WATER AND DEVELOPMENT IN BANGLADESH

A Retrospective on the Flood Action Plan

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CONTENTS

ANNEXES

FIGURES

TABLES

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ACRONYMS

BDG	Bangladesh Government
BIDS	Bangladesh Institute of Development Studies
BWDB	Bangladesh Water Development Board
DAE	Department of Agricultural Extension
DPHE	Department of Public Health Engineering
EIA	environmental impact assessment
EWS	Eastern Waters Study (1989 ISPAN publication)
FAP	Flood Action Plan
FCD	flood control and drainage
FPCO	Flood Plan Coordination Organization
FCD/I	flood control, drainage, and irrigation
GIS	Geographic Information System(s)
GPA	*Guidelines for Project Assessment* (a FPCO document)
HTW	hand tubewell
HYV	high-yielding variety (rice)
IAM	Investment Analysis Model
IECO	International Engineering Co. (San Francisco-based)
ISPAN	Irrigation Support Project for Asia and the Near East
LCG	Local Consultative Group
LGED	Local Government Engineering Department
LLP	low-lift pump
MIWDFC	Ministry of Irrigation, Water Development, and Flood Control
Mha	million hectares
MOWR	Ministry of Water Resources
NGO	nongovernmental organization
NWP	National Water Plan
O&M	operations and maintenance
STW	shallow tubewell
USAID	United States Agency for International Development
WARPO	Water Resources Planning Organization

EXECUTIVE SUMMARY

When Bangladesh suffered devastating river floods in 1987 and 1988, a number of countries and international development institutions responded to the government's calls for assistance. Four reports evaluating Bangladesh's flood vulnerability and proposing remedial policies were written in 1989. One of these, the *Eastern Waters Study* (EWS) commissioned by USAID through ISPAN, purposely went beyond the immediate flooding problem to examine conditions throughout the Ganges, Brahmaputra, and Meghna basins in the dry season as well as the monsoon months. The cautious approach it recommended to the building of rural flood control structures conflicted with the thinking at that time of the Bangladesh Water Development Board (BWDB), which sought to use the international financial aid expected in response to the flood devastation for the construction of large embankments along the lengths of the major rivers. In December 1989, the World Bank, charged with a coordinating role by the Group of Seven, achieved agreement on a Flood Action Plan (FAP) program to run for roughly five years. Largely because of the conflicting points of view among the original four studies, the FAP became primarily a research and analysis program, with about 30 separate studies, rather than a blueprint for the immediate construction of flood control works.

Although the FAP will officially continue until 1995, the studies, of which the United States has sponsored four, have largely been completed. The present report, which is not as formal and comprehensive as the EWS, discusses selected aspects of the process and the outcomes of the FAP and examines the water policy in Bangladesh as it affects the country's development needs and opportunities, both agricultural and urban. It has been written after a five-year interval, and a ten-day visit to Bangladesh in June 1994, by the authors of the EWS (P. Rogers, P. Lydon, and D. Seckler) joined by G.T.K. Pitman, who has directed ISPAN and United States participation in the FAP for much of its duration.

The report expresses the independent views of these four authors; it represents their views, and not those of ISPAN, nor of any other organization with which they are affiliated. It should be read as a broad-brush clarification of a complex policy situation, not as a detailed discussion of the subject's many subtopics, special angles, and variations. It undoubtedly takes the same approach as the *Eastern Waters Study* of five years ago, but, as in 1989, it should not be read as advice against all rural flood control and drainage projects. What it does urge is that *all* project proposals, including those for irrigation, should be subject to multicriteria evaluation, including comparison with alternative investments from other sectors, an environmental impact assessment, and serious consultation with those who will be affected. Any surface water management, flood control, or drainage project that survives this scrutiny should be acceptable.

THE FLOOD ACTION PLAN (FAP)

The studies of the FAP, regional and thematic, are shown in Annex A, with their sponsors and approximate financial commitment levels.

From the extensive hours of FAP work by both Bangladeshis and foreign technicians, a new concept of water management in the deltaic environment of Bangladesh emerged. The important benefits of normal flooding were recognized, the full-length river embankments originally proposed were quickly discarded as uneconomical, and a more complex and environmentally responsive approach to water investments began to win general agreement.

Among the major achievements were the following:

- A broader and more detailed assessment of project costs and benefits—social, environmental, and economic—was stipulated in the *Guidelines for Project Assessment* that the FAP adopted. This examination of a larger range of benefits and beneficiaries came to be referred to as multicriteria planning.

- The consideration of sustainability and external effects was greatly refined and emphasized in comparison with the past. Environmental impact assessments became part of project preparation.

- With better study of fish migration and reproductive cycles and improved quantification of fish losses, traditional flood control, drainage, and irrigation (FCD/I) interventions were seen to damage Bangladesh's open capture floodplain fishing, upon which the rural population depends overwhelmingly for the limited animal protein in its diet.

- The need for much better consultation with beneficiaries and stakeholders, particularly the local farmers and others affected in a project area, was widely acknowledged.

- There was a deeper awareness that agricultural gains since the mid-seventies have come primarily from policy changes that fostered the use of groundwater extracted by private tubewells for the cultivation of high-yielding varieties (HYVs) of rice during the historically fallow dry season, rather than from the rural works of the water engineering sector.

- New technologies were introduced, notably Geographic Information Systems using satellite observations, cloud-penetrating radar and Global Positioning System data, and highly advanced mobile river-charting and analysis equipment was imported for the study of the major rivers.

- Some participants called for the national integration of water management planning, fresh attention to the 1983-1991 National Water Plans, and closer harmonization of water projects with nearby or related activities, such as transportation system development.

There is no question that the FAP expanded greatly from flood control to water management, although this was unevenly reflected in the regional studies. As this report is being written, the results and recommendations of the FAP studies are being pulled together in a major report under

preparation by the Bangladesh office that coordinated the FAP, the Flood Plan Coordination Organization (FPCO). As of mid-1994, there was less eagerness by the government and the BWDB to move rapidly into rural surface water control projects and almost certainly less readiness by many external donors to finance them. Although expensive, the FAP, it is to be hoped, will prove instrumental in a major reallocation of expenditure in Bangladesh.

Two major problems remain unresolved:

- The FAP study process and the more sensitive approach to water management that it has generated must be institutionalized by a major overhaul of the large water sector administration. The drive for environmental sustainability is still at a fledgling stage, and much work is needed to institutionalize it and assure its broad application.
- While the five-year debate about the merits of embankments and polders has been going on, local flood preparation and flood proofing steps have not been pursued, so that the countryside could be as vulnerable to a major flood now as it was in 1988.

AGRICULTURE

The central purpose of rural water control works has traditionally been to increase the security and productivity of agriculture, but Bangladesh's remarkable success in rice production over the past 20 years indicates that foodgrain supply will no longer be a problem except for occasional setbacks because of weather or other reasons. The present trends should soon yield growing surpluses of rice for export and opportunities for crop diversification. The key to this success has been dry season cultivation of HYVs with tubewell irrigation. About one-third of the land irrigable by this method is now receiving winter water, and the application of proper levels of fertilizer to these crops is growing. Analysts in the Ministry of Agriculture and in agricultural technical support missions are correct in predicting that the present national cereal production of about 20 million metric tons per year could be greatly increased in the next 20 years by the extension of tubewell irrigation and by better fertilization and management. The constraint on such growth is no longer productive capacity but the need for strong and steady demand to ensure that the prices paid for rice can meet the costs of cultivation. This demand must come from strengthening other sectors of the economy. To maintain agricultural momentum, we suggest studies of the international market for Bangladeshi rice and of opportunities for crop diversification and exports.

GROUNDWATER

Many Bangladeshis worry that groundwater reserves might not be enough for the expansion of tubewell irrigation. Our analysis of rainfall, percolation into the alluvial soils, and the output of existing tubewells indicates that this fear is unfounded, and that the reserves can be developed without major risks for at least the next decade. Some shallow wells, notably those using handpumps to draw drinking water in the western parts of the country, are likely to experience shortages at the end of the dry season, but there are inexpensive remedies for this. A seasonal

shortage does not indicate that a well is permanently going dry but that the extraction is creating larger underground storage for the following monsoon's rainfall. Not understanding this, the government for a time in the early eighties regulated groundwater use and pumping equipment. But private shallow tubewells operate remarkably well as a small-scale technology that individuals or small groups of farmers can afford. Governmental interventions like those in 1982-85 are counterproductive.

THE REGIONAL PICTURE

Our recommendation made in 1989, that each country sharing the Ganges, Brahmaputra, and Meghna basins would do well to optimize its internal water management rather than wait for the remote possibility of a satisfactory regional agreement, regrettably still remains valid. Bangladesh's relations with India are difficult, and water is now a particularly sore point. There has been no progress toward cooperation in augmenting supplies during the dry season in the eastern subcontinent, and India, which controls virtually the entire dry season flow of the Ganges through a barrage at Farakka, has not renewed the Ganges water-sharing agreement that existed from 1977 to 1988. Bangladesh asserts that the loss of Ganges water diverted by India is harming the southwestern region of the country, permitting deeper penetration of ocean salinity into the tidal river channels, aggravating the difficulties of the Ganges-Kobadak irrigation project, and threatening the water supply for Khulna. Bangladesh could strengthen its case before the United Nations and elsewhere by sponsoring an independent and objective study of the harmful environmental effects of diminished dry season water in the Ganges.

INSTITUTIONALIZATION OF THE FAP AND REFORM OF THE WATER SECTOR

The most important contribution of the FAP, and it is a substantial one, is the opening of alternative approaches to water resource development in Bangladesh. The objective is to preserve and extend the spirit, as well as the letter, of what has been learned. Our conclusions on institutionalization are that:

- The analysis and planning element of the water sector, presumably the Water Resources Planning Organization (WARPO), should be rehabilitated and greatly strengthened, especially if FPCO is to be incorporated into it. The planning function should be kept distinct from implementation, and the integration of the FAP and the National Water Plans of 1987 and 1991 should be made a goal.

- The BWDB should place far greater stress on liaison with other relevant agencies of the government and project-affected publics, on financial transparency, and on the long-term management, not just the construction, of projects. First priority in its flood control and drainage work should be given to the protection of land for the expansion of towns and industrial areas. O&M of projects should be decentralized.

- The groundwork should be laid for a shift of national resources from traditional rural surface water control to urban water supply and sanitation (estimated to require an investment of at least $1.8 billion in the near future), with the possible allocation of BWDB staff to urban works.

- An Institute of Land and Water Management should be created as a partnership between the government and the private or NGO sector, on the model of the Bangladesh Institute of Development Studies (BIDS).

- Finally, and most important, with basic agricultural sufficiency secure under private sector control, Bangladesh's planners must turn attention to the cities and to industry and the long-range requirements for urban and industrial water services.

In sum, the central points of this report are:

1) *Irrigation, primarily from groundwater, and dry season HYV cultivation have brought Bangladesh to foodgrain self-sufficiency (within the limits of effective demand). The country can confidently look forward to a substantial rice exporting capacity or to greatly diversified crops for domestic consumption and export. Few limitations on groundwater quantity and quality are foreseen for the next decade or so which would place a ceiling on this line of growth and little if any government intervention is needed. Further extensive rural flood protection investment is not necessary for this promising agricultural future.*

2) *The lessons and processes of the FAP offer much needed improvement of the water sector. The reforms initiated by the BWDB in the summer of 1994 should signal a broadening of national analysis and planning capacities and a refinement of implementation ability in water management.*

3) *With the food situation basically secure, planners and senior government officials should focus on a new future for Bangladesh. Current trends make it clear that the country's still growing population will be concentrated in cities, where water planning should support the development of the industries and services that will provide productive employment. Flood protection and water supply and sanitation for urban and industrial areas should be given increased priority.*

4) *Poor drainage probably damages the aman crop as much as the floods do. Indeed, along with road and rail embankments, flood protection works are major obstructions of drainage. A short-term study of drainage problems in Bangladesh to provide a basis for corrective policies should be commissioned. This could perhaps be attempted by the GIS/flood modeling groups (FAPs 19 and 25) as an innovative challenge to their techniques.*

Chapter 1

INTRODUCTION

The densely populated deltaic nation of Bangladesh, as it had in the past, suffered disastrous river flooding in 1987 and 1988, with the loss estimated at more than 3,000 lives and heavy property damage. As a first response to the calls for international assistance from the Bangladesh Government (BDG), several studies were prepared on the hydrology and flood vulnerability of the country. At the initiative of then U.S. Representative Stephen Solarz, the U.S. Agency for International Development (USAID), through the Irrigation Support Project for Asia and the Near East (ISPAN), commissioned the *Eastern Waters Study*, which was prepared by a team of advisors with backgrounds in water engineering (Rogers), development economics (Seckler), and regional affairs (Lydon). The team intentionally considered the monsoon flood danger in the context of the large river basins of which Bangladesh is a part, and took into account the long dry season as well as the rainy months. The *Eastern Waters Study* (EWS) was carried out quickly in response to the urgency of the situation, and was published by ISPAN in May 1989.

Three other studies were prepared at the same time, respectively by Bangladesh in cooperation with a UNDP team, by the French Engineering Consortium with Bangladeshi collaboration, and by the Japanese International Cooperation Agency. The studies arrived at conflicting conclusions. The Bangladesh/UNDP and the Bangladesh/French analyses generally concurred in recommending large earthen embankments to confine the country's three major rivers. The EWS believed that this approach would be costly, ineffective, and harmful, especially by devastating fish reproductive cycles and fish catch, and by cutting off rice farmlands from beneficial monsoon flooding.

At the request of the BDG and of the Group of Seven leaders meeting in Paris in July 1989, the World Bank agreed to coordinate international assistance to reduce Bangladesh's flood vulnerability through measures that would be "technically, financially, economically, and environmentally sound." Social soundness was later added to this list. However, the result of the conflict about the methods to be pursued was that, after extensive consultations, the Flood Action Plan (FAP), which the Bank staff proposed in London in December 1989, was to be a set of studies conducted from 1990 to 1995, rather than immediate projects for feasibility review and execution. Under the FAP, some 26 studies and numerous sub-studies have now been largely completed with the support of 15 donor entities coordinated by a temporary special unit, the Flood Plan Coordination Organization (FPCO), within the former Ministry of Irrigation, Water Development, and Flood Control (MIWDFC), now re-titled the Ministry of Water Resources (MOWR). The United States generally followed the orientation of the 1989 EWS as its policy framework for participation in the FAP. Through USAID and ISPAN, it sponsored four FAP supporting studies at a cost of about $11 million on Environment, Flood Response, Flood Proofing, and Geographic Information Systems, respectively—subjects that did not presuppose a need for embankments as a solution to the flood problem.

The EWS authors visited Bangladesh periodically between 1989 and 1993 to review U.S.-sponsored participation in the FAP. Five years after the EWS, USAID asked them to conduct this fresh review of the FAP and the water situation in Bangladesh. G.T. Keith Pitman, a water resources planner who served as the manager for U.S. participation in the FAP, joined the team for this purpose.

The report that follows embodies the conclusions of the team during a short visit to Bangladesh in the first half of June 1994 and in the drafting period since. It appraises the water resource situation since the 1989 EWS and discusses regional water issues and future water policy in Bangladesh. It is a much shorter and less formal paper than the EWS and focuses on Bangladesh rather than the entire Ganges-Brahmaputra-Meghna basins, although it does discuss Bangladesh's water relations with its principal basin neighbor, India.

The FAP has been surrounded by confusion about its purpose and function. Some people still identify it with the original proposals for heavy civil engineering flood control construction. In this sense, opposition to "the FAP" is an article of faith in certain environmental circles. Those closer to the subject know that the original river-length embankment proposals were discarded early in the process and have not been an active issue for several years; for those involved in it, the FAP means the study process.

This paper could well be read in conjunction with 1) the *Eastern Waters Study* of 1989; 2) a recent work entitled *Flood Plans or Flood Plains* by Hughes, Adnan, and Dalal-Clayton, which offers an extraordinarily valuable compendium of FAP background and details; 3) *Flood Action Plan, Bangladesh: A Study of the Debate on Flood Control in Bangladesh*, released by the Operations Review Unit of the Netherlands Ministry of Foreign Affairs; and 4) the detailed review of the FAP now under preparation by the Bangladesh Government's FPCO as this report is being drafted.

It is emphasized that the views in this report are those of the authors alone, and not of organizations with which they have been or are now affiliated.

Chapter 2

THE FAP

The FAP's major categories and the projects under them, with donor countries or lending institutions and rough cost levels, are found in Annex A.

The first major attempt at regional water planning was the Master Plan of 1964, which was prepared by the International Engineering Co. of San Francisco (IECO) and came out heavily in favor of large embankments and polders covering most of the country. The World Bank's *Land and Water Study*, completed just after Bangladesh's independence in 1971, took a contrasting path and pointed the way to small-scale incremental development, primarily through irrigated dry season cultivation using low-lift pumps and groundwater. This path has proved a major success. The National Water Plan (NWP) of 1987 and its associated studies also emphasized groundwater development. The so-called French plan of 1989 that proposed massive river-length embankments to deal with flood vulnerability was an ambitious and large-scale extension of the traditional modus operandi of the Bangladesh Water Development Board (BWDB), put forward to be funded by the additional external aid that the flood disasters of 1987-88 were expected to bring in. Instead, this call for a sudden and very large expansion of the traditional approach brought the FAP, with its unaccustomed scrutiny and evaluation of the traditional water sector that exposed engineering and hydrological flaws, doubtful economic viability, environmental shortcomings, and other problems that had been accumulating for several decades.

The FAP, with the exception of urban protection, became a study process, rather than a blueprint for new construction, due to the conflict between those who were referred to as "structuralists," centered in the BWDB, and those who questioned a heavy reliance on rural surface water control structures and sought to stress environmental, fishery, and related concerns. The concept of large embankments thereafter elicited growing Bangladeshi opposition from elements of the public and some officials, and encountered the dissent of certain external donors and technical advisors.

