because the physical layout of the channel system is not conducive to their formation, the introduction of a lower administrative level becomes more problematic. An expanded role for the Dewahuwa farmer representatives in maintenance contracts might provide a partial solution.

Improving Management through Farmer Participation

An alternative to enhancing the authority of agency staff is to promote management capacity by farmers themselves through local-level organizations. In the two systems under study, there *are* nominal farmer "organizations" in the sense that farmers fill the designated role of farmer representatives, but there is no involvement of farmers in group-management decisions. Even channel cleaning is usually done by farmers individually and not as a group activity. Water is acquired by tail-end farmers not by discussing their problems with head-end farmers, hut by blocking the inlets to those farmers' fields during the night, thus, allowing water to reach the tail end.

Promoting farmer organizations at the level of the field channel and the distributary would not replace any of the agency staff currently involved in irrigation management, although there would be a potential for farmers to fill some of the field-level staff functions eventually. The primary objective would be to ensure the flow of irrigation information among farmers, and to promote the cooperation necessary for equitable, secure water distribution. The formation of farmer groups would require a concerted effort for extension of both farmers and the agency staff with whom farmers would now have closer contact. In cases where farmer groups have been successfully organized for irrigation, catalysts were used for periods of 6-18 months to stimulate interest and help develop the necessary organizational skills (Uphoff 1986, Bagadion and Korten 1985, FAO 1985).

CONCLUSIONS: SELECTING MANAGEMENT STRATEGIES FOR IMPROVED IRRIGATION MANAGEMENT

Strengthening the roles of existing agency staff is often easier than promoting farmer irrigator associations, and has a social advantage in fitting nicely with a long tradition in Sri Lankan society. Farmers tend to look to the government as they once looked to the King; help comes from outside to solve internal prohlems.5 The complacency of farmers, coupled with the willingness of government to provide a broad range of services (and there is a close relationship between farmers' expectations and government services) sets the stage for top-down development.

Yet, farmer participation in imgation management through organizations built up from the grass roots would provide farmers, as well as agency staff, with a potentially valuable learning process which can be viewed as a development objective in itself. Farmers would learn organizational skills while acquiring a sense of belonging and a spirit of self-reliance (Goodell 1984). As Blair (1982) observes, such influences are not always welcomed by established interests. Political empowerment, for example, is not the sort of development objective normally found in project appraisal reports, whereas water savings and increased crop production are generally accepted targets.

The costs and benefits of irrigation management options are determined both by quantifiable variables of water use, crop production, operations and maintenance costs, as well as by qualitative variables such as sense of community, well-being, and security. Socioeconomic analysis of irrigation management arrangements bridges quantitative as well as qualitative aspects, and must be grounded in a clear understanding of the physical parameters of the irrigation system and irrigated agriculture.

This paper has discussed two contrasting management strategies of potential relevance to irrigation systems in Sri Lanka: strengthening the capacity of agency staff, and promoting the organized management participation of farmers. The two approaches are not mutually exclusive, but they imply certain trade-offs in terms of development objectives. If development is viewed broadly to include equity as well as economic improvements, the *approach* to management becomes a critical element in evaluating management effectiveness.

NOTES

[1]The term "sociology" is used as a simple label to refer to the social science component of IIMI's research, although the principal investigator was an anthropologist.

[2]Percentages refer to a sample of 56 operators from 3 FCs along I distributary, during maha season 1985/1986.

[3]Their salary is equivalent to about 25 percent of the salary paid to an agricultural extension worker.

[4]*Bethma*, a traditional custom in small, communal tanks of Sri Lanka (see Leach 1961) has been reintroduced recently into the Mahaweli Scheme and in several other agency-administered irrigation schemes, including Dewahuwa.

[5]The theme of farmers' dependence upon government is discussed in Moore (1985).

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