Bank Support for Flood Control in Bangladesh

An urbanizing population, soon to be 115 million strong, crowded into the delta of one of the world's great river systems, presents special problems. Bangladesh's rivers bring down a volume of water exceeded only by the Amazon in South America and the Congo in Africa. The annual floods from such a river system have never been contained. A third of the country is inundated every year, and up to two thirds in some years.

Bank support for flood control in Bangladesh goes back 27 years. OED audited the fourth out of ten projects, the Bangladesh Drainage and Flood Control Project (approved 1978, completed 1986).* The audit also reviews experience with previous flood control operations and the literature that helped shape them. It suggests it is time to overhaul the approach to economic analysis and justification of flood control investments in Bangladesh.

For a long time it seemed the two concerns were complementary. The first flood control investments were made to facilitate the more intensive wet-season agriculture thought to be needed to reduce food shortages (see box). But today, the widespread success of dry season irrigation in increasing food supplies, largely independent of flood control, means that civil works for flood control are no longer justified by their contribution to dry season food production and must be considered on their own merits. Unusual floods such as those of 1987 and 1988, with all the suffering they involve, push the space problem dramatically to the fore. Naturally there are demands for the government to solve the problem with large-scale civil works, yet when the economics, finances, and ecological impact of such works—quite aside from their technical feasibility—are examined closely they appear very doubtful undertakings.

History of flood control

Most of the early investments in flood control and irrigation in Bangladesh derived from a 1964 master plan. Under this plan, embankments and polders were to be constructed to keep the annual floods out of most of the arable land.

The Bank's first support for flood control in Bangladesh (BREI) (1963) financed large-scale embankments for partial flood control over some 72,000 ha of the Brahmaputra and Teesta River basins, to stimulate more intensive rice production.

A second project, Chandpur I, set out to combine flood control with dry season irrigation, by constructing polder cells equipped with large reversible pumps for drainage in the wet season and for canal irrigation of dry season rice. Late in the design stage, it was seen that the irrigation canals would have had to be built on the highest and hence most valuable farmland, in a country where all farmland is very scarce. Farmers' resistance to loss of land for canals stopped this initiative. Without the dry season irrigation canal component and its expected benefits,

* "Performance Audit Report: Bangladesh Drainage and Flood Control Project", Report No. 8805, June 29, 1990. OED reports are available from the Internal Documents Unit and from Regional Information Services Centers. Audit reports make a point of documenting differences of opinion on the operations being evaluated. Footnotes and endnotes to this Precis give some sense of the differences in the present case, but for a fuller account see the Audit.
Agriculture and Flood Control

Flooding in Bangladesh usually peaks in July and August when the runoff from melted snow coincides with the monsoon rains. Soils are actually damp enough to grow rice for about half the year, from mid-April to end-November. This, the wet season, is sometimes referred to as the Kharif. Rabi, or dry season, crops—wheat, oilseeds, pulses, and vegetables—are grown in November-March. A dry season rice crop, Boro, is also grown, usually under irrigation.

Before modern farm technology was introduced, farmers mainly grew low-input low-yielding varieties of rice, adapting themselves to the annual floods. If the floods could be controlled, reducing the risks to standing crops, it was argued, farmers would find it worthwhile to transplant, rather than broadcast, the rice crop, and thus get higher yields. Flood control would encourage higher inputs and higher, more dependable, output.

Introducing irrigation for dry season crops was much more revolutionary than controlling flooding, for it called for dramatic changes in farmers' crop cycles and rhythms of life. This happened when high-yielding short-stemmed rice varieties were introduced in the 1960s together with irrigation based on small low-lift pumps using surface water and, later, tubewells using ground water. High-yielding wheat varieties followed in the mid-1970s.

The project was no longer economically viable and had to be redesigned.

The revised sequel, Chandpur II (1970), also combined irrigation with flood control. For dry season irrigation, farmers would use small low-lift pumps to take water from natural drains as they needed it, rather than having to wait for an irrigation bureaucracy to provide it through canals. The project had no need to acquire land for canals and it gave an acceptable economic return. Perhaps more important, engineers abandoned the arid area concept of gravity canal irrigation in favor of low-lift pumping from drains—a much more suitable technology for the humid tropics. But three fourths of its benefits came from the dry season crops while most of its investment costs were for the flood control embankments and facilities.

It began to be seen in the literature that large-scale canal irrigation and flood control investments were questionable ways to address the food problem, especially when compared with the high returns from investment in so-called minor irrigation using low-lift pumps and tubewells, pumping from one of the largest aquifer reservoirs in the world.

The 1972 Bank/FAO Land and Water Resources Study (LWR) took note of the lessons learned from BREI and Chandpur experience and remains a basic document even today. It noted that the only way to control flooding was embankments on both sides of the river channels—a scheme that had several disadvantages:

- technical feasibility unclear;
- huge capital costs;
- huge maintenance costs and problems;
- environmental and ecological changes associated with the loss of the natural inundation regime;
- potential disaster if embankments broke.

