Irrigation Investment in Pakistan

Pakistan's Indus Basin irrigation system is the largest integrated irrigation network in the world. It irrigates 16 million hectares and provides the lifeblood for agriculture, which employs more than half the workers in Pakistan and provides 70 percent of exports. Yet for many years the system has been plagued by under-investment, poor maintenance, vested interests, and operational difficulties. Income from irrigated agriculture is not contributing as much as it could to economic growth and poverty alleviation, and Pakistan's scarcest natural resource, water, is inefficiently used. OED recently evaluated the impact of four projects of the 1980s that were undertaken to address these problems.

The projects achieved their main physical goals and added substantially to farm production and incomes. But by straying from original strategies, impacts were reduced, and equity and participation concerns were overlooked. The projects could not solve the deep-rooted institutional and social problems affecting system performance.

In 1979, the Pakistani government introduced a Revised Action Program (RAP) for irrigated agriculture. Rather than build more dams, the action program concentrated on saving water and reducing drainage problems. It focused on better use of existing infrastructure, especially watercourses, reduction of water losses from irrigation channels, and better management of water on farms.

**Goals**

The four projects evaluated were the first of ten that the Bank financed to support the action program. Approved in the early 1980s, they supported physical investments in canals and watercourses, backed by institutional initiatives to improve irrigation management and services to farmers. (Box 1.) The projects were expected to increase agricultural production by making more water available for cropping, and to contain waterlogging and salinity problems by reducing water losses from channels. Three other similar projects followed the four evaluated.

The evaluation focused on the effects of the projects on water supplies and their reliability at the farm level. It also assessed the impacts on cropping, the welfare of irrigator families, waterlogging and salinity, and institutions responsible for managing irrigation and supporting irrigated farming. A survey of beneficiary farmers and separate interviews with farm women, by local consultants, were used to supplement Bank staff discussions and field visits; consultant engineers inspected a sample of project canals.

**Implementation and outcome**

As approved, the four projects supported some of the most important priorities established in the RAP. But as implemented, they strayed from the program's agreed strategy:

- They failed to give highest priority to improvements in saline groundwater areas. In these areas—which have no supplementary well water—the returns to controlling watertables and supplying more surface water are the highest.
- They came to be dominated by quantitative targets for watercourse improvement, regardless of the likely effects on water supply, waterlogging, and salinity.
- Canal rehabilitation and lining work in practice included significant capacity expansion contrary to the agreed program. This apparently occurred to allow the provinces to absorb additional water becoming available from Tarbela dam and to establish rights to that water before a formal allocation agreement took effect in 1991. In areas that could not safely absorb more water, the resulting increases in waterlogging and salinity have caused serious human and environmental problems. (See Box 2.)

Program designers had envisaged a farm credit approach, argu-
The wide popularity of the on-farm water management program also reflects other types of benefits. In Punjab, in particular, the lining of watercourses has reduced the stagnant swampy areas caused by seepage and overflow, bringing health benefits. Villagers reported they have less malaria and fewer flies.

Farmers said that watercourse renovation has improved communications within and among villages, since small channels are easier to cross than overgrown, embanked, unimproved watercourses. But the reengineering, renovation, and lining of large irrigation channels have often inconvenienced the communities through which they pass, particularly where too few bridges were provided and canals have become more difficult to use for household purposes and livestock watering.

**Environmental impact**

On balance, the projects have had a positive environmental impact. In the fresh groundwater areas of Punjab and Sindh they had a limited impact on waterlogging and salinity, compared with that from the massive increase that took place in pumping from private tubewells. The farmer survey revealed large differences between the conditions in the two provinces:

- In Punjab, 80 percent of project farmer groups reported a decrease in waterlogging. All the control watercourses reported no increase in waterlogging, and there was no reported impact on salinity.
- In Sindh, one-fourth of project farmers reported a decrease in waterlogging, almost all in fresh groundwater areas, but almost one-third reported an increase in salinity. All the control watercourses reported increased waterlogging.

In the saline groundwater areas of the Sindh, 93 percent of farmer groups reported that salinity had increased. But problems are less in project areas than in the control watercourses which were not improved. Further drainage investments remain a high priority.

**Social impact**

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**Economic returns**

Though economic rates of return (ERRs) vary considerably, the average ERR of the projects today is around 20 percent, indicating that they were sound investments.