As the studies and their associated workshops and debates continued from 1990 to 1994, it became clear that the work done under the FAP would not vindicate the structuralist analysis but would confirm the need for a much broader water management perspective. In particular, the introduction of environmental impact assessments and considerations of sustainability into the evaluation of water projects changed cost-benefit calculations irreversibly. A 1992 FPCO manual, *Guidelines for Project Assessment* (GPA), developed within the FAP, greatly increased the range and comprehensiveness of cost-benefit calculations and made the coverage of social and environmental effects obligatory in evaluations. Also important were the environmental impact assessment (EIA) guidelines and manuals drawn up by FAP 16, and the *People's Participation Guidelines* prepared by FPCO after much debate on a difficult subject.

The greater complexity and sensitivity of project evaluations were reflected in the retrospective evaluations done by FAP 12/13 of 17 existing embankment projects; some were judged to have justified themselves decisively, but many had been very costly for the return they gave, or had

fallen into disuse. FAP 12/13 highlighted the damage done by inadequate consultation with local people and by overemphasis on engineering rather than social criteria in project choice and design. New tools, such as the GIS of FAP 19 using satellite observations, brought out the instability of the Brahmaputra, as did FAP 1, an evaluation of the Brahmaputra Right Embankment, which did not hold back the floodwaters in 1988. The studies of subregions did not propose the river-length embankments envisaged in 1989 as the best solutions in their areas (although if all the polders in FAP 3 had been built, they effectively would have embanked the eastern bank of the Brahmaputra). Regional studies did propose more limited embanking schemes, usually linked to compartmentalization or polder creation. The Tangail Compartmentalization Pilot project developed into the major test case for this concept of water control, which came to be widely discussed within the FAP (see below).

The FAP process also brought out the fact that embankments often increased the vulnerability of those living in unprotected areas outside the embankment. This would apply to at least 4 million people who live between riverbanks and embankments set back some distance from the river edge. Structures particularly aggravated the danger for persons living on silt-accreted land in or very close to the rivers (char-dwellers), of whom there are more than 1.8 million. Even those protected from river flooding behind an embankment could receive disbenefits as well as benefits: if the flood came from rainfall rather than the river, as was true in many localities in 1987, the water impounded by the embankment only worsened waterlogging. Such harmful drainage-blockage also occurred in ordinary rainy seasons. If an embankment was overtopped or failed during a severe river flood, the people who were counting on its protection were taken by surprise and thus in a worse position than without it.

The FAP 15 study of Land Acquisition and Resettlement made clear the common difficulty and inequity of that process and how hard it is to redress the hardship it imposes. This was particularly striking since at that time the forced resettlement of rural dwellers as a result of development projects was attracting world attention, notably in the case of the Narmada project in western India.

The FAP studies confirmed that embanking interfered with traditional free capture fishing, and that privately owned pond fisheries were no substitute for poor people dependent on common property to obtain essential animal protein. Indeed, an extremely important achievement of the FAP was the re-examination of fishery trends it provoked. The country's riverine environment, including the floodplain, supports one of the richest inland fisheries in the world, where more than a million professional fishermen and three-quarters of the rural population are fishing at some time in the year. Fish provide 80 percent of the animal protein in the national diet, and the flood cycle is an essential element in the life of most river fish. The monsoon floods conjoin the primary habitats (rivers, floodplains, beels, and estuaries), producing a single integrated biological production system in which fish and prawns breed and grow in both numbers and biomass. The inundated floodplains play a most significant role in this ecosystem, because they provide nursery and feeding grounds for the hatchlings, fry, and juveniles of a number of species for four to five months before they enter riverine or estuarine habitats. In the past, agriculture and fisheries complemented each other on the floodplains, but population pressure and increasingly intensive agriculture have now brought the two into conflict. Beels have been

pumped for irrigation and drained for dry season cropping, and rivers cut off by embankments; fish habitats and migration routes have declined with these interventions, since the fish productivity of a floodplain can be correlated with the area inundated. The FAP studies have found that fish production on the floodplains is two or three times greater than previously believed, often achieving over 100 kilograms per hectare, and also have established that, where flood control reduced the depth and extent of flooding, the professional fishermen were the principal losers. FAP studies are now, as a result, suggesting fish-preserving mitigation measures.

Breaches made in embankments by villagers to relieve impoundments or to bring water into a field are known as "public cuts." They are made when an embankment for any one of several reasons is not wanted by elements of the local population. The issue of widespread public cuts, which are a major reason for the failure of earthworks constructed under the classic top-down decision-making procedures, brought forward the need for local consultations on projects that altered the local environment. From this, "people's participation" in decision-making developed into a major theme, with even BWDB officials agreeing that poor local consultation had long been a principal deficiency of the agency. The FPCO generated *Guidelines for People's Participation*, an important document that nonetheless does not yet manifest a stable consensus on how this participation can be achieved and managed. Interestingly, the BWDB itself has now issued public participation guidelines for all its projects. Public "transparency" became an issue with regard to the FAP, and after the democratically elected Bangladesh Nationalist Party took over national leadership, two open conferences on the FAP were held in Dhaka in the spring of 1992 and 1993. They represented a substantial step forward in openness and public exchange in Bangladesh's development planning, and were followed by similarly constructive public meetings in outlying districts on proposed flood management options, with Members of Parliament participating.

About a dozen countries offered assistance in response to the September/October 1988 flood. Unlike most previous floods affecting only outlying rural areas, water inundated the capital city, Dhaka, and the flood was vividly experienced by foreign representatives as well as the BDG officials living there. Dramatic flood pictures and reports, moreover, were widely disseminated across the world by heavy media coverage. Gathering such a large number of donors and lending institutions into one effort was an important achievement for the FAP, contrasting with the individual way external assistance has traditionally been handled in Bangladesh by donor countries and international lending institutions such as the World Bank and the Asian Development Bank. The multiplicity of FAP donors created a complex situation, and the division of the activity into more than 26 study projects increased the complexity greatly. (The normal pattern was that a donor sponsoring a FAP study brought in consultants from its own country, who in turn engaged Bangladeshi consultants to assist them.) The need for coordination was clear. The World Bank was assigned this role, and the FPCO was created for just that purpose. The UNDP-funded international and national panels of experts (later effectively merged) served the same function.

The role of the World Bank has been controversial throughout the FAP. Some donors have looked to the Bank to take charge, while the Bank at times has been eager to explain that it was merely a coordinator and facilitator, not the prime mover nor even an important source of funds. This difference in perspective has preoccupied participants in Dhaka through the years of the FAP

studies. Meanwhile, the Bank headquarters was under pressure to pay greater attention to the environmental effects of its loans and was formulating new worldwide water sector policies. As the official coordinator of the FAP, the Bank has at times been ambivalent in the conflict between old and new attitudes toward flood control and water management.

In this complex situation, donor representatives in Dhaka began to consult more among themselves through an informal body known as the Local Consultative Group (LCG), which in the course of the FAP formed a water resources subcommittee. With the passage of time, consensus achieved in the LCG tended to unify support for the modern approach to planning in the water sector.

The Dutch took the lead in the water resources subcommittee. Drawing on the eminence of the Netherlands in the field of water engineering and prodded by environmental groups in Amsterdam, they expressed dissatisfaction with the state of environmental and engineering knowledge upon which the BWDB was ready to proceed to the construction of projects. In 1993, after a careful review by an office of the Foreign Ministry (Dutch Ministry of Foreign Affairs, 1993), the Netherlands urged that investment be suspended until all the FAP studies have been completed, which is likely to be some time yet.

It seems fair to say that modern views are winning the day through the long process of the FAP. There is no longer any question of the BDG's proposing river-length embankments as in the original French proposal, nor of any donor's funding them if they were proposed; and the FPCO itself states that the scope of the FAP has been broadened from flood control to more inclusive year-round water management. Flood protection projects for cities are going forward, although these are not part of the controversy being described here; it is generally agreed that densely settled or highly capitalized urban and industrial land should have flood protection. A pilot project to protect agricultural lands with polders is under execution in Tangail, taking advantage of an existing horseshoe embankment, but an economic appraisal estimates a rate of return for it between +5 percent and -5 percent, which is well short of the usual +12 percent standard for funding. This project is of value primarily as a test of compartmentalization. Projects at Jamalpur and Noakhali North are being re-evaluated and are not sure of receiving donor funding if the BDG ultimately proposes them. Riverbank and shore protection projects on the Brahmaputra and the coast, which on balance are meritorious, were held up in the summer of 1994 because of World Bank dissatisfaction with BWDB procedures and performance at that time. After talks in August between the Bank and the BWDB that yielded agreement on a process of reform, the preparation of loans is going forward, subject to the satisfactory and continued implementation of the reform.

Perhaps because of the cautious views of the Finance Ministry, as well as the accumulating evidence of the FAP studies, senior water sector officials said in June 1994 that they were ready to wait until the completion of all the FAP studies, plus the performance of a study integrating the regional studies into a national plan, before considering major construction proposals or seeking funds for them. This would appear to mean that none of the controversial project proposals within the FAP will be presented until the end of 1995.

Two major issues remain. The 18,500-man BWDB work force, including 2,000 engineers, which will implement the majority of the projects that come from the FAP, needs substantial reform to permit the institutionalizing of the FAP gains and to increase the responsiveness and effectiveness of the water sector. This is discussed in Chapter 7.

The second unresolved issue is that the BDG has made virtually no progress on much needed flood proofing to reduce the population's exposure to flood damage. Should another 1988-size river flood occur, it could wreak the same havoc in rural areas. However, even more disturbing, although not fully within the FAP, is the long delay in adequate cyclone protection on the coast.

These subjects are taken up in the following chapter.

Chapter 3

THE FLOOD PROOFING GAP, INCLUDING CYCLONE PROTECTION

The task perceived after the floods of 1987 and 1988 by both the BDG and the countries that offered aid was to reduce the flood vulnerability of the very large population affected. As it became evident that the BWDB's original idea of constructing embankments against major river floods was not feasible, and indeed likely to be harmful, attention turned to solutions for specific sites and categories of land use. One such category was cities and present and future industrial locations. There was general agreement that it would be appropriate to seek international loans or grants to provide flood protection barriers for large concentrations of people. Although expensive, these could be economically justified because the concentrations of people and activities being protected were of high value. Since then, projects for the protection of Dhaka and secondary cities have gone forward without controversy, although there were problems caused by premature implementation before environmental mitigation measures were properly applied.

The rural areas are also densely populated, but it has now been generally recognized that full flood protection for paddy land is marginally economic because flood damage usually is limited to the loss of one crop, and high flooding is not so frequent that large physical protection investments will bring an adequate return. However, the 1988 floods also took about 1,600 lives, destroyed very large numbers of dwellings and livestock, and displaced people from their houses, exposing them to risk and danger for several weeks in some cases. It seemed sensible to consider what the rural people themselves do to reduce the danger and economic interruption of high floods, and also to investigate what programs by different levels of government could minimize flood damage. Government help of a non-structural nature has come to be known as "flood proofing," in contrast to (physical barrier) "flood protection."

Flood proofing could include such measures as raising elevated areas (especially roadways) for use as refuges; making advance provision for handpump wells protected from the flood; providing sanitary facilities; storing emergency supplies of water, food, fuel, and fodder; providing flood prediction and warning systems; elevating houses and other structures above anticipated flood levels; protecting the properties of families that are evacuated; and flood zoning.

The United States sponsored FAP 23, the Flood Proofing Pilot Project, as well as FAP 14, the Flood Response Study, which investigated the steps people customarily take to respond to flood danger. What the Flood Response Study learned from extensive village surveys was that the flood threats differed, that people were acutely aware of the particular features of each threat, and that their responses were most appropriate. FAP 14 results and guidelines tell planners that broad measures at the national or even district level are not enough. The flood and impoundment situations, which can be very different even when they are quite close together, call for local-level participation and planning.

When the FAP got underway, some officials saw flood proofing as of value merely where flood protection could not be offered or was being awaited, rather than as an alternative that in certain situations could offer better and cheaper protection than embankments.

The FAP study on Flood Proofing was eventually linked with the Flood Response Study, and after completion of flood proofing guidelines, arrangements have been made with CARE and the Local Government Engineering Department (LGED) for a set of pilot applications. But the fact remains that although many people in flood-affected zones have raised the plinths of their houses and taken other common sense private steps on their own, virtually no flood proofing has been done with government participation or support since 1989. It is this absence of action that gives rise to anxiety that another flood like that of 1988 could cause equal loss and damage, and perhaps even more, because of the intervening growth in population and the economy.

The CARE/LGED pilot flood proofing applications should be given the maximum publicity and exposure so that they can be evaluated and emulated by localities, and, it is to be hoped, will stimulate all agencies involved with development activities to take appropriate flood proofing measures. Flood proofing clearly needs an institutional base, and the water sector, even if it is reformed, is not a good candidate for this localized work. Flood proofing could well benefit by the re-activation of local government, definitely a major national need in any case, and LGED could well prove to be the appropriate home for this important activity.

Another problem, not strictly part of the original FAP, could also be considered in the context of flood proofing. The eastern coastal zone was struck by a cyclone in April 1991 that caused more than 100,000 deaths. Cyclones in this area are a known danger; one in 1970 was a great deal more lethal. Since 1991, the cyclone defense and relief needs of this area have been studied, partly under the FAP, leading to the conclusion that the principal need is for many solid (pucca) flood-resistant structures to serve as shelters. The Multipurpose Cyclone Shelter Project, carried out in 1992 by a panel based at the Bangladesh University of Engineering and Technology and the Bangladesh Institute of Development Studies and reputed to be an excellent analysis, determined that about 2,500 shelters are required in high-risk areas. Of these, about 600 have been constructed with funds from several sources, including the Saudi Fund, the European Community, and Caritas, so that the area is somewhat better prepared for the next cyclone, but roughly 1,900 structures remain to be built.

However, in 1992 and 1994 there were close calls from cyclones that turned away or weakened before they struck the coast. Another devastating cyclone with tidal surge could come at any time. The cyclones from the Bay of Bengal are both more frequent and much more dangerous than the major river floods that brought the FAP into existence. A stronger and more rapid response to protecting the coastal and island population from tropical cyclones is very much needed.

Chapter 4

AGRICULTURE

Overview

Bangladesh can rightly claim to be one of the success stories of the green revolution in Asia. It is now producing more than sufficient cereal to satisfy the average calorie requirements of its population, although the diet should be more varied and less dependent on rice.

This achievement is all the more impressive since its 1992 average per capita GNP of $220 makes Bangladesh one of the poorest countries in the world. Contrary to a widespread misconception, it is not more densely populated than many other Asian countries. With a man-to-arable-land ratio of about 13 persons per hectare, it is nearly the same as China and Indonesia but only one-half as much as India. But a more important ratio is the number of people per hectare of irrigated land. Bangladesh, with 39 persons per irrigated hectare at present, is less well off than other Asian countries with more irrigation.

Fortunately, as discussed at greater length in Chapter 5, the country has a rich reserve of water, much of it stored in the best possible way: in shallow aquifers that can be tapped economically through tubewells. Over the past decade, shallow tubewells (STWs), combined with the associated green revolution inputs of high-yielding varieties (HYVs), fertilizer, market roads, and policy reforms to encourage the private sector, have contributed to an annual growth rate of 2.7 percent in total cereal production. This has meant a substantial rise in per capita cereal consumption on the order of 0.5 percent per year, and, most important for poor people, rapidly decreasing real food costs.

Bangladesh also is frequently cited as the exemplar of successful family planning programs in poor countries where per capita income is growing slowly. Population growth decreased from an average rate of about 2.6 percent per year in 1970-80 to about 2.1 percent in 1980-91, and was given as 1.8 percent in 1994 in the June 10, 1994 budget speech of the Finance Minister. It is projected to decrease continually into the next century.

With decreasing rates of population growth and steady rates of agricultural growth, per capita agricultural production will progressively increase in the future. With rising per capita production, the quality of the diet (both in nutrient variety and satisfaction of taste preferences) will improve through the consumption of more meat, milk, fish, fruit, and vegetables. Indeed, it is clear that the limiting factor of agricultural growth has shifted from the supply constraints of the past, mainly due to lack of irrigation, to potential inadequacies of demand in the future.

With slowing population growth, it is necessary to increase per capita income rapidly in order to provide effective demand for agricultural products. In 1993, for example, a modest increase of rice production above trend resulted in a substantial collapse in rice prices on the order of 18 percent, although other factors, including marketing policies, discussed by Haggblade (1994) also contributed to the price drop. The growth of Bangladesh's industrial production, which would

provide the wages to support a demand for agricultural products, has been particularly disappointing to date. The Finance Minister has projected a 6 percent Gross Domestic Product (GDP) growth rate for 1994-95. If achieved, this will help stimulate agriculture. But without high GDP growth, prices for agricultural products could fall below costs. In that case, farmers will no longer invest in STWs, and agricultural employment, which is nearly 70 percent of total employment, will decrease. This could throw the economy into a depression.

While energetically pursuing macroeconomic growth policies and stimulating domestic demand for agricultural products, the BDG should also focus on the potential for agricultural exports as part of an export-led growth program. Much attention has been paid to the export potential of high-value crops such as fruit and vegetables, along with increasing traditional exports such as jute and leather, but the world rice market may provide Bangladesh with an important export opportunity for its core crop.

Rice production depends mainly on water, fertilizer, and labor. With its enormous water resources, production of urea from natural gas, and plentiful low-cost labor, Bangladesh should have a comparative advantage in the international rice market that will increase rapidly as industrialization in other Asian countries raises rural wages. Because rice is one of the most labor-intensive crops, it is likely that historically major importers (such as Indonesia) will import more, while major exporters (such as Thailand) will export less. Bangladesh can supply high-quality rice for the world market; even some of its HYVs are reportedly graded as "fine" rice. Because of this crop's important implications for agricultural and economic growth, rural employment, and reduced rates of rural-urban migration, it would be useful for a team of experts in international rice marketing to assist the BDG in exploring this opportunity.

Naturally, the rapid development of intensive agricultural production raises legitimate concerns about the environment. First, it should be noted that the preservation of land for forests, wildlife reserves, and similar needs is less affected by intensive (high-input) than extensive (low-input) cultivation. Secondly, an adverse effect of pesticides on fisheries is expectable, although there is no scientific evidence of a large impact yet. DDT is banned but is being smuggled in. Given the importance of common resource fisheries to the economy and to the welfare of poor rural people, however, it is important to control pesticide use. The BDG should be helped to assess and implement integrated pest-management systems and, as needed, to gain access to less harmful and biodegradable pesticides such as those used in the United States.

