Paddy Irrigation and Water Management in Southeast Asia

For some years it has been thought that in the large, government-operated, gravity-fed irrigation schemes in the humid tropics, poor operation and maintenance drives down the benefits from investments, jeopardizing farmers' incomes and investment rates of return. These threats to the sustainability of irrigation investment are attributed to mismanagement by official agencies and to anarchic distribution of water, caused by farmers' opportunistic behavior.

Results from a recent OED impact evaluation* of six gravity irrigation schemes in Southeast Asia contradict this paradigm. The six schemes are performing much less well than expected at appraisal. But in most of them the performance gap cannot be attributed to decaying infrastructure or wasteful water distribution. The more important reasons are falling paddy prices, overoptimism about the crop area to be served, and project design faults, including choice of unsuitable technology. Agencies generally operate and maintain irrigation structures quite well. And farmers, whether or not they are formally organized in water user groups, cooperate to share water and get essential maintenance done.

The evaluators visited farmers and officials at the scheme sites, and public irrigation authorities responsible for the schemes. Interactive group and household interviews were arranged in all four countries. The evaluation focused on agroeconomic impacts, and on operation and maintenance issues.

Agroeconomic impacts

In the irrigation schemes:

- Crop yields have been close to expectations.
- In four schemes, including three of the large ones, irrigation covers much smaller areas than planned. The main reasons are planners' overoptimism, engineering errors, lower-than-normal rainfall, and failure to extend the tertiary canals.
- Cropping intensities are much lower than expected at three sites and are falling at a fourth.
- Only one scheme—the small Azin scheme in southern Myanmar—has reached its targets for both area and cropping intensity.
- In two thirds of the schemes, output is much less than expected when the projects were appraised. Output of paddy, and of a few other major crops at the two schemes where paddy is not completely dominant, is from 32 to 73 percent of appraisal.

Results from a recent OED impact evaluation* of six gravity irrigation schemes with reservoirs for water storage in Myanmar, Thailand, and Vietnam. Widely dispersed in the region, the schemes were chosen for their variety, rather than their typicality. Though paddy predominates in all, four of the schemes are large—at least 40,000 ha—and the other two are small. Four have plenty of water; the other two, in the central dry zone of Myanmar, have much less than planned. To compare the organization and effectiveness of operation and maintenance (O&M) between irrigation and flood control, the study also reviewed the performance audit findings from flood control schemes at three sites in Bangladesh. (See box.)

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The results emphasize the value of pragmatic approaches to operation and maintenance that bring together public irrigation agencies, local authorities, and farmers to address specific problems and strengthen appropriate incentives. Based on the results of the impact evaluation, suggestions are offered for the management of paddy irrigation systems and for policies affecting them.
Box 1: The schemes evaluated

Irrigation

- **Thailand**: Lam Pao in the northeast (50,000 ha, implemented 1974-86), Maeklong right bank (40,000 ha, implemented 1979-86).
- **Myanmar**: Kinda (71,000 ha, 1980-91) and Kimmundaung tank (1,000 ha, 1982-90) in the central dry zone; Azin tank in the south (1,200 ha, 1982-90).
- **Vietnam**: Dau Tieng, northwest of Hu Chi Minh City (45,000 ha, 1978-86).

Flood control

- **Bangladesh**: Chalan Beel (38,000 ha) and Satla Bagda (21,000 ha), two traditional polder schemes in the northwest and southwest; Hail Haor (19,000 ha), a flood control scheme in the northeast. All implemented 1981-89 under the second Bank-assisted Drainage and Flood Control Project.

estimates in five schemes. Again the exception is Azin in Myanmar.

- **The collapse in international rice prices** since the early 1980s, after the projects were appraised, helped drive down profitability. In real terms, the price of rice in 1995 was only one-third of the 1995 price that was projected in 1980. Farmers could have coped more easily with the price decline had they diversified their cropping pattern, as planned in four of the schemes. Instead, they grew more paddy.

- **Economic rates of return** are no higher than 7 percent in all schemes and are negative in one.

By the Bank’s standards, guided by opportunity costs, these have been uneconomic investments. But borrowers point to the visible signs of substantial intensification of agriculture and increases in yields over large areas that were previously rainfed—as well as the considerable indirect regional and social benefits of the investments that are not captured by rate-of-return estimates. They are committed to maintaining the schemes.

Welfare impacts

In most cases, incomes from paddy in the project areas are well below appraisal estimates. In Vietnam and Thailand, actual incomes are only 10-30 percent of appraisal estimates. The gap is lower in Myanmar, but mainly because appraisal projections were less ambitious.