Meanwhile, the LWR found enormous potential for irrigation using groundwater.

The LWR approach set the implicit pattern for the Bank's next 20 years of support:

- respond to the food problem by developing ground water irrigation for HYV rice and other crops in the dry season;
- respond to the food problem and space problem by building polders, starting in the shallowest flooded areas where embankments are cheapest and the agricultural payoff greatest.

Drainage and flood control project

Project definition, design:
Approved in 1978, this project comprised three subprojects whose main purpose, according to the staff appraisal report (SAR), was to promote increases in wet season agricultural output.

The largest subproject, Brahmaputra River Embankment II (BREII), was the Bank's last attempt at flood control through large-scale engineered river embankment works. Its expected benefits came entirely from agriculture; net increases in wet season rice output supplied three fourths of the expected annual benefits; increases in dry season crops other than rice supplied the rest.

The other two subprojects, the Chenchuri Beel (CCB) and the Kolabashukhal (KBK) shallow flooding polder schemes, were simple polder operations without stationary pumps for drainage or irrigation. In each of them, two thirds of the benefits were expected to come from increases in wet season rice output, and the other third from dry season non-rice crops. All the subprojects were administered by the Bangladesh Water Development Board (BWDB).

Outcome: BREII quickly ran into basic problems. The main one concerned the "retirement" versus the protection of old parts of the embankment as the Brahmaputra shifted its course westward. Rather than try to protect the threatened sections from erosion, the project was to "retire" them and construct new sections about half a mile from the river.

The river's natural westward shift—taking with it about 800 ha a year of arable land and urban real estate—and the project's plans to accommodate this, were not accepted locally. Land was too scarce and the losers too well defined. BWDB responded by
building costly groins in the river to protect the old embankment and avoid the need to retire it or to buy land on which to build the new embankment. The Bank refused to finance this construction on technical and economic grounds. Some of the groins were eventually washed away, the embankment was eroded and breached, and the maintenance facilities degenerated into a series of emergency operations. BREII had a 36 percent cost overrun; it eventually dominated the whole lending operation.

The fact that the BRE does not give very good flood protection is now well known and accepted. The Bank's unwillingness to finance the protection of the old embankment was well-founded technically and economically, yet these considerations do not carry much weight politically. The roughly 100,000 landless squatters who have set up house above the high water line along the BRE are visible proof of the social dislocations associated with a "rational" embankment retirement process.

The two polder subprojects proceeded on schedule and were completed at substantial cost savings.

Sources of benefits: Given the progress of groundwater irrigation technology in Bangladesh and the difficulty of maintaining the flood protection embankment and internal drainage system, it is difficult now to see the agricultural argument for BREI—only 3 percent of whose annual benefits now appear to have come from wet season crops—or for the flood control structures that were supported by CCB—69 percent of whose gross benefit stream came from increments in dry season crops. In KBK, where special circumstances prevailed, wet season rice actually supplied a larger share of benefits than expected in the SAR.

Maintenance: BWDB has not maintained the flood control facilities well, perhaps for two reasons:

- beneficiaries of these "free" facilities do not perceive that they benefit, or do not effectively communicate their demand for maintenance to the government;
- incentives facing government decision makers may favor frequent rehabilitation and reconstruction over maintenance. Unless these incentives are understood and changed, maintenance will probably remain poor.

The fact that privately owned tubewells and low-lift pumps are now self-financing, self-operated, and self-maintained indicates that farmers truly want minor irrigation equipment and that it is truly effective. This cannot be said about all BWDB flood control investments, which there is no market test demonstrating their usefulness or farmers' desire for them. Formal economic analysis must then bear the entire burden of justification (see box).

Food problem: lessons from the record

The annual breaching of the BRE confirms earlier evidence that flood embankments subject to erosion from a migrating river bed are a poor way to promote wet season agricultural production because they cannot be made to work effectively.

Polder investments in deeply and moderately flooded areas, using fixed pumps for drainage in

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**Economic Analysis of Flood Control Projects**

What is the project economist to do when powerful forces favor investments in flood control civil works that may not be technically or economically feasible? As long as rice prices were high and documented experience scarce, one could assume that flood control would yield enough wet-season agricultural benefits to justify almost any engineering works that were technically feasible. Under these circumstances both the food problem and the space problem could be addressed together.

As rice prices fell, and evidence for the effectiveness of dry season irrigation mounted, Bank lending rightly stressed minor irrigation investments to address the food problem. As the problems of polder schemes with large-scale pumps for irrigation and drainage became clear, the Bank's emphasis rightly shifted to simple polders in shallow flooded areas. Even when it became clear that in the shallow polder areas most of the agricultural benefits were coming from dry season irrigation, the wet and dry season investments could still be analyzed as a unified package, as was done, for example, in the completion report for the Drainage and Flood Control Project.