**Institutional impact**

**Government agencies**

In general, the projects’ goals for institutional change turned out to be too ambitious. Though the On-Farm Water Management (OFWM) and Command Water Management projects sought to improve coordination between the provincial irrigation and provincial agriculture departments, they could not overcome the cool relations between the departments. In the OFWM projects, the incentives for implementation staff were closely tied to construction progress rather than to institutional progress and development impact. This did not encourage the pursuit of sustainable institutional improvements. The

**Water users’ associations**

At the watercourse level, the projects ignored the traditional local
**Farm water supply**

Though conditions vary widely throughout the system, watercourse upgrading has reduced average losses by 25-40 percent—down from about 40 percent to 25-30 percent of the flows at the watercourse head. The greater estimate implies that, on average, the improved watercourses are supplying farmers with an extra 230 cubic meters of water annually. And water supplies have been evened out between farmers at the heads and tails of watercourses.

The water savings attributable to the four projects total about 2.3 billion cubic meters. Subsequent on-farm water management projects have raised the savings to 5 billion cubic meters. Though the volume of water saved is little more than half of what was expected under the RAP, it is more than a new surface storage dam at Kalabagh, the next large dam site identified, would have provided, and its unit cost is about one-fifth of the unit cost of water from a new dam.

**Agricultural output**

Food production has increased in the project areas, as has the overall value of agricultural output. Nearly all project farmers reported a shift and expansion into higher value crops, which are also more water-intensive: cotton, sugarcane, vegetables, and orchard fruit.

More reliable water supply has given farmers confidence to take risks: the evaluators found that 46 percent of project farmers were risk takers, compared with only 12 percent of farmers in the control group unaffected by the projects.

The projects have clearly helped to accelerate income and consumption growth in an agricultural sector whose growth has been quite high for some time. Farmers are spending the increased income from cropping on better houses, electricity, education (including for girls), motorcyles, and better clothes.
watercourse committees. As a condition for granting large subsidies for renovation, they called for the creation of new water users' associations, which would assume responsibility for maintaining the rehabilitated watercourses.

The new associations were not the innovation they purported to be. Some were merely token institutions, and many were traditional committees renamed in order to qualify for the subsidies. In feudal Sindh, with its large farms, the fact that most farm families cannot join water users' associations, because they are landless laborers or sharecroppers, made even the traditional committees superfluous and the formation of new associations often no more than an empty ritual.

Today, farmers are maintaining improved watercourses well, but most of the associations are now dormant, mainly because once the improvements were completed there was little left for the associations to do. The experience emphasizes that village-level institutions must be fostered, rather than imposed, in response to substantial needs identified by participants.

Issues

Alternatives for increasing surface water supplies

The evaluation confirms that renovating watercourses is a cheaper way to increase irrigation water supply than adding large dams. The capital cost of water saved through watercourse investments is roughly one-fifth the unit cost of water added by new large-scale storage facilities.

To the extent that watercourse improvements can be community based and sustained, these investments are preferable to other methods of improving the efficiency of Pakistan's surface irrigation system, provided unsustainable subsidies can be reduced.

Poverty

Poverty considerations were not a high priority in these projects. While the projects helped alleviate poverty through their effects on farm production, they also provided large and unnecessary transfers of public resources to some of the rural elite. Watercourse improvements were intended to benefit mainly small farmers. But this intention was unrealistic in much of Sindh. In general, the implementation targets for each OFWM unit ensured that the watercourses that were more cohesive, better organized, and led by well-connected farmers came to the fore for selection. This self-selection process speeded implementation, but resulted in many desperately poor areas being left out.

Dealing with diversity

All four projects were national in scope, whereas the evaluation points to the need to increase desirable impacts by tailoring future investment packages closely to the specific physical, social, and economic characteristics of the different areas within the system.

Recommendations

Much remains to be done to improve the system's efficiency, physical maintenance, and responsiveness to diverse local conditions, and to better meet the irrigation needs of small farmers. Experience suggests the following lessons.

Watercourse renovation

- Tailor operations to circumstances. Within agreed guidelines for the area, command, and province, and with full farmer participation, improvements for each watercourse should be designed according to what people want and are prepared to finance and implement. Targeted subsidies may need to be tailored to needs, for example to favor watercourses at the tail ends of supply channels. For tracking purposes, interventions may need to be broken into separate monitorable packages—even within canal commands—with their own development impact indicators.

- Base the design of institutional components closely on existing local institutions, but seek to ensure that farmers themselves participate in designing and implementing each watercourse subproject.

- Strictly enforce formulas for cost sharing (possibly by requiring farmer contributions up-front) with attention to relative needs in the interests of greater equity, particularly so as to end the large transfers of public funds to many of the rural elite.

Canal rehabilitation

In designing canal improvements, irrigation departments should consult closely and continuously with communities, so as to take community concerns about amenities into account.

Monitoring and analysis

None of the projects was well monitored during implementation. Irrigation flows—which in a water-scarce economy are a proxy for farm income and family welfare—are readily measured, but few measurements were taken. More effort to monitor and evaluate water-related matters is needed if this scarce resource is to be used more efficiently and equitably.