Farm incomes in the project areas may not be high enough to keep families, and especially their youth, committed to farming. Net household incomes from irrigated cropping on average-size farms in the six schemes range from $600 to $2,000 a year, depending on the size of the farm, local market prices for paddy, and the extent of diversification out of paddy (see figure).

Unless these farms adopt higher-value cropping systems, their sustainability is in doubt. The relation between low paddy prices and rising wages suggests an irreversible trend. In Thailand, the world’s largest rice exporter, economic modernization is pulling farmers into factories even as low paddy incomes push them out. Vietnam and Myanmar, also rice exporters, can be expected to follow the same route.

Operation and maintenance

Through field surveys, the evaluators assessed the performance of agencies and farmers in operating and maintaining the schemes. They observed the condition of canals and control structures, agency activity in allocating, distributing, and maintaining the flow of water, and the strengths and weaknesses of O&M by farmers. In the irrigation schemes, they found that:

- **Water appears to be generally well managed.** In the three major schemes, water-use efficiency ratings are high, at 43-52 percent. This com- pares with the 25-40 percent ratings that the International Food Policy Research Institute quotes as typical in Asian irrigation schemes.

- Though errors were made in design engineering, there is no evidence at the six sites that original construction was so poor as to make maintenance difficult.

- Agencies generally operate and maintain irrigation structures quite well, at least as regards operational plans. Dams, main canals, and structures on these canals under agency responsibility are in good order, except that many measurement devices have been removed or allowed to deteriorate. In Vietnam, the knowledge and hands-on involvement of field engineers from the two provincial irrigation services at Dau Tieng; in Thailand, the purposive reforms promoted by the Royal Irrigation Department’s new project manager at Lam Pao, backed up by technical assistance; and in Myanmar, the intelligent management of scarce supplies by the Irrigation Department at Kinda, are impressive.

- Sophisticated measurement and allocation programs promoted by consultants have been abandoned, both in Myanmar and Thailand. They are premature for paddy cultivation, given the loose institutional arrangements in place and the high water tolerance of rice.

- Assessed against engineering design, irrigators behave poorly. Assessed against their collective self-interest on individual watercourses, their behavior makes sense. In all the schemes surveyed, farmers maintain their canals to serviceable standards. Vandalism and neglect affect mostly structures that are ill suited to community needs, such as tertiary gates that interfere with the flexible operating protocols favored by farmers, inlets that induce excess flooding in the lower reaches, and embankments that prevent drainage. When siltation and weed infestation threaten irrigation, farmers readily mobilize labor to clean up watercourses. They handle routine maintenance and minor repair of tertiary canals, chan-
nels, and associated structures on a collective basis with a modicum of support. The evidence confirms that farmers will act collectively in the common interest if substantial benefits, broadly available to the irrigator community, are at stake.

- **Farmers share water.** Crop yields differ little from the heads to the tails of watercourses. Farmers' own customary arrangements allow significant advantages to those at the heads of canals, but provide enough water for those at the tails. Even where water is short, relations between farmers at the heads and tails of canals are quite civil and accommodating, suggesting that enough "social capital" is available to overcome collective action dilemmas.

**Role of water user groups**

Water user groups (WUGs) are not functioning as well as expected.

Nominally, water user groups exist throughout the command areas of the six irrigation schemes, and are responsible for O&M below the turnouts of tertiary canals. Public agencies retain ultimate responsibility for operating and maintaining the tertiary gates, but usually share these jobs—especially the operation of gates—formally or informally with unfederated tertiary water user groups.

The water user groups vary in type and effectiveness. In the internationally assisted sections of the scheme at Lam Pao, Thailand, both the water user groups and the federated groups of WUGs organized along some of the distributaries clearly show the improvements in the irrigation system, and on farms, that can follow effective organization. None of the other schemes attains this level of performance. Elsewhere at Lam Pao, the WUGs accomplish their basic purposes—to keep the tertiary canals and watercourses open and to assemble labor to help the agency keep the larger canals clear—but do little else. In Myanmar, the WUGs are subordinate to the village councils and do not seek or achieve any higher purpose. In Vietnam they are barely more than arms of the provincial irrigation authority.

**Strong water user groups are not a primary cause of the relatively successful O&M observed in the schemes studied.** Groups with broad participation and strong leadership enhance the efficiency of water distribution and use. But weak groups do not condemn schemes to utter inefficiency. Farmers cooperate to achieve at least basic O&M goals regardless of the maturity of the formal organization.