Intensive use of organic or inorganic fertilizers also can cause water pollution from residues (although in smaller quantities such residues stimulate the growth of the food supply for fish). Lowering the groundwater table in the dry season by pumping from STWs is often cited as a liability of agricultural growth. But, as discussed in Chapter 5, groundwater is abundant, and in the extreme case, STWs can be used to fill fish ponds and provide domestic water if there are shortages at the end of the dry season even after hand tubewells (HTWs) have been deep set. The damage to fish breeding cycles from reduction of water on the floodplain by dry season use of beel and haor surface water via low-lift pump (LLP) irrigation and, to a lesser extent, by groundwater use is a more difficult problem that should be studied for remedial measures.

Agricultural Development

Rice is by far the largest crop in Bangladesh. Although the area under cultivation has decreased since the early 1980s, the increase in production has come from higher yields per unit of land. The yield is considerably higher than in Thailand, but lower than in Indonesia, probably due to the difference in the percentage of the crop irrigated. A large share of irrigation and a larger share of the growth in irrigation have occurred in boro (dry season) rice production using tubewells.

The area under HYVs increased from 14 percent in 1973 to 54 percent in 1993. Over 90 percent of the boro crop is now in HYVs. Of the total increase in rice production of 4.5 million metric tons (MMT) from 1980-81 to 1992-92, 3.04 MMT, or 68 percent, occurred in the boro crop. The remainder was contributed by the transplanted aman (late monsoon) crop, with the production from the broadcast aman and aus (early monsoon) crops decreasing. Evidently the rapid expansion of the area under the boro crop decreased the area under the broadcast aus and aman crops, which are the lowest yielding. Average yield has increased from around 1.4 tons per hectare in the early 1980s to about 1.9 tons per hectare in 1993 due to this shift among seasons, seed types, and planting techniques.

Bangladesh should be congratulated on being one of the few countries to publish national statistics that distinguish between local varieties and HYVs. Further disaggregating yield statistics on this basis provides a real eye-opener. Nearly all the increase in yields since the early 1980s has been due not to yield growth in the same season and variety, but to shifts from local varieties to HYVs. Once the shift is made, yields do not increase. This is a mystery, because the HYV boro crop yields are only about 50 percent of economic yield potential such as is achieved in Indonesia.

There are two theories about this. The first, which has been proposed for eastern North India by one of the authors (Seckler), is that there is a deficiency of summer sunlight in this area. If so, it is a very serious problem indeed. But deficient summer solar radiation should not affect the winter boro crop. The other theory relates to the application rates and balance of fertilizers.

Fertilizers

The principal inputs for intensive, high-yielding agriculture are irrigation, HYVs, and fertilizers. None is more controversial and poorly understood than fertilizers. The basic mineral constituents of plants and animals are carbon (C), nitrogen (N), phosphorus (P), and potassium (K), all of which complement, not substitute for, one another. A deficiency in any one of the nutrients will cause the productivity of the others to decrease. Thus, it is not only the level but also the balance of nutrients that is important, and proper attention must be paid as well to micronutrients, such as sulfur and zinc.

A materials balance approach must be followed for sustainable agricultural production. The minerals withdrawn from the soil system by the crop and by other means must be replaced by minerals from outside the system. Since N is both volatile and soluble, much is lost not only to

the crop but also to the atmosphere and in water runoff. For this reason, N requires the highest percentage of replacement in the soil relative to the other nutrients needed. A much higher percentage of the carbon and other minerals is recycled in the roots of the plants (usually 50 percent of the total biomass) and in stubble, so that apart from N, the import requirement is equal to the mineral content of the crop exported from the system.

Since N is soluble, it can become a major water pollutant in the form of nitrates and nitrites, regardless of whether it is from organic or inorganic sources. Moreover, as N application rates increase, diminishing marginal productivity sets in. In other words, the percentage absorbed by the plant decreases while the amount entering the water (and air) increases. The optimal application rate of N, including both economic and environmental considerations, varies according to relative food needs, effects on drinking water and fisheries, and the like. Wherever the optimal point is, it is certainly less than in some of the highest N-using nations like Japan, and greater than in low N-using areas like Bangladesh or sub-Saharan Africa.

The progress of the green revolution in Bangladesh has been similar to that in other Asian countries. In the first few years as the HYVs spread, mainly on irrigated land, they produce substantial increases in yields with only modest increases in fertilizer, because stored nutrients are drawn from the soil. But these nutrients are being withdrawn from the system in the form of agricultural products, a process known as "nutrient mining." As nutrient mining continues, fertilizer application rates per hectare necessarily increase to maintain the same or rising yields. As yields increase, the need for fertilizer is compounded by the law of diminishing marginal productivity, so that yields per unit of fertilizer applied decrease. This natural effect, observable all over the world, is often interpreted as an inevitable loss of soil quality due to poor and assertedly unsustainable management practices such as irrigation or the use of inorganic fertilizers. In reality, it simply reflects the materials-balance requirements of an ecological system.

About 80 percent of all fertilizer use in Bangladesh is for rice. If the total fertilizer consumption is divided by the boro area from year to year, the application rate per acre of boro rice is seen to be constant. This solves the mystery. HYV rice yields have not changed because fertilizer application rates in the growth sector of rice production—the boro crop—have not changed. It is commonly agreed that Bangladeshi farmers apply considerably less than the recommended rates of fertilizer, and it is presumed that the recommended rates are economically optimal. Under-fertilization is a factor holding down yields.

In addition to providing these data, John Allgood of the International Fertilizer Development Corporation (IFDC/Dhaka) offers a further important explanation. If the ratios of the recommended levels of N, P, and K are compared with the ratios of total consumption, it is clear that the fertilizer mix is out of balance: P and K are deficient relative to N. The price of domestically produced N has decreased substantially relative to the prices of imported P and K. This has caused farmers to substitute increased quantities of N for P and K—a commonly recognized practice in the retail markets. This does not work, since N, P, and K are complements, not substitutes, a fact of which farmers evidently are unaware. If this is true, substantial yield gains could be achieved at little cost by a better balance of fertilizers. Extension

efforts should continue to concentrate on demonstrating the difference between N, P, and K, and the need for the right balance, including with the micronutrients. The price relationship could possibly be adjusted, increasing the price of N to subsidize the import costs of P and K, or fertilizer could be sold in pre-mixed form, with the components properly balanced for local soils, as is common in many countries.

Clearly, the problem of static yields needs close examination. But with higher and better balanced fertilizer application rates, there is no reason why this cannot be corrected. It is possible that yields could even grow to levels comparable to those of Indonesia. If so, as shown in the next section, there would be an enormous export potential for rice.

The Future of Agriculture in Bangladesh

Goletti and Ahmed (1990) have projected Bangladesh's foodgrain needs to the year 2000 under various assumptions. They assume that wheat production does not increase, so the relevant figures are for rice production. Under their medium production, medium calorie, and medium population scenario, Bangladesh would produce a rice surplus of about 2.0 million metric tons. (See Table IV-1.)

Table IV-1

Rice Requirement Gaps in Year 2000 (million metric tons)

	Medium Population	Low Population	High Population
HIGH PRODUCTION			
High Calorie	0.051	1.027	-0.277
Medium Calorie	2.389	3.259	2.096
Low Calorie	4.631	5.399	4.372
MEDIUM PRODUCTION			
High Calorie	-0.374	0.601	-0.703
Medium Calorie	1.963	2.832	1.670
Low Calorie	4.205	4.973	3.946
LOW PRODUCTION			
High Calorie	-.792	0.183	-1.120
Medium Calorie	1.545	2.415	1.252
Low Calorie	3.787	4.555	3.529

Source: Goletti and Ahmed, 1990

Notes: a. Production Growth: High (2.7%), Medium (2.5%), Low (2.3%)
b. Population Growth: High (2.4%), Medium (2.32%), Low (2.0%)
c. Calorie/Day: High (2020), Medium (1800), Low (1589)

From one perspective this projection is probably too low because population is likely to grow at the low rate while production is likely to grow at the high rate, assuming sufficient growth of per capita income to generate demand. On the other hand the calorie assumption, while sufficient for basic needs, is not sufficient for a welfare target—especially given the high degree of income inequality. Thus the high calorie, high production and low population scenario is more desirable and even likely. This foresees a rice surplus of 1.03 MMT in the year 2000, which is about the same as present foodgrain imports.

The total increase from 1992-93 to 2000 would be about 19 percent. It is not inconceivable that this could be achieved by yield increases alone, through a greater use of HYVs and fertilizers and a better balance of fertilizers. On the other hand, it could be achieved by increasing irrigated area, mainly through tubewells and the boro season crop. While increasing yields may be cheaper, increasing the irrigated area may yield greater social benefits since it will generate more rural employment.

In any case, it should be possible to reach the target through a combination of increased yields and increased irrigated area. The most cost-effective way to achieve increased yields is through more and better-balanced fertilizer application. The most cost-effective way to achieve increased irrigated area is by developing STWs. Experimenting with different techniques and approaches, which was one tenet of the FAP, before embarking on large-scale and capital-intensive surface irrigation and flood protection projects for agriculture is correct.

Some water sector officials believe that only flood control and drainage (FCD) works can lead to food production increases, despite the evidence of most studies that such increases are small. But even if the FAP surface water projects could induce farmers in the wet season to shift to HYV aus and aman based on FCD support, growth would be virtually immobilized by the extremely slow rate of implementation of FCD projects. Between 1986 and 1993, FCD covered only a tenth of the hectares prescribed for it by the National Water Plan. A comparison of the expansion of 4,250 hectares per year under FCD and the 120,000 hectares per year under STW irrigation in the same period should be enough to establish from where major agricultural output gains are more likely to come.

A special study of long-term agricultural strategy touching on the important policy issues raised here should be conducted, with particular attention to the merits of concentrating on rice versus crop diversification, both for home consumption, which has dietary balance implications, and for export.

Chapter 5

GROUNDWATER

Since the late 1970s, groundwater development has been the main basis of Bangladesh's agricultural growth. At the beginning of this period the outlook was grim, with a foodgrain deficit of more than a million tons a year that was expected to grow to 5 million tons with the rapid growth of population. Faced with this daunting challenge, the Ministry of Agriculture (MOA) decided to shift from dependence on high-risk monsoon crops to reliance on low-risk irrigated crops grown in the dry season from November to May. This policy succeeded, because Bangladesh meanwhile adopted HYVs and rapidly expanded irrigation by 1.5 million hectares (Mha), mainly by using groundwater and STWs (Figure V-1).

To meet the food supply for a growing population, HYVs, improved farming practices, some flood control and drainage, and more fertilizers are essential. But it is clear that continuing expansion of the irrigated area will be critical to further gains, and that a well-managed package of all modern farming inputs, applied primarily to the unused dry season irrigation potential of 4.1 Mha, could yield not only enough foodgrains for domestic consumption, but a large exportable surplus or an opportunity to diversify crops.

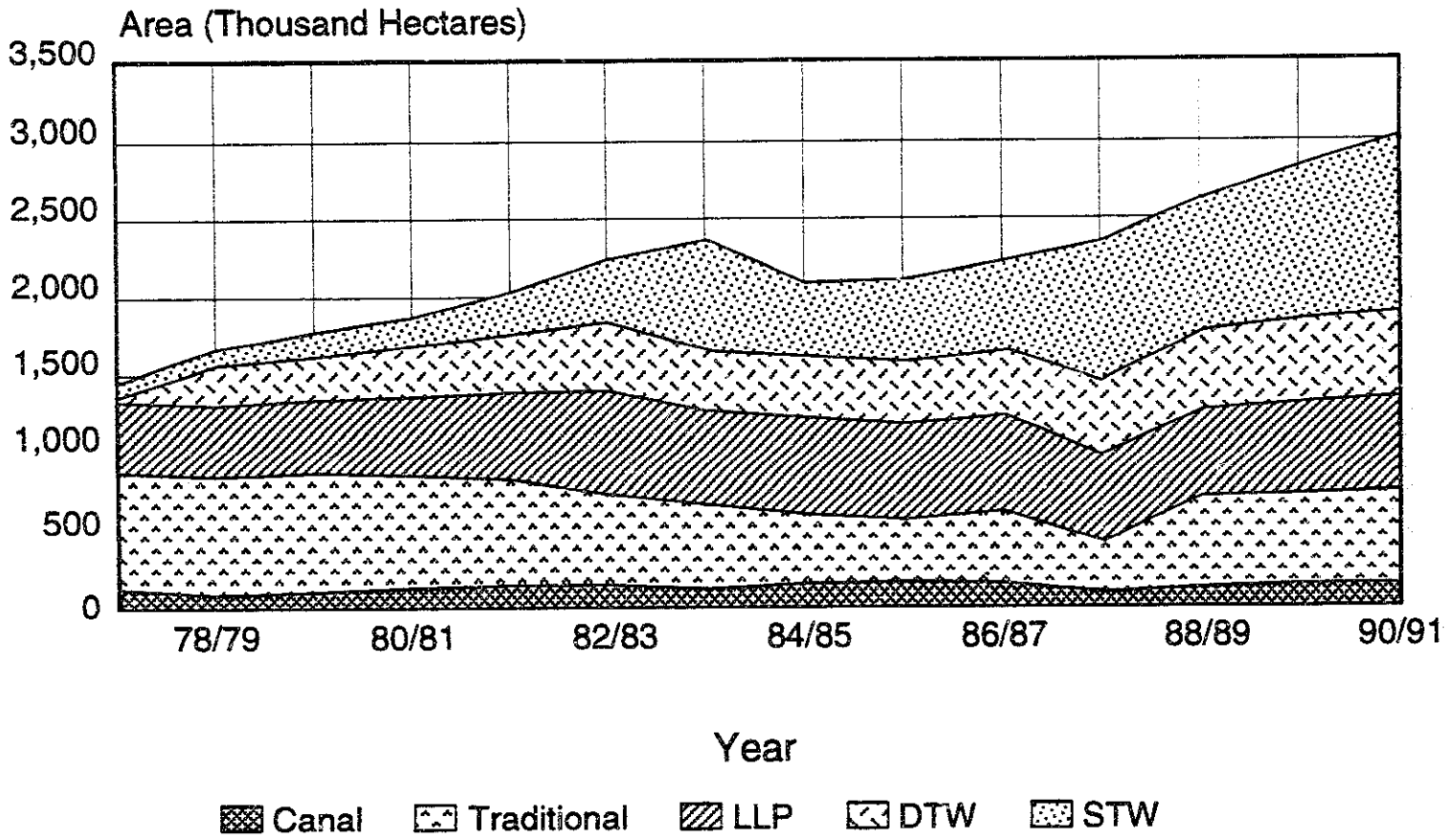
However, there is some concern that expanded irrigation might soon exhaust groundwater reserves. Undoubtedly, large-scale groundwater development is controversial for several reasons:

- There is a widespread belief that declining groundwater levels indicate that development of the resource is reaching natural limits, and that groundwater mining—the use of water that will not be recharged—is taking place.
- Chief among unacceptable environmental impacts is the drying-up of drinking water wells in some areas at the end of the dry season.
- The sinking of private wells leads to suboptimal well spacing and command areas and inefficient water use.
- Equipment failure and high running costs impose a financial risk for the farmer.

A strong lobby argues that groundwater development should be regulated to protect national interests and the environment, and to save the farmers from over-reliance on tubewell technology. Specifically, it advocates reimposing zoning and spacing rules and the standardization of imported tubewell equipment.

Each of the reasons for concern is examined below.

Figure V-1
Irrigation by Method



Source: Government of Bangladesh, 1994b;
data from BBS, Statistical Yearbook, 1992.

OBSERVATIONS AND COMMENTS:

This diagram shows the annual growth in irrigation over the last 12 years.

There was rapid growth from 1978-79 to 1983-84 and from 1987-88 to the present time.

The period of decline in irrigated area corresponds to the period when tubewell siting and standardization of diesel engines was in effect.

Concern 1: Groundwater resources are nearing full utilization.

National groundwater resource potential was estimated at 69 billion cubic meters (bcm) in the 1987 National Water Plan (Government of Bangladesh, 1987), using a hybrid analytical approach based on extensive empirical data and mathematical modeling. Subsequent fine tuning of the model revised this upward to 78 bcm under the 1991 NWP (Government of Bangladesh, 1991b). This exercise indicated that about 20 percent of annual rainfall, equivalent to an average depth of 480 mm/year over the area of the country, can percolate to groundwater storage. In the NWP, the term "usable recharge" covered 75 percent of potential recharge, 25 percent being allocated as a safety margin for unforeseen factors and unplanned development. Figure V-2 maps usable recharge, which varies from over 1,000 mm/year in Sylhet to less than 200 mm/year in Kushtia zila in the west.

In a local context, the percentage of land that can be irrigated is measured by comparing availability with crop water demand (Figure V-3). Typically, crop demand (net of rainfall) in the dry season varies from about 300 mm for a mix of wheat, wetland rice, and other crops, to 550 mm for wetland rice alone. In Figure V-3, a 20 percent supplement is added to crop demand to allow for irrigation losses that do not recycle to groundwater; thus, gross consumptive demand for groundwater lies between 360 mm and 660 mm.

Apart from a few small areas in Rajshahi and Kushtia, over half the cultivable area of 9.56 million hectares could still be irrigated from groundwater if required (Table V-1). The total area potentially irrigable by groundwater is close to 4 million hectares. If about half of the existing potential area in the Southwest Region (.5 million hectares) is not used due to salinity and none of that in the Northeast Region (.9 million hectares), it still leaves about 3 million hectares for future growth. Even if only half of that were developed and crop water demand were twice that estimated, it would be sufficient for 10 to 15 years' growth at present rates.