But the Bank's most recent flood control operation, the Fourth Flood Control and Drainage Project (DFCIV), approved in 1987, had to recognize that dry season irrigation was already widespread in the project area, and so could not be packaged with flood control investment. For this project it was assumed that failure to build polders would decrease cropping intensity, because other polders being constructed in the area would raise water levels in unpoldered areas. The standard technical and economic assumption in earlier flood control projects was that a polder project would have no negative impact on unpoldered areas. In DFCIV, the reversal of this assumption has become a major justification for building more polders.

With the real price of rice expected to remain at half the levels of 1948-81, and with the increasing concern over the effectiveness and externalities of poldering, it seems to be time to overhaul the approach to justifying flood control investments in Bangladesh.

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The Region feels that although the economic returns may be overstated in the PCR, the low-cost interventions would still yield acceptable returns since they are for rehabilitation and improvement.

The Region notes, however, that conditions in the Baranai-Atrai basin, where DFCIV is located, are not typical for Bangladesh.
the wet season, have not been a cost-effective way to address the food problem either. Nor have cheaper, simpler polders without pump drainage in shallow flooded areas—unless it is true that dry season crop production based on low-lift pumps or shallow tubewells would not have taken place without the polders.

Dry season irrigation resists drought (which is far more damaging, if less dramatic, than floods); it seems to be cost effective with or without polders; and the incentives to intensify farming are much greater in the dry season than in the wet. Extremely low prevailing and predicted prices for rice strengthen this tendency.

Recently a connection has been drawn between flood control embankments and dry season crop production, especially of rice. But the fact that the poor performance of the BRE has not kept dry season irrigation from developing in its shadow suggests the dry season technology is largely independent of protection from floods in that area. More broadly, while it is true that early floods sometimes damage the nearly-ripe Boro rice crop before it can be harvested, there are not enough statistics to show that flood control embankments are critical for the adoption of dry season irrigation technology. The benefits from irrigated Boro rice are big enough to continue the general expansion of low-lift pump and shallow tubewell investments for this crop, with or without flood control investments, particularly in areas subject to deep floods. (It is likely, too, that further development of the Boro rice crop will depend much more on other factors and policies than on those toward flood control.)

**Space problem: continuing dilemma**

While groundwater and low-lift pump irrigation development address the food problem effectively, they do nothing about the space problem. Three studies published in the wake of the catastrophic floods of 1987-88 differ as to what should be done in future.

The French Engineering Consortium Study (FEC) calls for a 20 year $5.2 billion civil works program for double embankments, with an annual maintenance cost of about $150 million. The program’s economic rate of return (ERR) would be four percent, counting only the agricultural benefits. Counting avoided property damage raises the ERR to six percent. Only by claiming certain indirect benefits is it raised to 12 percent.

UNDP’s Bangladesh Flood Policy Study also recommends a costly 20 year investment program for embankments and integrated polder components. The expected benefits come from avoiding agricultural and industrial output losses and damage to capital stock. But the study concludes that “The low benefits from stand-alone flood protection are in contrast with the favorable returns commonly accorded to water projects aiming at increased agricultural production and associated area development.”

USAID’s Eastern Waters Study argues that controlling floods with river embankments is not technically feasible nor ecologically desirable, and that trying to do so would put at risk resources that could be better used otherwise. It asserts that more people suffer annually from drought than from floods, and that even a US$6 billion flood control program (annual operating cost, $600 million) would be highly unlikely to generate enough benefits “to justify the investment and recurring costs of embankments [or to be] the best use of Bangladesh’s extremely limited resources.”

Addressing the space problem, it notes the possibility of building embankments to provide refuges from catastrophic flooding, and smaller ring dikes for high-value agricultural or very crowded residential areas.

The Bank’s 1989 Bangladesh Action Plan for Flood Control draws on the FEC and UNDP studies to offer the donor community a single framework for discussing elements of aid. It makes the underlying assumption that the major rivers will have to be controlled. But it attempts a unified treatment of the food problem and the space problem, whereas experience now strongly suggests that for investment planning purposes the two are better treated as conceptually separate. The attempt to satisfy both concerns simultaneously accounts for the tentative nature of the plan and its heavy conditioning of implementation on technical, economic, financial, social, and environmental feasibility.

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1 The Region notes that significant progress on the maintenance issue is now reflected in agreements under the BWDB Systems Rehabilitation Project.

2 The Region feels that the relationship between agriculture, flood control, and irrigation in Bangladesh is more complex than suggested here, and that the potential for free-standing irrigation development has been overestimated.