The experience shows there are other viable organizational models for allocating water than formal irrigator groups. The field studies identified a wide range of organizational procedures, including some reasonably well administered systems developed locally, or with targeted TA from donors, that combine hierarchical authority with user participation and are shaped by country tradi-

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**Figure: Profitability of paddy**

**Annual net farm incomes from irrigated paddy (US dollars)**

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<tr>
<th>Country</th>
<th>Upland</th>
<th>Lowland</th>
<th>Myanmar</th>
<th>Azin</th>
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- Impact evaluation (actual)  - Appraisal (forecast)

**Note**: Household income in 1994 US$, assuming five people per family: Thailand $11,050; Vietnam $495; no data for Myanmar.

**Wage as ratio of output price increases as countries develop**

<table>
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<tr>
<th>Country</th>
<th>Myanmar</th>
<th>Vietnam</th>
<th>Thailand</th>
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<tr>
<td>Paddy/wage</td>
<td>263/1</td>
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tions. At Dau Tieng and the left main canal at Kinda, for example, public agencies ration water intelligently according to availability, and farmers cooperate, inside or outside formal associations, to keep channels open.

Relationships between tertiary units are more problematic than those within. At this level, neighborhood cohesion, and the other social forces that ensure reasonable cooperation within each tertiary system, are too weak to guarantee equitable water sharing. Here associations and formal federations of primary WUGs can make a substantial difference. (At Lam Pao, as the associations of WUGs sharing the same secondary canals gain strength, the functions and prominence of the watercourse WUGs themselves tend to diminish. This is predictable, because once the association of WUG leaders has determined an appropriate water-sharing formula, or cleaning schedule, meetings at the lower level can be dispensed with.)

Contrast with flood control

The flood control schemes in Bangladesh present a different profile, more in keeping with the paradigm of poor maintenance and lack of cooperation among farmers. Actual benefits are closer to expectations in these schemes than in the irrigation projects, but maintenance standards are deplorable and the sustainability of the structures and benefits is in doubt. Professional incentives at the Bangladesh Water Development Board favor civil engineering skills over water management skills, and the involvement of agriculture and rural development agencies is minimal. The board has only recently made efforts to organize farmer groups for maintenance, and farmers have not associated spontaneously. Though they would all benefit from proper maintenance of polder schemes, the benefits of cooperation are less certain, being reaped only when floods appear, and they are not equally shared. The potential implications for the economic and social sustainability of the major flood control investments taking place in Bangladesh are disturbing.

Looking to the future

The turning of the terms of trade against paddy growers in the early 1980s casts a shadow over plans for better O&M. At Lam Pao, farmers who let their land lie fallow in the dry season, instead of double cropping, do not join the working groups. In Thailand and increasingly in Vietnam, families who continue to farm must contend with husbands and young adults leaving the fields and wives, and older members taking up the slack. Such trends imply a shift back to subsistence production, and less interest in or ability to do good operation and maintenance. Dry season production will be the most seriously affected by these changes, but the monsoon labor profile is also changing and with it attitudes to operation and maintenance.

Conclusions and suggestions

Though the sample is small, the similarity of the findings across the different schemes suggests that the following lessons may have wider application:

- Tailor the prescriptions of programs for improving O&M. Agencies and irrigators do well at some functions and fail at others, often a reflection of the incentives they face. For example, exhortations to farmers to keep tertiary gates in working order, and thus risk curtailing their own water supplies, are unlikely to succeed. Hence the need to identify poorly performing components, provide incentives to bring them to appropriate standards, and tailor prescriptions based on intensive consultation with farmers and officials.
- Simplify technology. Sophisticated water distribution and monitoring technologies should be put aside in favor of controls that need less human intervention, at least until intensive diversified cropping systems are in place.
- In Bank projects, emphasize capacity building for effective water distribution associations, giving priority to federating user groups beyond the tertiary watercourse level. Hybrid organizational arrangements that take careful account of existing social networks, and that combine community labor with official agency support, should be piloted to improve the maintenance of canals and gates. Flood control and drainage schemes, where the development of user groups has been ignored, are prime candidates.
- Ensure that project engineering takes adequate account of hydrological, topographical, and social factors. If farmers are to take over responsibility for financing and developing tertiary networks, or managing irrigation, they should be involved early. Even if not formally organized, they should be brought into the design process of the irrigation system and then persuaded to enter agreements for partial financing, approval of designs, participation in construction, and management after construction is completed. Participatory project design is important everywhere but should be mandatory in flood-prone, poorly drained, densely populated areas.
- In government policy, favor crop diversification and intensification, supported by enhanced extension and marketing services. Exhortations to recover costs from farmers should be muted until water systems are reliable, more remunerative crops are introduced, and volumetric water delivery becomes practicable.

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