There are two reasons why this area is considerably larger than that presented in the NWP. The first is removal of the constraint in the NWP against using groundwater in areas nominally served by public sector surface irrigation projects, that is to say, removal of a bar against conjunctive use. The second reason is the very high figure for irrecoverable water losses (60 percent) used in the NWP calculations, which reduces the area that can be irrigated with a finite amount of groundwater. While irrigation efficiencies (and, therefore, the amount of water demanded) can be debated, the proof lies in the actual amounts used in groundwater-based irrigation systems. If areas where groundwater use appears to be near its limit can be located, the NWP assumptions about how much water is available can be tested to clarify whether mining of the resource is occurring.

Figure V-4 maps the percentage of cultivable land irrigated by groundwater, based on the Ministry of Agriculture/Agricultural Support Team irrigation census of 1991 (Government of Bangladesh, 1991a). If the western areas where groundwater appears to be the limiting development factor are considered, the zones of highest groundwater-based irrigation are around Bogra and west of Jessore in the southwest. Table V-2 lists the water development status of thanas using more than 60 percent of either the annually replenished groundwater resource or net irrigable land area. Also shown are the number and variety of tubewells.

Table V-1

Groundwater Development Potential for Those Thanas with Data
(Assumes current crop mix in each Thana and water requirements at 80% efficiency)

Percent of Land Irrigable from Groundwater	Number of Thanas	Total Irrigable Area, ha	Irrigated Area in 1991, ha	GW Irrigation 1991, ha	SW irrigation 1991, ha	Future GW Irrigation Potential, ha
>100	232	4,708,264	1,438,903	830,568	608,335	2,512,055
75-99	61	1,424,395	407,773	367,257	40,516	872,891
50-74	51	1,147,799	313,144	290,692	22,452	413,632
<50	11	283,267	45,979	40,457	5,522	86,509
TOTAL	355	7,563,725	2,205,799	1,528,974	676,825	3,885,087

Data source: MOA/AST 1991 Survey

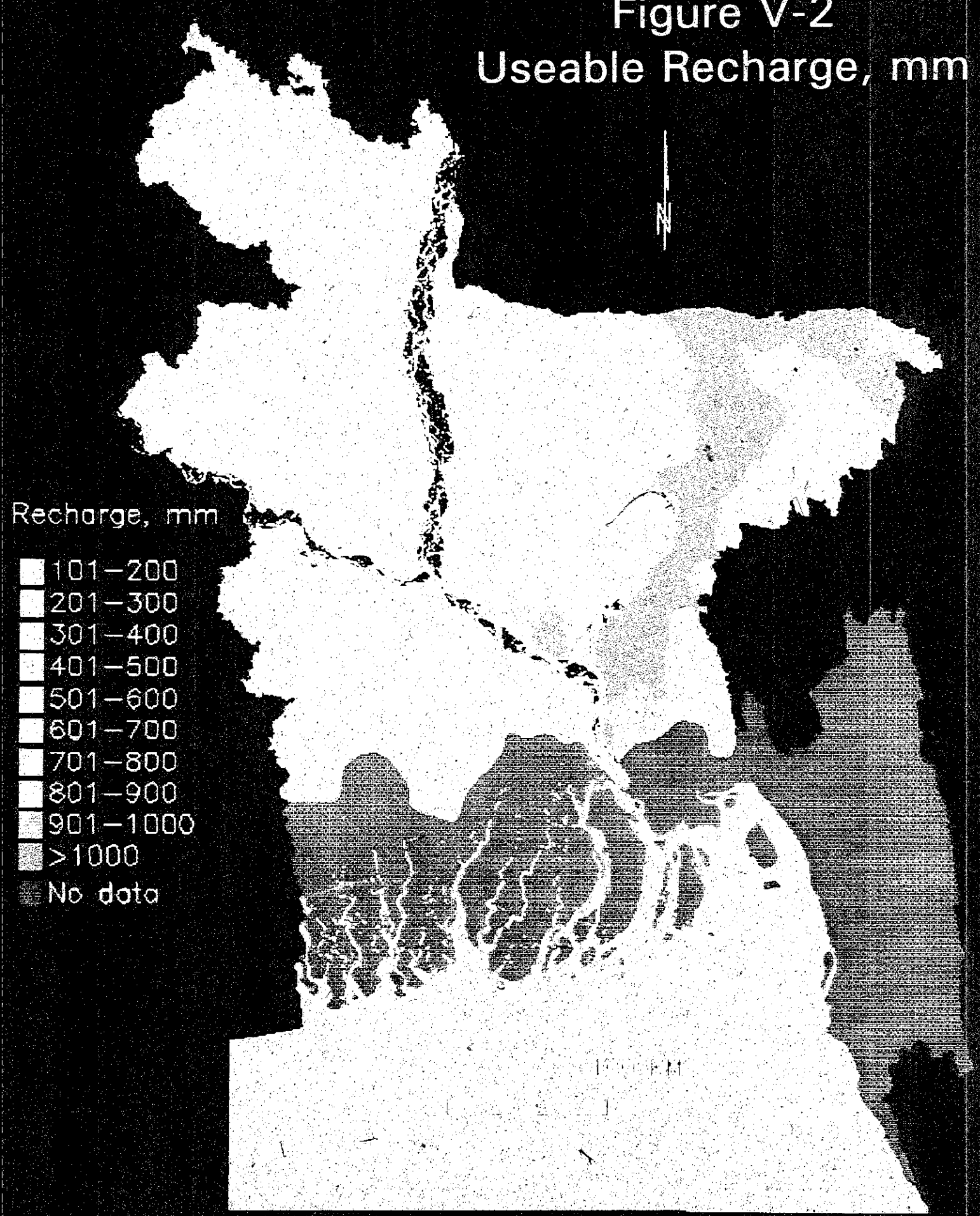
Table V-2

Areas of Maximum Groundwater Use, 1991

Zila	Thana	Percentage of NCA Irrigated	Percentage of Usable Recharge Utilized	Mechanical			Manual	Traditional or Artesian
				STW	DSSTW	DTW		
Tangail	Gopalpur	81	63	2500	0	96	330	142
Bogra	Adamdighi	91	101	1172	724	125	0	1360
Bogra	Dupchanchia	91	121	1015	56	200	0	1206
Bogra	Gabtali	95	85	3423	0	45	0	140

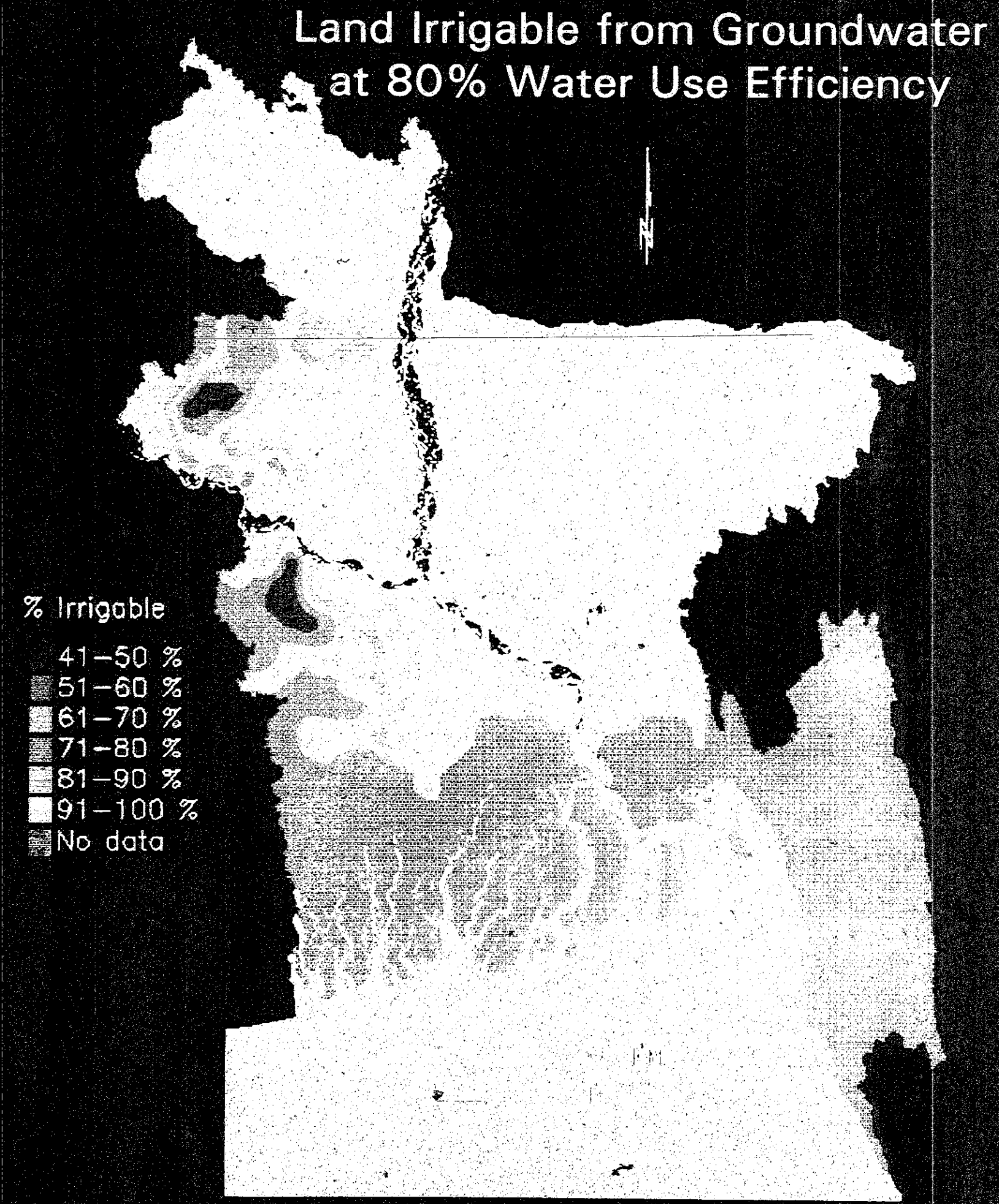
Data sources: Usable recharge from the National Water Plan, 1987 Irrigated area and tubewell numbers from FAO/DAE/AITA, February 1994.

Figure V-2
Useable Recharge, mm



Source: Data from National Water Plan, 1991 (Government of Bangladesh, 1991b)

Land Irrigable from Groundwater at 80% Water Use Efficiency



Source: Data from National Water Plan, 1991 (Government of Bangladesh, 1991b)

Figure V-4
Percent of Land Irrigated from Groundwater, 1991

Source: Government of Bangladesh, Ministry of Irrigation, Water Development and Flood Control, 1991a.

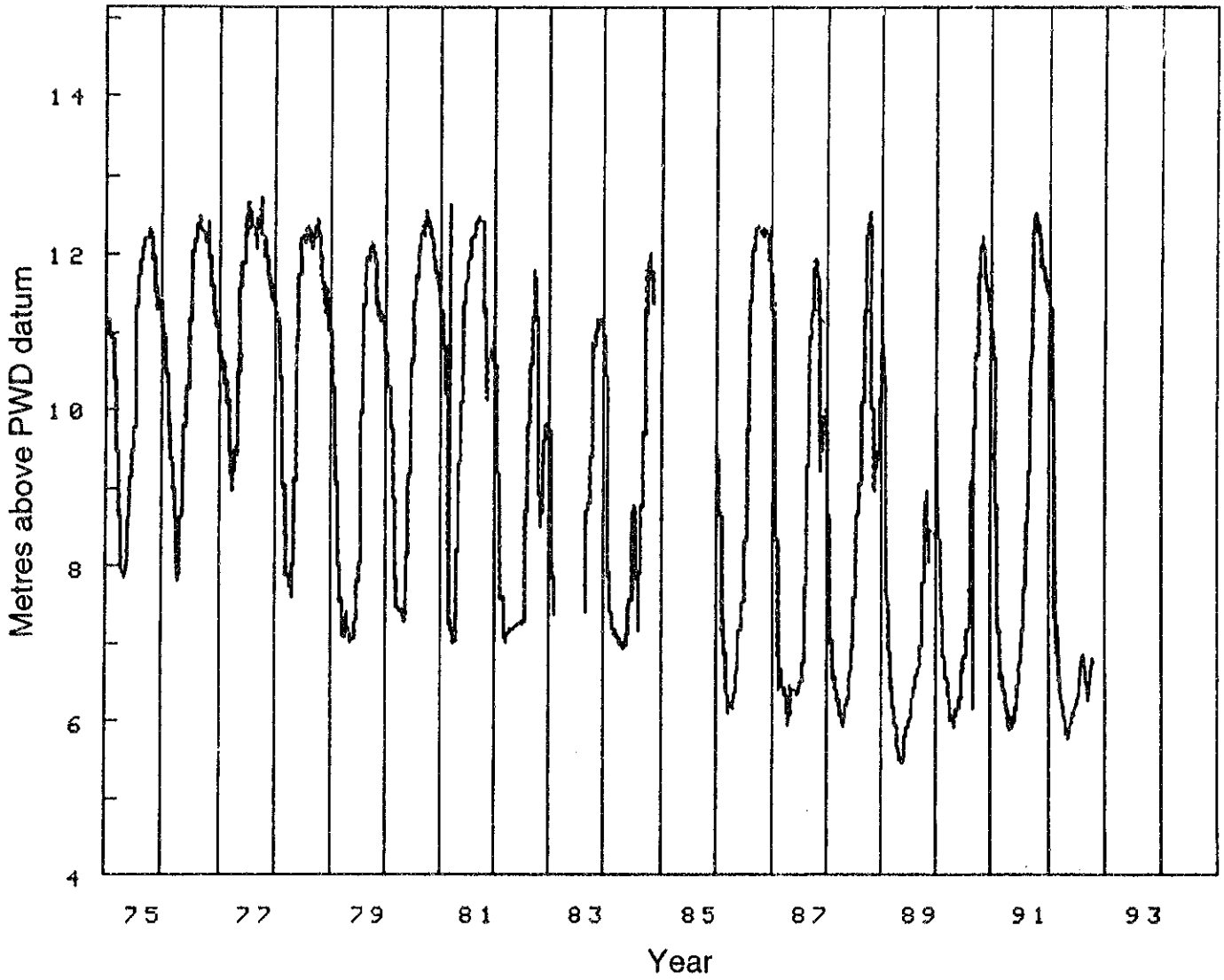
If the groundwater resource were being overdrawn, then. for example, Dubchanchia thana (which is using 21 percent more than the estimated usable annual recharge limit) would be mining the resource base and causing a general decline in groundwater levels. This hypothesis is not supported by the large number (1,015 wells) of STWs in Dubchanchia, and the small number (56 wells and 200 wells, respectively) of deep-set shallow tubewells (DSSTWs) and deep tubewells (DTWs). Deep-set shallow tubewells are STWs placed in a pit to increase their reach. If mining had occurred, it would be expected that STWs would be converted to DSSTWs or would disappear altogether. A similar argument can be applied to the other critical thanas shown in Table V-2. The general conclusion is that the usable recharge estimate is probably very conservative, and that the storage properties of the upper aquifer on which STWs depend are much better than estimated in the NWP. From these empirical data, groundwater availability clearly does not appear to be a constraint on the expansion of irrigation.

Groundwater hydrograph data collected by the BWDB show that the heaviest withdrawal is beneath Dhaka for municipal and industrial water supplies. A recent survey by the Dhaka Water and Sanitation Authority (WASA) shows that in 1990, 274 million m^3 were withdrawn by wells from an area of 271 km^2, equivalent to an annual depth of 1,011 mm over the whole area. Of this supply, 72 percent, or 740 mm, was from rainfall, supply losses, and flood water recharge, and the balance of 26 percent from leakage from the Turag, Buriganga, and Balue rivers. Historically, the proportion of leakage from these rivers has increased as groundwater levels have fallen and water has flowed down a steeper gradient. Given the general uniformity of floodplain geology across the country, the far greater intensity of groundwater withdrawal in Dhaka than in the rural areas for irrigation shows that the water needed to sustain agriculture (between 330 mm and 660 mm) can come from groundwater recharge.

An examination of groundwater hydrographs for all thanas outside the Dhaka area shows convincingly that the system is not being overdrawn. Hydrograph data for Dubchanchia are not available, but the data for the next most developed thana, Adamdighi in the same Bogra District, show that the aquifer is behaving as predicted in the 1987 NWP (Figure V-5).

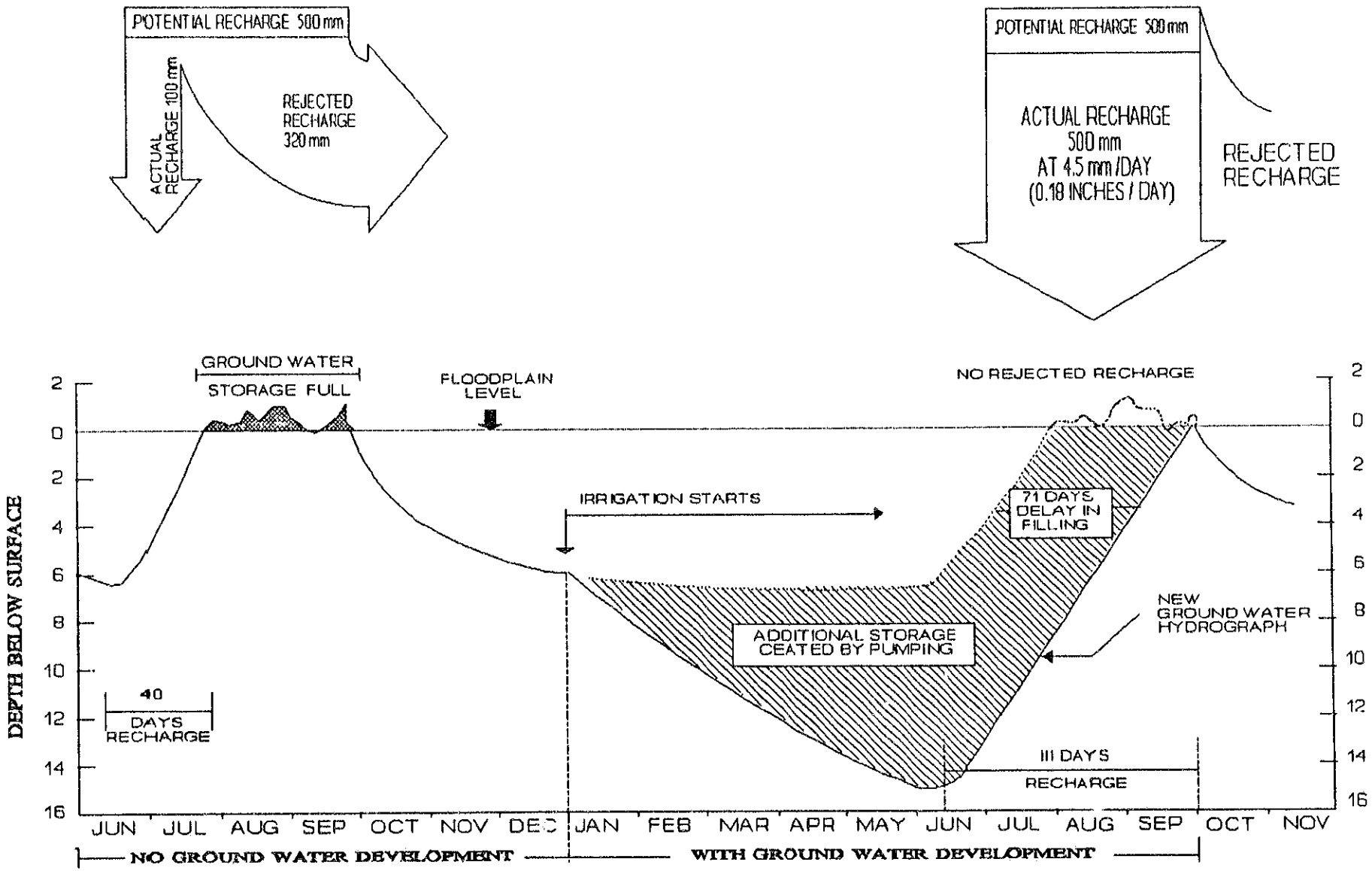
Generally, as well sinking and water withdrawal intensify, the groundwater level in April-May falls by several meters below its pre-development level. Because there is a greater volume of emptied aquifer to recharge due to withdrawals, the water level rises later and more slowly during the rainy months. Thus, before significant groundwater development, the Adamdighi hydrograph came back to the surface in late July; now, at almost full development, it reaches the surface in September. This important mechanism is essential to understanding how groundwater works through the annual cycle of use and recharge, and how the use of groundwater increases the amount of rainfall that goes to recharging groundwater for availability in the subsequent dry season. This is illustrated in Figures V-6 and V-7. (In the dryer western parts of the country, in an extremely dry year such as 1994, the groundwater level may fail to reach the surface at the end of the monsoon as it normally does, and there may be local stress on groundwater supplies in the following boro season, particularly if groundwater has been used to irrigate aman crops because of a dry monsoon. This may require limiting hectarage in the following boro season, but this would be a short-term

Figure V-5
BWDB Groundwater Levels in Adamdighi Thana



Source: Bangladesh Water Development Board, Groundwater Circle Data Base.

Figure V-6
Groundwater Storage Creation to Capture Potential Recharge



Source: National Water Plan, 1987 (Government of Bangladesh, 1987).

measure since the groundwater level would be replenished by the following normal monsoon unless a long-term drying of the climate is underway, for which there is no present evidence.)

Concern 2: There is no way to manage drying-up of drinking water tubewells and other environmental impacts.

Hand-pumped tubewells (HTWs) are typically used for village drinking and household water. The Department of Public Health Engineering (DPHE) recognizes that continued groundwater development for irrigation will cause occasional drying-up of the shallow-reach suction lift HTWs in the dry period of March-May. This is a consequence of the deepened recharge cycle that comes with groundwater use, mentioned above and illustrated in Figures V-6 and V-7, and is not a sign that groundwater is running out. To counter this problem, DPHE and UNICEF have embarked on a program to replace surface mounted HTWs with deep-set models or Tara pumps in the affected thanas. DPHE indicates that the cost of deep-setting an HTW is Tk 3,000 ($75), and installing a mini-Tara only Tk 1,000 ($25). The lobby opposing groundwater irrigation in order to "protect" HTWs—composed of environmental groups and those who promote construction-intensive surface irrigation systems instead of STWs—is ignoring DPHE's inexpensive and effective solution to the problem. Just how inexpensive it is can be seen from the fact that typically about 110 people, or 20 families, are served by an HTW. If they gave up using STWs for cultivation to save the $75 cost of deep-setting their HTW, they would be foregoing irrigation earnings of $3,220 per year and the benefits of boro employment. They clearly would not choose this alternative if they had enough information.

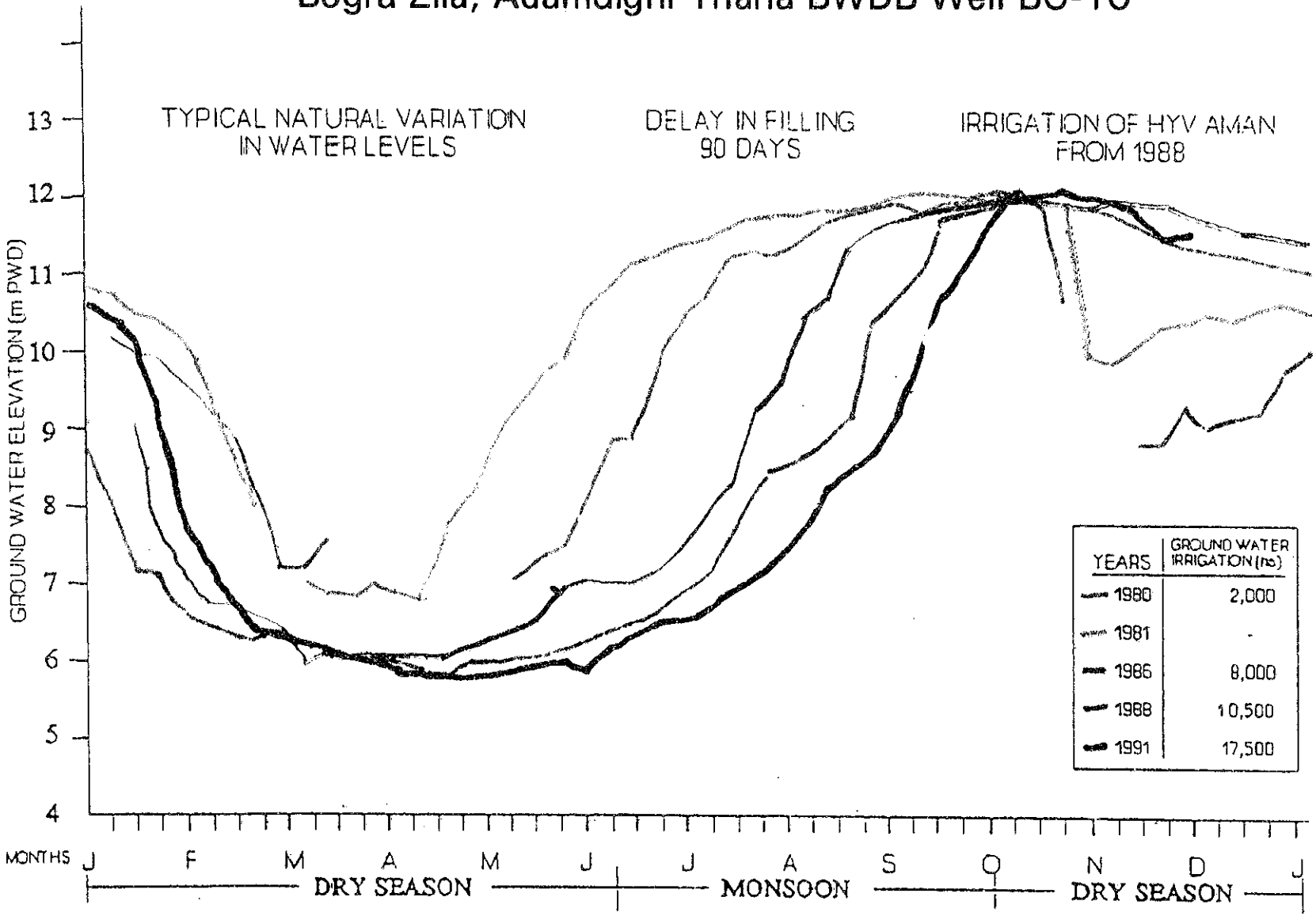
Alternatively, the motorized STW pumps normally used for irrigation can quite easily be used to pump high-quality and aerated water into fish ponds, and can be used to provide high-quality domestic water supplies.

Monitoring the groundwater resource is simple. The well inventory for the STW/DSSTW mix shows when the limit of surface mounted STWs has been reached. Following very dry monsoons like the current one, many STWs are temporarily converted to DSSTWs, and some may temporarily run dry, as happened in 1983. After very wet monsoons and large-scale flooding, DSSTW numbers are reduced, meaning that the STWs are being operated from the land surface again. This shows that farmers are able to fine-tune the well technology to the resource base.

Concern 3: Regulation is needed to ensure optimal water use, tubewell utilization, and quality pumping equipment.

Much of the 1994 Department of Agricultural Extension (DAE) report stresses that irrigation command areas are less than optimal: wells are spaced too closely together, discharge is less than what was designed for, and wide variations in the manufacture and quality of equipment cause significant operation and maintenance problems (Government of Bangladesh, 1994c). These arguments are true, but are based on an impractical textbook approach to irrigation. In practice, topography and land ownership determine command area. When equipment has a command area bigger than a single farmer's holding (almost always the case), cooperation among farmers is the key to full exploitation of the water a well can produce. Indeed, recognition of this factor in the later 1970s led to the switch from public sector DTWs to private sector STWs.

Figure V-7
Empirical Evidence of the Increase in Groundwater Storage Capacity Through Irrigation Development
Bogra Zila, Adamdighi Thana BWDB Well BO-10



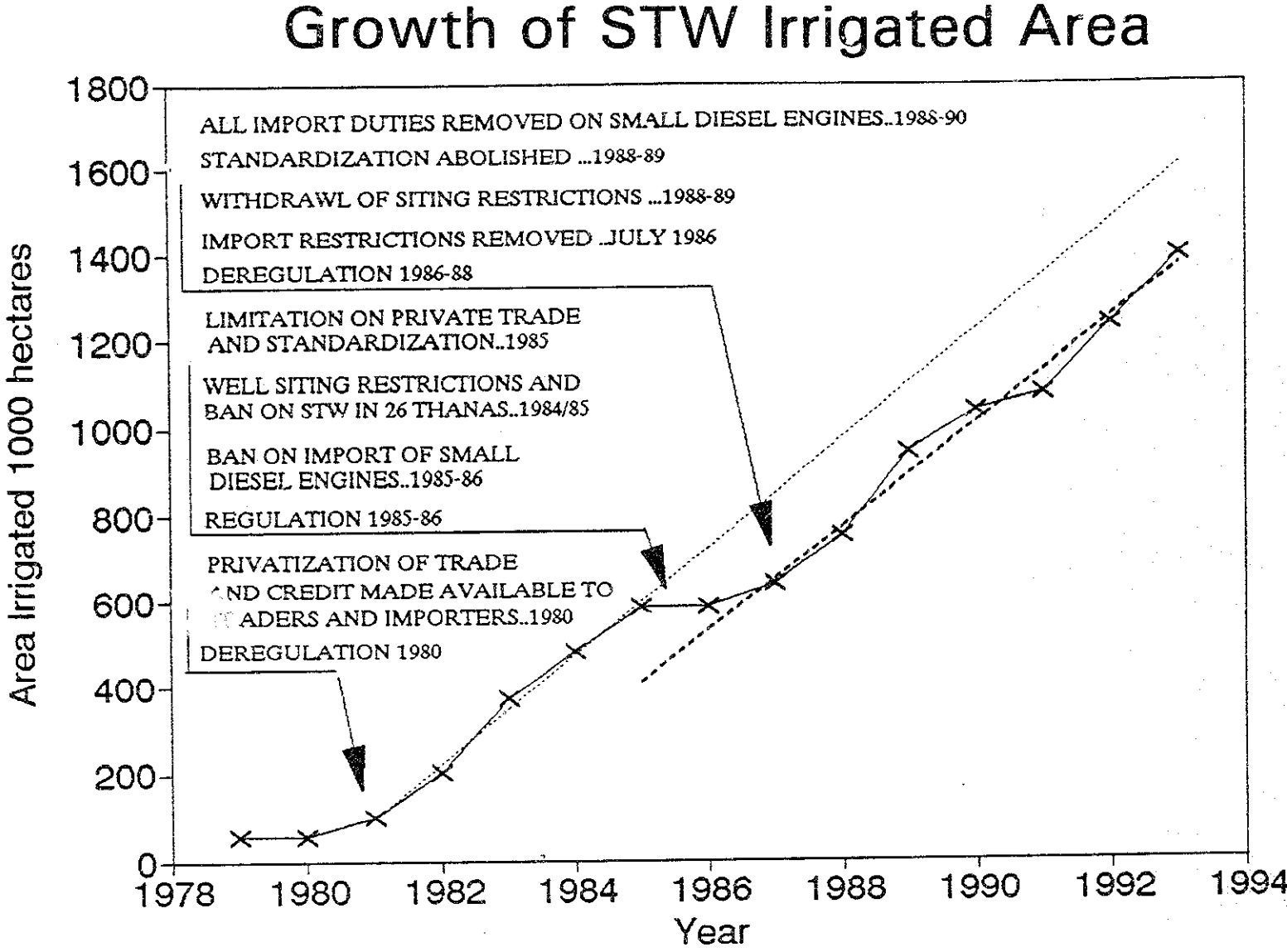
Source: BWDB, Groundwater Circle Data Base.

Well spacing and discharge capacity should not be of concern as long as they do not affect the profitability of irrigation. If farmers are prepared to continue to irrigate and pay the additional costs of interference from adjacent wells, discharge and spacing are irrelevant. Moreover, any irregularities that arise from spacing are easily dealt with locally. Basically, if farmers are happy with the system, the state should not interfere.

Indeed, misplaced government intervention can be damaging. STW sales figures over a 15-year period demonstrate the adverse effects of government attempts to regulate an efficient private market. Figure V-8 shows the growth of the area irrigated by STWs from 1979-1993. Two distinct growth trends are present, the first from 1981 to 1985, the second from 1987 to 1993. With allowances for a normal time lag in effects, the deregulation of tubewell imports in 1980 sparked the first growth spurt in 1982; then well siting restrictions in 1984-85, provoked by overreaction to the very dry monsoon of 1982, caused a hiatus in growth from 1985 to 1987.

A notable feature shown in Figure V-8 is the similarity of STW irrigation growth rates when a completely free market was allowed to operate: in the period 1981-85 the rate was 126,000 ha/yr, and since 1987 it has been 120,000 ha/yr. On the realistic assumption that growth would have proceeded along the upper dotted line, farmers' reactions to the 1982 dry monsoon and subsequent governmental regulation of the private irrigation market cost Bangladesh between 184,000 and 216,000 ha of boro rice production. On average this would have yielded 524,000 tons a year valued at $84 million. In human terms this now-lost production would have provided several million person-days of dry season employment, helped lower the price of rice, reduced imports, and significantly increased the food consumption of the very poor. Fortunately, once constraints were removed and farmers' confidence was enhanced by a longer-term experience of groundwater irrigation, the free market resumed its momentum.

In a broader sense, a pattern of irrigation growth has been worked out in the current version of the NWP dated 1991, from which data and analyses have been drawn upon in this report. But an important caution should be raised. The NWP, including its Investment Analysis Model (IAM), embodies outdated biases toward both a government-dominated economy and in favor of the continued satisfaction of the historical claims on investment funds by major government departments such as the BWDB. The roles of the far more active and efficient private sector, and of private STW use of groundwater, are systematically underplayed. The NWP/IAM, for example, assumes that $1.4 billion will go to the water sector in the Fourth Five-Year Plan (1990-1995), and that a steady 15 percent of planned development investment will go to the water sector thereafter, although it is true that this represents BWDB requests more than it does final allocations and that in very recent years BWDB funding has been contracting sharply.



Source: Bangladesh Bureau of Statistics and ATIA Survey (Government of Bangladesh, 1994b).

Chapter 6

THE REGIONAL PICTURE

Bangladesh covers only about 8 percent of the Ganges-Brahmaputra-Meghna basins and is the farthest downstream country. India, Nepal, China (Tibet), and Bhutan share the basins with it, but only India and, to a much lesser extent, Nepal are relevant to its water relationships at present and in the medium-term future. Cooperation among the riparians of the basins is clearly very desirable, but competition, exploitation of power positions, water disputes, and failure of transborder cooperation have been the rule.

For this reason, the 1989 Eastern Waters Study concluded with regret that "the quest for a broad cooperative regional approach to water development is likely to delay rather than hasten" the water arrangements and investments that can benefit the populations of each country. Unfortunately, no change in the nationalist perspectives that regional governments and populations bring to using the basins' water resources is in sight. The South Asian Association for Regional Cooperation (SAARC) excluded the difficult subject of water from its purview for fear that water conflicts would overwhelm the embryonic organization.

India is the middle riparian between Nepal and Bangladesh on the Ganges, and between China and Bangladesh on the Brahmaputra, but just as important is its overwhelming presence in the multibasin river system, 62 percent of which it covers. There has been no change in India's insistence on dealing with other riparians bilaterally (New Delhi with Kathmandu and New Delhi with Dhaka) rather than in a common gathering of the countries of the basins. There has been limited but still arduous progress in cooperation between India and Nepal for the exploitation of Himalayan hydro-power potential. However, between Bangladesh and India, water disputes have become the center of an unhappy general relationship.

Contention over dry season water, no nearer a solution than in 1989, has lately risen in intensity. India completely surrounds the deltaic plain of Bangladesh, and all of its 40 or more externally-sourced rivers flow in through Indian territory. The Ganges, Brahmaputra, and Meghna each enters Bangladesh from somewhat different terrain, but generally speaking, India, like Bangladesh, is intensifying dry season cultivation and increasing the use of both river water and related groundwater in areas upstream of Bangladesh. The eastern subcontinent as a whole is almost certainly approaching an overall shortage of October-May river water in relation to the growing agricultural, domestic, and other needs for dry season water traditionally met from surface sources. Moreover, river courses are slowly shifting, altering the discharge of water into one country or another and among the subregions of a country. These considerations, of course, turn the spotlight onto alluvial groundwater as a substitute for surface water (see Chapter 5).

The most visible theater, but by no means the only one, for playing out this water use conflict of interests between India and Bangladesh is the Ganges basin. The Ganges enters Bangladesh after traversing Uttar Pradesh, Bihar, and West Bengal, which themselves have large and growing populations and intensifying dry season agriculture. In the late sixties and the seventies, India

built the Farakka barrage, a low gated dam across the Ganges, just inside its border with Bangladesh. In the rainy season with its gates lifted, the Farakka barrage does not affect the flow of the river, but in the dry season it is now capable of diverting almost the entire Ganges flow, via a 40,000 cusec (cubic feet per second) canal, into the Bhagirathi/Hooghly river, the westernmost distributary of the Ganges, which goes to the sea within the Indian state of West Bengal.

In its original version, the 1977 agreement on low-season water sharing at the Indo-Bangladeshi border gave Bangladesh about 63 percent of the water, and both sides also agreed to seek ways to augment dry season water availability. India's augmentation proposal is a canal crossing northwest Bangladesh to bring Brahmaputra water to the Ganges in India; Bangladesh is totally opposed to such a link canal. In 1988, India, complaining of a lack of cooperation from Bangladesh on augmentation, declined to renew the water sharing agreement. Bangladeshis complain that since 1988 the amount of water coming across the border at the low point of the year has declined, to as little as 9,500 cusecs in March 1993, which would be about a third of the guaranteed minimum stipulated between 1977 and 1982.

It seems clear that in 1977 and the period thereafter, India used the short-term water sharing agreements to pressure Bangladesh into cooperation on water augmentation, that is, to obtain Dhaka's consent to the link canal. The ploy failed, and the lapse of the agreements has left the two countries in a deadlock, which now continues with no resolution in sight.

The decisions of the central government in New Delhi on how to divide the water arriving at Farakka are certainly important. Also important, however, is the total usage of Ganges-system water by farmers in the large agricultural upstream states of Uttar Pradesh and Bihar, as well as in West Bengal, through both low-lift pumping and diversions from the river and its tributaries, and through pumping groundwater from aquifers linked to the river. These factors, not entirely under control of the central government, will tend to become more important as dry season cropping continues to spread in India's Gangetic plain. Foreign observers have speculated that the Ganges as it enters Bangladesh could be virtually dry at the April-May low point in the foreseeable future, although the stream would be regenerated to some degree by groundwater draining into its bed.

The Bangladeshi government has insistently raised the damaging effects of lost dry season surface water, especially on the southwestern part of the country. These effects include a general increased dryness in that part of the country that impedes dry season cultivation, aggravates the difficulties of the Ganges-Kobadak irrigation project, and threatens the water supply for Khulna, as well as causing an increased inflow of salty ocean water into the delta because of reduced outflows of fresh river water. Prime Minister Zia raised this matter with Indian Prime Minister Rao in 1993 and was promised discussion of ameliorative steps, but these apparently have not been forthcoming. Begum Zia made a plea to world opinion about it the centerpiece of her speech to the 48th United Nations General Assembly in the fall of 1993. In frequent statements by representatives of the Bangladeshi government, the subject is cast as an Indian abuse of the human rights of the affected population and of the environment. This grievance is a perennial item in the Dhaka press.

The southwest regional FAP study (FAP 4) gave considerable stress to the increasing dryness and salinity in that area, highlighting the gradual silting up of the offtake of the Gorai river, a principal distributary of the Ganges and the most important single carrier of surface water to the southwest region, which includes the famous Sunderbans delta forest. The Gorai currently takes no water from the Ganges during the dry season, and it is feared that if this persists the Gorai may be cut off in the wet season as well, which would greatly reduce the flow of surface water to southwest Bangladesh. The very large volumes of silt carried by the Ganges rule out keeping the Gorai open through dredging. The solution discussed in FAP 4 is to raise the level of the Ganges by means of a barrage between the Gorai offtake and the junction with the Brahmaputra, which would send water down the Gorai course. Such river works would cost billions of dollars, displace tens of thousands of people, and for international funding would require a firm understanding with India on how much water will be available in the Ganges as it enters Bangladesh. This leads back, of course, to the present impasse with India on exactly that point.

Bangladesh and India are making competing claims for what appears to be an inadequate regional supply of dry season river water. Such transboundary disputes have the same basic nature, if their details always vary. There is no international law to offer clear-cut solutions to such impasses, but when they can be negotiated or adjudicated in a setting influenced by international legal thinking, two sometimes conflicting principles traditionally are cited to legitimize claims. One is that the possessor of water may dispose of it on his territory as he is able and as he sees fit; the second is that past or current use of water (prior appropriation) demonstrates a need for it and makes the claim to it legitimate and compelling. These principles have been made more detailed and subtle by the nonbinding but respected International Law Association's "Helsinki" rules for transboundary water negotiation/adjudication (International Law Association, 1967), which in turn are reflected in as yet unratified drafts of the United Nations International Law Commission.

The Helsinki rules provide that a claim to disputed water is weakened to some extent if a country has alternative sources to substitute for it. Bangladesh therefore understands that to maintain its claim to Ganges water it must show both that the denial of water it formerly received is causing it damage, and that it has no usable substitute. The desire to demonstrate reliance on river water, and thereby increase the strength of Bangladesh's case against Farakka diversions, has been among the reasons for the lack of BWDB support for the use of groundwater in the Ganges-Kobadak project area of the southwest region. Although groundwater aquifers often pass beneath international borders, as rivers cross them on the surface, there is no international law on groundwater rights. Indeed, the international law on transboundary surface flows is so embryonic that there is virtually no possibility the Ganges dispute will come into a binding courtroom setting in the foreseeable future, a procedure that would require the agreement of both sides to handle the matter in that way.

The impasse with India on surface water has changed little in its essentials in the five years since the Eastern Waters Study, but it is now attracting greater public and governmental attention than it did. No major concessions by India nor changes in Bangladesh's attitude are in view. It must be remembered that the dry season water problems are not limited to the Ganges; there is an Indian water control structure on the Teesta and one likely to be built in the future on the Meghna. Even without barrages, Indian dry season use patterns are tending to reduce the water

flowing annually into Bangladesh on many of the more than 40 minor rivers that cross the border, although many of these are naturally dry for some weeks in the dry season. The cumulative effect of increased dry season abstractions on all incoming watercourses by its all-surrounding upper riparian could well be a great deal more serious than what Bangladesh has felt so far.

Given that there is no optimistic prognosis for adequate dry season surface water, what can be said about a strategy of minimizing the use of groundwater in the Ganges-Kobadak project area, for example, even though this is sometimes bypassed by farmers who install their own tubewells? In general, in a high-rainfall and alluvial land such as Bangladesh, the response to a reduction in dry season river water would be a shift to groundwater, since groundwater is recharged annually by the much larger river flows of the wet season, as well as by local rainfall. In principle, by overtly turning to groundwater for irrigation in the southwest, Bangladesh might somewhat weaken its claim on regional surface water from India. However, it is very difficult to know how much of real value would be sacrificed. It is quite plausible that the hoped-for legal benefit from Bangladesh's self-denial of groundwater is a hollow asset being hoarded for a negotiation or adjudication that may never take place. It could well be better to accept it as such, and proceed to foster utilization of groundwater that is useful here and now for the population.

This evaluation leaves us with an extension of our 1989 conclusion that there are slim grounds at present to hope for meaningful basin cooperation between Bangladesh and India, and that Bangladesh should proceed to optimize its internal use of water resources rather than hope for major early gains from dispute resolution or regional cooperation.

What should be the advice to the Bangladesh government from other governments if they feel a need to speak to this situation? With due regard for the strong emotions involved, the BDG could be advised that its case is weakened by the lack of detailed study and documentation of the effects of Indian restrictions of the crossborder flows of the Ganges and the Teesta. There has been no analysis, for example, of the relative contributions to Ganges flow reduction of India's upstream offtakes and Farakka diversions versus the regular trend of the Ganges to move north and east, a long-term pattern that is drying up the western part of the Ganges delta independently of human action. It would be useful to have such an environmental study done. To be scientifically defensible, this study would inevitably take several years of effort and considerable expertise, as well as independence, to complete. A technically oriented international body, such as the World Meteorological Organization, the UN Environmental Programme, the World Bank's GEF, or the International Union for the Conservation of Nature, would be a better candidate than a foreign government to support such work. The hope of useful results from a study would be greatly increased if the work were requested jointly by Bangladesh and India; on the remote chance it could be organized, such a study would probably evaluate water needs and prospects in both eastern India and Bangladesh using a basinwide approach. It could aim to establish the minimum flow requirements for human use, as well as for maintaining the fisheries and the general ecology of the area. Hydrological and ecological models are available to help establish minimum flows when data are developed for the specific locations.

The Ford Foundation, with offices in Dhaka, Kathmandu, and New Delhi, is encouraging a slow but steady effort to develop expertise and communication on cooperative regional water

management and development among private study institutions in Bangladesh, Nepal, and India. A valid eventual goal would be a single independent international institute to gather data and lay the technical groundwork for basinwide cooperation, but this is clearly not possible at present. (Compare Q.K.Ahmad et al., 1994.)

The Ganges-Brahmaputra-Meghna basins, including their several nation-states and states of India, are also an increasingly marked region of poverty in South Asia and the world. The reasons for this are complex, involving many social as well as physical and geographic factors, but the persistent poverty and low per capita productivity of this multinational region, with a population approaching 500 million, justify focused attention. It would be very useful for the World Bank, in collaboration with the governments of India, Nepal, and Bangladesh, to organize a multidisciplinary conference to raise and address this troubling problem.

Chapter 7

INSTITUTIONALIZATION OF FAP/NWP, AND REFORM OF THE WATER SECTOR

Effects of the FAP

Under the FAP, much data gathering and a large number of studies have been undertaken, and important technical innovations have been introduced. Many of the FAP efforts have opened useful and challenging fields of research, such as environmental impact studies and the dynamics of major rivers, which can be continued for the country's benefit. The creation of a FAP project (FAP 26) specifically on institutionalization recognized the need to ensure that the FAP results and techniques are applied to ongoing water and environmental management, and that valuable data gathering and analyses initiated under the FAP studies are extended into the future. Mapping and GIS efforts under the FAP are making a particularly large contribution not only to the water sector but to national development in general. It is important both that they continue to receive support regardless of their ultimate organizational siting, and that their operational imperatives, such as centrality, nonduplication, and open data flow, be respected.

In addition to their technical achievements and perhaps going beyond original intentions, the FAP studies and activities (including the public controversy surrounding them) have brought a burst of fresh air, with broadened perspectives and new approaches, to the water sector. The FAP was the vehicle that brought to Bangladesh the intensified concern for the environment being felt around the world. To a static system, the FAP brought public reverberations and attention, donor coordination, multicriteria project analysis, and an explicit introduction of the issues of sustainability and people's participation. In this, the FAP extended the quieter but potentially revolutionary work of the Master Planning Organization (MPO) that produced the National Water Plans of 1987 and 1991. Together they represented the introduction of an important modern perspective to Bangladesh. The problem is how to make these gains permanent and give impetus and future life to the positive contributions of the FAP, that is, how to institutionalize them.

The problem of modernizing a large water engineering organization is not particular to Bangladesh. For example, it has arisen recently in the United States with the Army Corps of Engineers and the Bureau of Reclamation. To some extent it is a generational problem, which can be eased by the eventual rise of younger engineers to positions of policymaking and influence.

The issue is not simple. The new approach of the FAP has been supported by both Bangladeshi and foreign NGOs and by private citizens, but the innovations are largely the work of donors and consultants. Now, however, the FAP's achievements must pass into the hands of civil servants, who must be sincerely convinced that they are worth preserving. It is absolutely essential that the officials feel and assert "ownership" of the new approach. But the engineering establishment strongly opposed the innovations introduced at the Second and Third FAP conferences in 1992 and 1993 and will not support them without a change of heart. In 1987 and 1991, the National

Water Plans were largely ignored and WARPO's capacities curtailed. Although the FAP innovations have a stronger and more visible base, they still face a good deal of resistance, a factor that cannot be ignored in institutionalization.

The Present Water Sector

The water sector at present is part of the Ministry of Water Resources (MOWR). which is under a full-fledged minister who also holds the Agriculture portfolio. MOWR has a junior minister of state as well.

MOWR contains the large, partially autonomous, Bangladesh Water Development Board (BWDB), which plans, implements, and manages large surface water projects, and a relatively small and new permanent body, the Water Resources Planning Organization (WARPO). A Surface Water Modelling Center and a River Research Institute report to WARPO. MOWR also directly controls a temporary Flood Plan Coordinating Organization (FPCO), created in 1989 to handle the extensive task of coordinating the FAP.

The water sector, with its significant share of the development budget, sees itself as primarily supporting agriculture through surface water irrigation and flood control works. It designs and manages the construction of large surface water projects in rural areas, using contractors who hire local or migrant laborers. It has nothing to do with urban water supply and waste removal, which are entrusted to chartered water and sewage agencies (WASAs) under the Local Government Ministry for the two largest cities, and to a Public Health Engineering Department of the same ministry for over 100 smaller urban centers. Small-scale water control projects at the thana level in rural areas are planned and executed by the Engineering Department of the Local Government Ministry (LGED) and the municipalities.

The large central element in this picture is the BWDB. With about 2,000 engineers and 16,500 support staff, it has a very strong sense of its own identity and mission. Its functions and its conception of them date back to the IECO Master Plan for flood control and irrigation of 1964, which amounted to its founding charter. It is divided into five sections covering Planning and Design, Implementation, Operation and Maintenance, Finance, and Administration. The BWDB has suffered from a reputation for a top-down style of decision-making, a reluctance to consult those who will be affected by its projects, slow implementation, and a lack of interest in the operation and maintenance of its earthworks and structures after they are built. While the skills of its engineers are considered good, the BWDB for many years has been marked by its indecision in operational matters and slow internal communications.

This summer, the BWDB's governing body initiated several steps to improve its performance and worked out a program of reform with the World Bank. Subject to satisfactory progress on this reform, the preparation of Bank loans for the water sector will go forward. The reform centers on making permanent appointments to the governing body of the BWDB; approving the Guidelines on People's Participation for all BWDB projects; accepting a modern accounting system, including bringing in chartered accountants; separating sector analysis, project planning, and evaluation from implementation, since implementation tends to overwhelm the analytical

functions with its bias toward construction; and stressing the importance of O&M through better staff, greater motivation, and more local revenue input. There is no question that if carried out, these reforms of the BWDB will bring in many new people and ideas and will greatly improve the water sector.

Urban Water Supply Issues

The cities of Bangladesh are growing much faster than the population as a whole. The estimated growth rate is 6 percent per year for Dhaka and Chittagong, and 3-4 percent for the smaller urban centers. This expansion has taken place by default as a result of migration from the rural areas, and has proceeded without development of an adequate infrastructure to mitigate the environmental and health challenges of urbanization.

The population of metropolitan Dhaka is now estimated at 7 million, and according to a United Nations estimate could reach 10 million by the year 2000. The Dhaka Water and Sewage Agency (WASA) estimates that 55 percent of the population has access to piped water, most of it supplied by WASA, and that less than 40 percent is served by sewers. Chittagong, the second largest city, which also has a WASA, lags behind Dhaka in coverage.

The Dhaka WASA gets 98 percent of its supply from groundwater, which is of good quality and requires only chlorination to keep it safe in transmission. The use of surface water, with more extensive and expensive purification techniques, has been discussed. The cone of depression around WASA's 174 wells averages 20 meters in depth, and is dropping at an average rate of 60 centimeters a year. No land subsidence as a result of groundwater withdrawals has been noted. About 70 percent of water service is metered, but WASA receives payment for only half the water it produces; it estimates that 40 percent of the loss is technical (leakage from pipes) and 60 percent is administrative (underbilling, theft of water, etc.). Revenues from consumers cover operation and maintenance costs but not capital investment. Sewerage services are billed at the same rate as water, and the sewage, only a small fraction of the city's wastes, is treated at Pagla, in the southern part of the city, at a plant with a capacity of 27M liters per day.

The extension to the entire city of a piped water supply (which would reach most people from neighborhood standpipes as at present) and of sewerage, with a waste treatment capacity to match, would entail an investment on the scale of US$600M. The comparable figure for Chittagong would be US$250M.

In the 110 smaller urban centers, water supply facilities are constructed by the Local Government Ministry's Directorate of Public Health Engineering (DPHE), which transfers operational responsibility to local municipalities. Piped water in 72 cities serves about 47 percent of their populations. DPHE has also installed more than 900,000 handpumps to supply about 85 percent of the rural population with drinking water. DPHE supports 1,000 centers that sell sanitary latrines at subsidized prices; there are now 1.3 million of these latrines in use, serving about 14 percent of the population.

Like the Dhaka and Chittagong WASAs, DPHE depends on groundwater, which is extracted by motorized tubewells for piped supplies in cities and by handpumps in rural areas. Chlorination is the main treatment applied, and iron is removed in some places. There is some concern that the intensified use of groundwater for crop irrigation recommended elsewhere in this report would lower the water table in the driest period of the year below the level at which handpumps could reach it. As discussed in Chapter 5, DPHE has encountered this problem in some locations, and has a program to assist villages in making inexpensive adjustments to solve it.

Conversations with DPHE suggested that complete piped water service to 61 district towns would average 20 crore taka per town, or a total equivalent to US$300M. Sanitary pit latrines for the same 61 towns would cost about half that, making a total of about $450M for water supply and sanitary waste disposal. Similar supply and sanitation coverage of the 50 towns below district level would cost roughly US$250M, for a grand total of US$700M. To operate and maintain such systems and expand them as populations grow would cost about US$70M per year. At present DPHE, whose primary external collaborators are Denmark, the Netherlands, Japan, the ADB, and UNICEF, has a development budget of about US$50M and an annual revenue, or maintenance, budget of about US$6.5M. Secondary city household water supply would therefore seem to be running at a small fraction of the estimated needed investment at present.

Water and waste removal services even for the present urban population are lagging severely. Immediate valid infrastructure investment possibilities are on the scale of US$1.8 billion when the needs of Dhaka, Chittagong, and the secondary towns and rural areas are totaled. Significant health and infant mortality gains could be expected with improved drinking water supplies. Improved urban living conditions are an important component of preparation for industrialization.

Suggestion for Capturing the FAP's Impetus

The preservation of the results of the FAP's research and the extension of its productivity when its work is over at the end of 1995 are often considered in terms of where to place the staff and assets of the FPCO, the temporary coordinating organization that was created to handle the FAP. This is only part of the problem, and the formal institutionalization of the FAP is only part of the problem of investing the water sector with health and balance. An effort to capture the impetus of the FAP, both for its own institutionalization and as a catalyst to reform the sector, would have four parts:

A. FPCO and the FAP library, along with the study and planning function for FAP initiated projects, should be incorporated in a revivified WARPO, which, restored to quarters in Dhaka, should be given much more centrality, an enlarged and diversified staff, and a substantially larger budget as the sectoral planning office of the Ministry. This is generally in accord with the first FAP 26 draft, and now with the prospective recommendation of the BDG's special panel on institutionalization of the FAP. It ties in with, and should be subordinated to, the BWDB/World Bank reform program, which is considering how planning and analytical functions should be related to implementation functions. The problem of where to situate the FPCO/FAP within the bureaucracy is less important than preserving its experience and approach. If these are safeguarded, there are any number of organizational slots into which it can fit. In essence, the

FAP represents a set of doctrines and approaches to water management that include long-term data collection, environmental awareness and sensitivity, respect for fisheries, multicriteria project review, people's participation, liaison with other sectors and ministries, and stress on O&M and full project-life benefit extraction. Whatever its name, the organization that institutionalizes the FAP must carry the message to the whole sector that, rather than coasting along with a fixed and unexamined share of the development budget, water projects must justify themselves by showing positive results and a real contribution to economic development.

The April version of the prospective report of the Panel of Experts on Institutional Issues (Government of Bangladesh, FPCO 1994d) notes that the Second FAP Conference of 1992 recommended that project proposals from the FAP studies should be subjected to the decisional processes of national development planning and be competitively evaluated for funding with projects from other sectors, rather than being funded from a special budget. However, the report then leaves open the question of whether or not there will be special flood control funding in addition to the normal development budget.

Understandably, the intense emotions immediately after the disastrous 1988 flood raised some talk and expectation of supplemental international aid specifically for flood control. However, as reflected in the Second FAP Conference, the idea appears to have been dropped. And rightly so. Each water management project should be able to stand on its own under the Guidelines for Project Assessment, against not only other water sector proposals but also the full range of developmental needs, such as schools, rural electricity, tubewells, and so forth. The water planning organization, or perhaps the national planning authorities, must be able to say "no" to proposals of the implementing organization, as well as "yes," and in this case may even have to preside over an extended contraction of the BWDB's mission. This is not an easy message to carry to any organization, from the inside or the outside.

The April report contains some notable insights and useful observations. However, it appears to assume that institutionalizing the FAP means deciding how to implement the project portfolio coming from the FAP studies for a total investment of $7 to 8 billion, in effect suggesting a very large expansion of the BWDB and a smaller expansion of other agencies that will share in FAP implementation. Our view is quite contrary. The purpose of institutionalization is to permanently establish processes such as multicriteria evaluation that will rule out many of the project possibilities discussed in the FAP studies. Institutionalizing the FAP and reforming the water sector should precede establishing an FAP project list. The eventual project portfolio should be worked out by the reformed institutions, primarily the new WARPO or a functional equivalent, greatly strengthened and quite detached and protected from the implementation wing of the sector, and integrating FAP and NWP matters.

B. The BWDB must convert itself into a responsive water management organization that maintains communication with the country's development agencies and an awareness of their agendas. This process has clearly started with the reform program now underway with the World Bank, and would be helped by an explicit announcement of government backing. A positive factor, as the reform program goes forward, would be the addition of nonengineers to the governing body, such as an agricultural scientist as Member for Agricultural Liaison, a

sociologist as Member for Public Consultation and Interministerial Coordination, and an environmentalist as Member for Project Sustainability (although these positions might be more appropriate in the planning organization, probably WARPO). Revised training programs, for both new and lateral entrants and in-career personnel, will be needed to introduce new aspects of the work, including environmental considerations, multicriteria project evaluation, consultation with the people, and conversion of the BWDB's culture to a concern for full-benefit extraction and performance optimization over the entire life of a project.

C. As a conceptual matter, limiting the definition of the water sector to rural flood control and irrigation works is overly narrow. Flood control engineering can be applied to the protection of cities and industry, but other water management needs in the growing cities are much more pressing than is commonly recognized. Some engineering resources freed up in the rural areas could well be redeployed to greatly expanded programs in urban water and sanitation. Perhaps the BWDB should not be directly involved in these tasks, but some of its staff could be shifted in this direction.

The BWDB's mission has suffered for many years from poor coordination with the rest of the government. The Agriculture Ministry is now calling for diversion of funds from rural flood control to more productive uses. Similarly, flood embankments have been built without regard for roads, although roads are usually elevated above field level and guide or block drainage as embankments do. Roads can also serve efficiently as flood refuges. Planning and operational coordination between the BWDB and the Roads and Highways department must be improved on the basis of regular communication between all such development agencies and the central planning authority, which exercises the supra-sectoral role that multicriteria decisions necessitate.

Consideration should be given to forming a national water committee, bringing together the Ministers of Water Development, Agriculture, Health, Local Government, and Transportation at perhaps quarterly intervals, with their Secretaries meeting more frequently. Greatly intensified liaison among these elements of the government should become a routine matter at the working and local levels. This suggested national water committee would be much more specific, more limited, and more work-oriented than, for example, the present National Water Council, a largely ceremonial meeting of the entire cabinet that anyway has not taken place for several years. An attractive alternative would be to revive the Governing Body and Executive Committee provided for in the WARPO Act, with senior level representation from the Planning Commission and concerned ministries. The formation of either kind of national water committee would permit eliminating some existing inactive bodies in this field.

As the reform program goes forward, serious consideration should be given to the decentralization and revision of the functions of the BWDB as proposed in a study for the World Bank (Gisselquist, 1991). It suggested that medium and small projects become the responsibility of either thanas or appropriately drawn local water districts or project societies. Projects would have substantial local funding, or funding from development block grants given to localities by the central government with few strings. With local control of investment decisions should come generally smaller and better projects, a greater sense of ownership, and better operation and maintenance. The BWDB would provide technical advice and coordination with other agencies

such as roadbuilders active in the countryside. It could manage a flow of project information no longer designed for central decisionmakers but packaged for application at the thana or equivalent local level. Above all, local elected decisionmakers would have the latitude to spend their funds inside or outside the water sector, choosing surface water investments only when these were more desirable than roads, a clinic or school, or electrification, for instance.

It is important, before or during reform of the water sector, that the BDG and external donors and financial agencies should scrutinize the large number of water projects already in the pipeline. If any of these are no longer justified, they should be denied funding. Donors should maintain the close liaison among themselves in the water section of the Local Consultative Group developed in the course of the FAP, and exchange views on old and on new projects that are proposed.

D. In the private or NGO sector, donor countries should assist the BDG in the establishment of an Institute of Natural Resources Management, comparable to the Bangladesh Institute of Development Studies (BIDS). This institute, primarily devoted to research and data archiving and analysis, is thoroughly justifiable on its own merits but could also serve as a resource center for the modern approach to water resources planning and management. With an academic approach, it would be detached from the fierce bureaucratic/political battles in the world of government and also have a close and mutually supportive relationship with the university and research communities. Such an institute is described in Annex A.

Perhaps a foundation or NGO could coordinate the creation of this institute, or a single donor could act on behalf of several other donors who wished to support such an enterprise.

Chapter 8

PLANNING FOR THE FUTURE: THE OVERALL NATIONAL CONTEXT

Features of the Present Situation

By the year 2010, Bangladesh on its present course will have developed much of its agricultural potential. Its population will have increased by about 40 million and is expected to stabilize in the latter part of the century, perhaps at more than double the current figure. While only 15 percent of the population was classified as urban in 1981, the World Bank projects that this will increase to 30 percent, or 46 million, by 2005. Most of the increase will be a result of the decreasing ability of the agricultural sector to absorb the growing labor force.

Poverty is pervasive; some, but by no means all, of its specifics are detailed in Table VIII-1. The small-farmer agriculture currently practiced is still dominated by simple technology. Lack of information and low inputs keep farmers from boosting production from fields, ponds, trees, and livestock. Small land parcels, low profitability, and insecure land tenure discourage investment and the improvement of productive or renewable resources. Population pressure and poverty have contributed to resource overuse and environmental degradation. Poverty and environmental degradation are positively correlated; the poor are forced to meet short-term needs at the expense of long-term depletion of the natural resource base.

The National Water Plan of 1991 (Government of Bangladesh, 1991b) estimated that the overall labor force will increase from 7.6 billion to 11.2 billion annual man-days between 1989-90 and 2010. However, the agricultural labor force will increase by only 1.4 percent annually over the same period, falling from the present 36 percent to 24 percent of the total labor force. There is an immediate need to plan for employment opportunities, infrastructure, and housing for this vast nonagricultural labor force and its dependents.

The government is committed to strengthening the manufacturing and industrial sectors. It took notable steps in FY 93 to liberalize trade and deregulate industry and finance, but much remains to be done to stimulate faster industrial growth. The manufacturing sector accounts for about 10 percent of GDP and 8 percent of total employment, and generates about 75 percent of total merchandise exports. In the past 10 years, the major source of industrial growth has been in textiles, led by ready-made garments. Leather exports have also grown quickly and are likely to continue to do so. Despite the notable performance of the garment and leather industries, overall industrial growth has been slow. The performance of some of the most important industries in the public sector (sugar, steel, cement, jute goods, textile yarn, and cloth) has been particularly poor (World Bank, 1993).

World Bank estimates require Bangladesh to maintain an acceleration in the rate of economic growth to 6-7 percent in the medium-to-long term if significant poverty reduction is to be achieved. This will require investment to reach 17-19 percent of GDP by the end of the present

decade. Unfortunately, overall investment fell to around 10 percent of GDP in FY 92 and the real economic growth rate has remained stable at 3-4 percent (World Bank, 1993). Higher growth rates will be possible only if there is an increase in savings and investment, led by a vibrant and dynamic private sector and a government that encourages efficient use of limited resources. To consolidate the recent gains in the macroeconomic management of the economy as well as to accelerate the pace of development and assure sustainable growth, strategic planning is needed.

Much of the problem arises from attempting to apply methods today that were appropriate to a centrally planned economy dominated by the public sector. Effectively, Bangladesh is still "driving to the future looking in the rear view mirror." With the exception of the ready-made garment and leather industries, the growth of manufactures has been poor. Foreign investment in the manufacturing sector has been almost absent, and a number of multinational firms have recently left (World Bank, 1993). Tanneries, leather, toy manufacturing, and seafood processing have been heralded as having strong export potential but are yet to make a sustained breakthrough in world markets.

A Fresh General Economic Planning Framework

Self-sufficiency in foodgrains should prompt a re-examination of the policies that brought about that historic success. It would be wasteful to continue to emphasize agriculture when it may be now far more rewarding to advance to new goals and orientations. Moreover, as a result of earlier policies and successes, the momentum in agriculture can be counted on to continue even if central attention moves to new objectives.

Looking 30 years ahead, there are two possibilities. The first is the continuation of present policies, making for business as usual. The second is a strategic commitment to move beyond small-holder rice agriculture to industry and participation in a much wider range of world markets. Both paths will see enormous growth in the urban population, but a commitment to industry will provide profitable employment for the many millions who will throng the cities.

Two strategic facts must decisively influence Bangladesh's plans and conceptions for the future.

- Very large population growth will take place.
- Even with steady continuing gains in farm output, agricultural employment will not grow fast enough to absorb the additional people. This means that the bulk of the increased population will end up in the urban areas.

There will inevitably be growth of the cities on a very large scale, and the big new problems will be urban-based.

Choosing the easier alternative of business as usual will increase the number of people skilled only in subsistence agriculture and living remote from modernity on the land. Agriculture already has too many people to permit wages to rise significantly, and substantial improvements in yield per hectare will only aggravate the labor problem. Moreover, a predominantly rural population will tend to keep population growth rates high, since contraceptive information and supplies are

less easily available in the countryside and fertility is higher; of itself, urbanization will tend to restrain population growth. At the beginning of this decade, contraceptive use in Dhaka was 55 percent, versus 33 percent nationally (USAID/Dhaka, 1990).

The present rural population, after several decades of very rapid growth and concentration on farming, faces an acute scarcity of land, which is forcing people to settle on marginal or dangerous tracts such as the chars and cyclone-affected deltaic coast. There are strong pressures on the government to protect certain lands, such as the right bank of the Brahmaputra, from river erosion. The available land must be used more intensely than traditional agriculture can use it to ease pressure on the general land stock and on marginal land.

In our recent visit, we sensed that Bangladesh would benefit from an increased institutional commitment to long-term planning. Three to five years appear to be the longest purview of most government agencies, exemplified by the Planning Commission's "Three Year Rolling Plan (FY 1994-96)." An interesting document with an atypical forward perspective is the Ministry of Agriculture's "Crop Agriculture Development: Trends, Issues and Opportunities."

Table VIII-1 shows the parameters used in the Planning Commission document. The usefulness of some of these as the basis of a 30-year forecast is questionable. For example, an annual population growth rate of 2.17 percent is used, whereas the World Bank's 1993 forecast until

TABLE VIII-1

Selected Socioeconomic Statistics for Bangladesh

Adult Literacy Rate	35%
Life Expectancy at Birth	57 years
Per Capita Income	Tk. 8800 or US$220
Population Growth Rate	2.17% annually
Unemployment Rate	12-15% of labor force
Daily Calorie Intake	1900 units
Coverage of Urban Water Supply	35%
Coverage of Rural Water Supply	80%
Average Housing Space per Family	641 s.f.
Average Land Holding	0.327 acre
Percent of Population below Poverty Line	48%
Tax/GDP Ratio (92-93)	11.6%
Investment/GDP Radio (92-93)	12.7%
ADP/GDP Ratio (92-93)	5.7%
Current Account Deficit	$535 million
Domestic Savings/GDP	6.5%
GDP Growth (92-93)	4.3%

Source: Government of Bangladesh, 1994a

2025 is based upon a rate of only 1.8 percent. The Bank expects that by 2010 the net reproductive rate will reach 1.0. Using 1.8 percent instead of 2.17 percent means that the population in 2025 will be 29 million fewer persons. Which of these divergent estimates proves true will make a large difference in the pressure upon agriculture and other resources to meet the demands for simple survival. The lower rate will allow for diversion of significant investment to improve the quality of life of the whole population. Other Planning Commission parameters that need to change, if the type of development envisaged here is to be achieved, are the adult literacy rate, especially for women, and the domestic savings rate.

Figure VIII-1a shows urban and rural population forecasts under the assumptions that the total population grows at 2.17 percent and the urban population at a very low rate of 3.5 percent (actual urban growth rates are much higher: 6.8 percent from 1970-1980 and 6.2 percent from 1980-92). The low rate was chosen to show that even then the urban population still triples over the forecast period. This forecast reflects the business-as-usual approach discussed above. Even under these conditions, the rural population reaches a peak of about 105 million in 2015 and starts to decline thereafter.

Figure VIII-1b represents a more realistic scenario using current rates of urbanization and the World Bank's total population growth rate. The rural population peaks at about 100 million in 2013 and declines rapidly thereafter. The startling projection from this forecast is that, despite a low overall population growth, the urban population grows sixfold from 20 million in 1995 to over 120 million in 2025. Preparing for this urban growth should be the major task of government planners. In June 1994, there was still little comprehension of the magnitude of this priority. Interestingly enough, the one agency with some awareness, albeit at the level of one city, was the Dhaka WASA, which has been striving to meet the water and sewerage demands of the Dhaka metropolitan area with plans until 2020.

Assuring adequate food supplies is fundamental and requires careful forecasts of future increases in staple food production. Thus, even though the Ministry of Agriculture (Government of Bangladesh, 1994b) predicts in Figure VIII-2 almost a tripling of rice production from increased fertilizer use (an incremental 17 million tons) and the expansion of tubewells (a further 13 million tons), we have assumed only the increment from expanded irrigation, which is much more certain. The Ministry predicts a production of 50.63 million tons, whereas the far lower figure of 31 million tons, based solely on the expansion of the irrigated area, suffices for the basic argument. Agronomic efforts will certainly engender some fertilizer response, not as large perhaps as the Ministry envisages, but certainly large enough to offer a surplus of rice for export.

Given the conclusion that food security can be assured by expansion of boro acreage through investments in irrigation (largely in private sector tubewells), the other water sectors can be examined to see what levels of investments will be needed over the planning period. In effect, surface irrigation structures can be set aside, and these resources can be redistributed. Only three other water sectors are examined here: urban water supply, urban wastewater management, and rural sanitation covering drinking water and domestic sanitation. Figures VIII-3 and VIII-4 show the relative magnitudes of required capital expenditure needed to meet the various demands and

Figure VIII-1a
Urban and Rural Population Projections at 2.17%

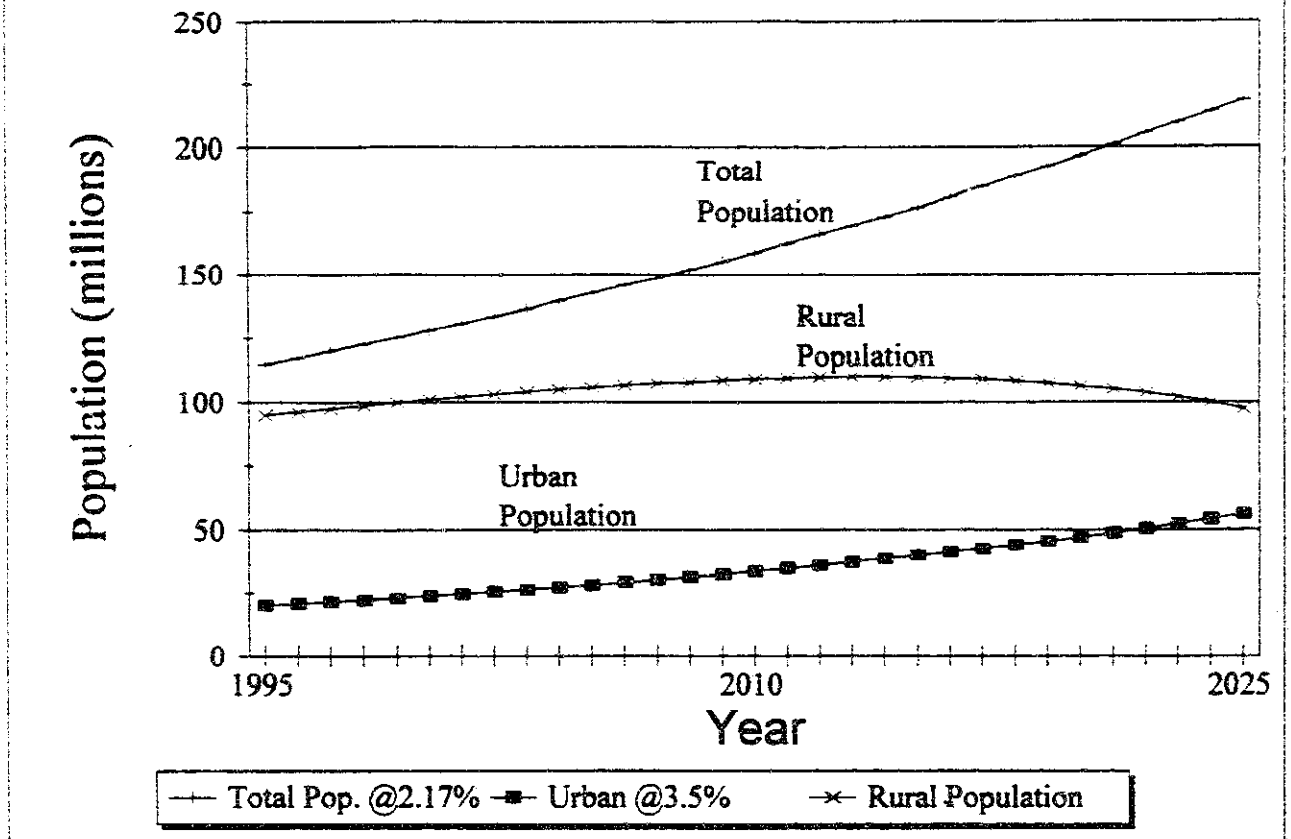
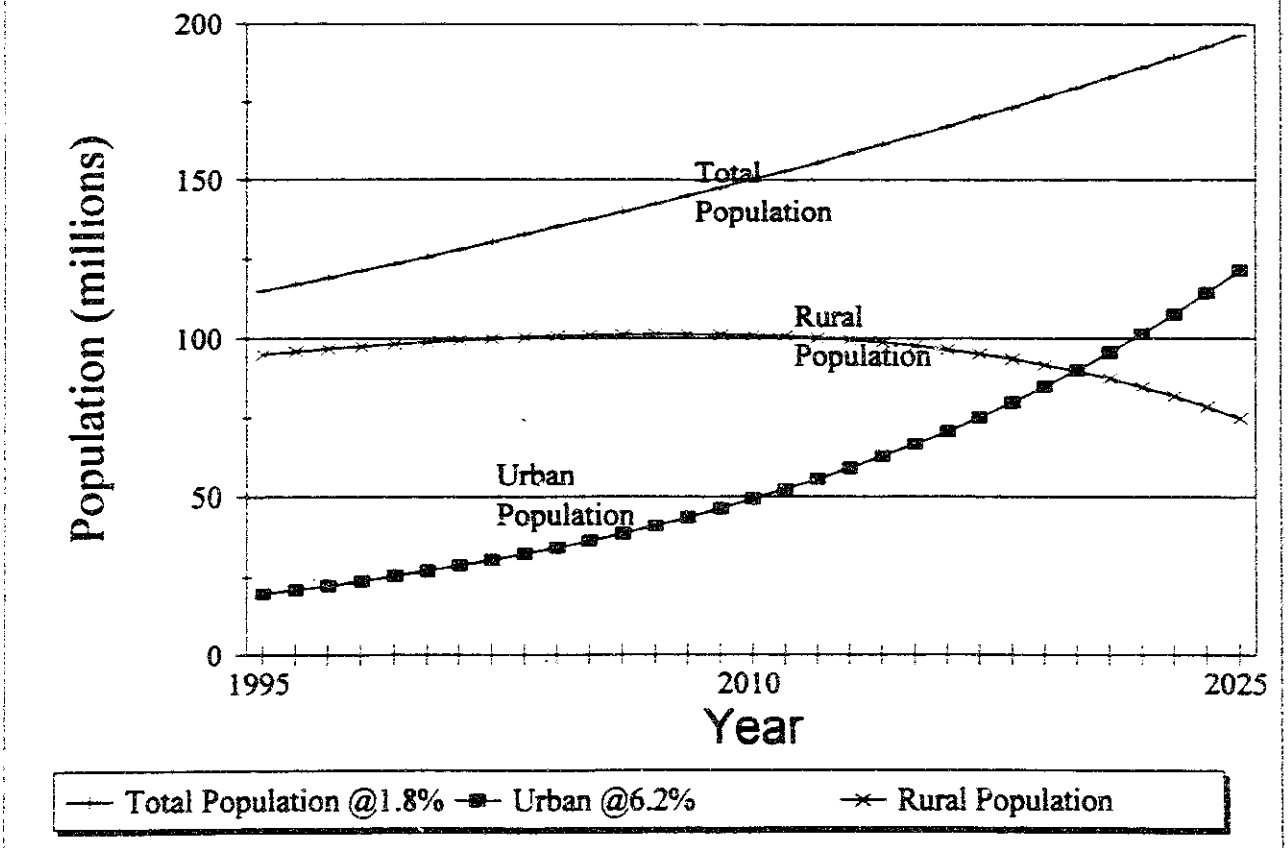


Figure VIII-1b
Urban and Rural Population Projections at 1.8%



compare them with the current expenditure by the BWDB on flood control, drainage, and surface irrigation projects. These figures indicate that the expenditures by the BWDB are far in excess of the capital amounts required to meet food needs in agriculture. Figure VIII-4 shows that substantial expenditures will increasingly be needed to maintain the supply of water and to control the health effects of wastewater disposal in the growing urban areas. The large initial step in these diagrams represents the fact that the urban and rural sanitation programs are currently not sufficient to meet the incremental needs.

Given the large asymmetries in costs and allocation of resources, the Ministry of Agriculture has suggested some reallocations that may be of particular use to the rural sectors of the economy. Figure VIII-5 shows the relative allocations in the Annual Development Plans from 1989 until 1994.

Finally, in Table VIII-2 we see the type of comparative intersectoral thinking that is missing in most of the discussions of development expenditures in Bangladesh. Given that more than $200 million is invested annually in flood control, irrigation, and drainage projects, one can see potentially large benefits by reallocating some of these funds. For example, even remaining in the irrigation sector, $10 million provides only 931.5 hectares of surface irrigation, but up to 162,000 hectares of STW irrigation. Between sectors, the same resources could provide 970 schools or 8 hospitals.

With deep and major problems of the past effectively settled by historic achievements in agriculture and in restraint of population growth, Bangladesh is in a position to move toward very substantial new gains in improving its economy and the life of its people. We have called for reorganization in the water sector, but to profit from what the National Water Plan, the FAP processes, and the past decade have brought to Bangladesh, there should be no illusion that a paper reorganization will do the job. Although there is no shortage of gifted hands to do the work, multicriteria project planning and people's participation, to name only two elements of the new approaches, are difficult, time-consuming matters, far more demanding than the old approaches. Moreover, if done properly, they must involve risks, for example, that the people of a locality will not assent to a work proposal, or that a project will be ruled out by new constraints among the wider range of criteria reviewed, or that more time will have to be given to unappealing tasks such as O&M. These risks, however, must be faced because they are real. To shunt them aside bureaucratically will inevitably mean that the national population will pay in the future for poor decision-making by those entrusted with responsibility for managing national resources. The need is for more than a reorganization of the water sector, but for the sector itself to rethink its agenda and its role in the Bangladesh of coming decades in the light of new evidence. We hope that this need can be faced squarely and debated vigorously, and we are confident that there can be large gains in national well-being if this is done.

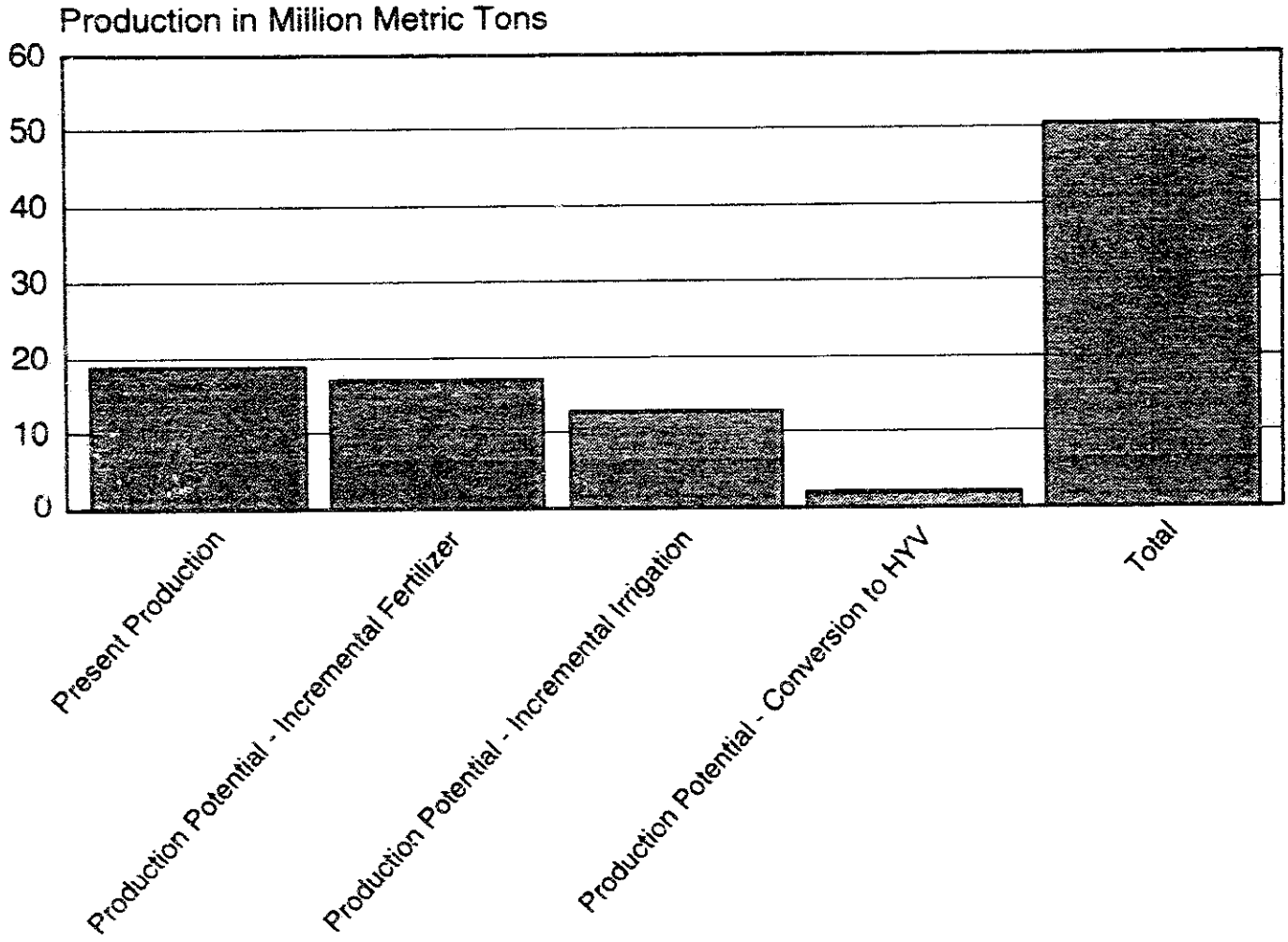
TABLE VIII-2

What Can Be Bought for $10 Million?

ROADS	
National Highway	17 kilometers
Feeder Road HBB	90 kilometers
Feeder Road HBB	430 kilometers
Rural Roads R1	560 kilometers
Turfing and Tree Planting	4600 kilometers
MARKETS	
Small (.5 acres and 60 traders)	476 markets
Large (100 acres and 11,500 traders)	5 markets
IRRIGATION	
STWs	
Yanmar (17,000 x about 4 hectares)	68,850 hectares
Dongfong (40,300 x about 4 hectares)	174,150 hectares
DTWs (2,220 x about 20 hectares)	44,550 hectares
Surface Irrigation	931.5 hectares
ELECTRIFICATION (Rural Connections)	500,000 houses
SCHOOLS (Four-room Tin Shed)	970 schools
THANA HEALTH COMPLEX	8 hospitals

Source: Government of Bangladesh, 1994b

Figure VIII-2
Existing and Potential Rice Production



Notes: Recommended dose are for low soil analysis interpretation and moderate resource base to achieve average potential yields.

OBSERVATIONS AND COMMENTS:

The first bar shows the current level of rice production (18.34 million tons).

The second bar indicates the amount of additional rice (16.64 million tons) that could be produced if farmers fertilized at the rates recommended by BARC.

The third bar indicates the additional rice (13.32 million tons) that could be grown if all irrigated land in the rabi season was irrigated and planted to paddy. It assumes current average yields.

The fourth bar indicates the incremental rice (2.33 million tons) that would result if all paddy planted was HYV.

The final bar shows the theoretical production of rice that would result (50.63 million tons) if all irrigable land was irrigated, fertilizer was used at recommended rates, and high yielding varieties of rice were grown.

Source: Government of Bangladesh, 1994b

Figure VIII-3
Capital Investments for Water Sector
High Total and Low Urban Growth

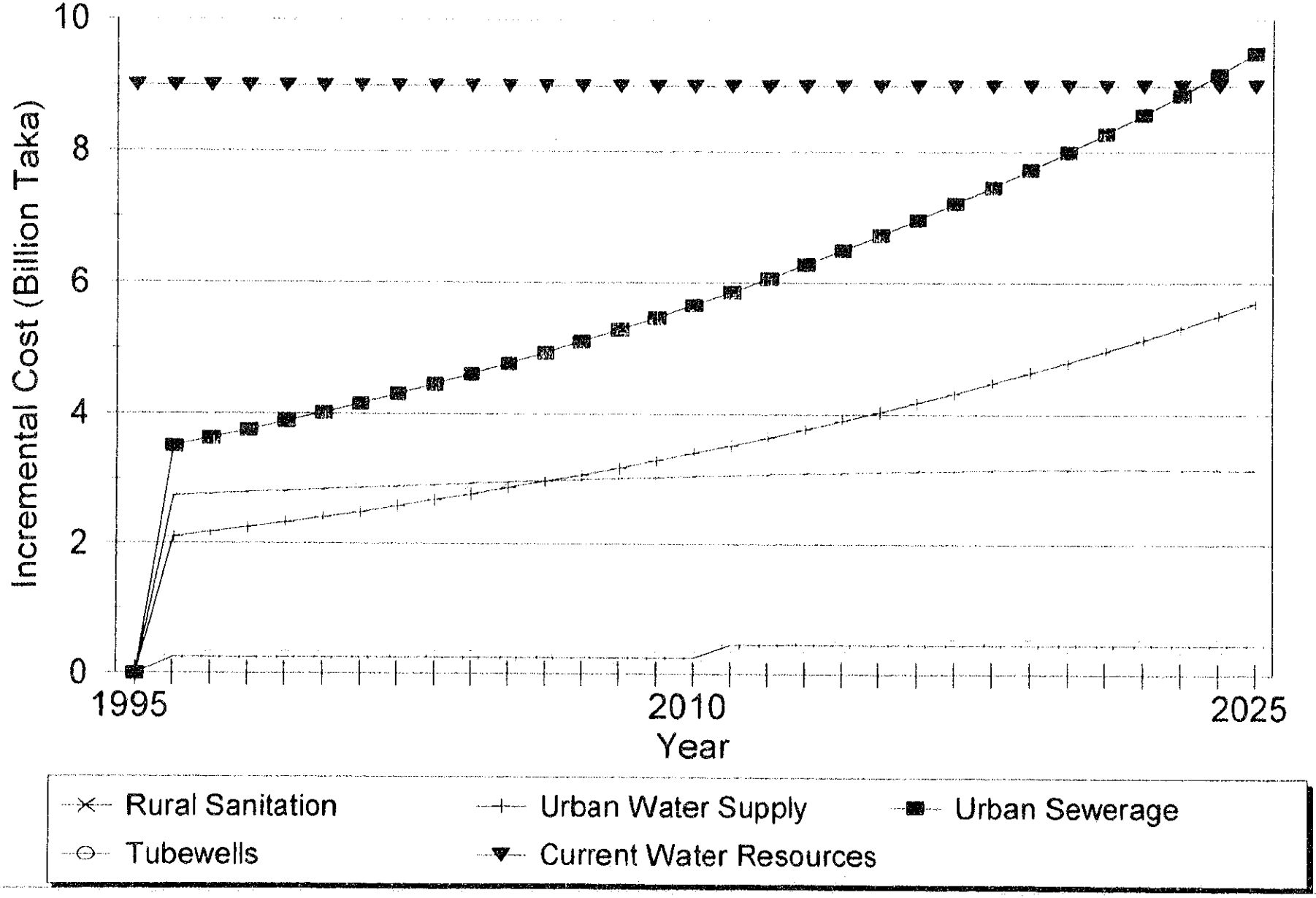


Figure VIII-4
Capital Investments for Water Sector
Low Total and High Urban Growth

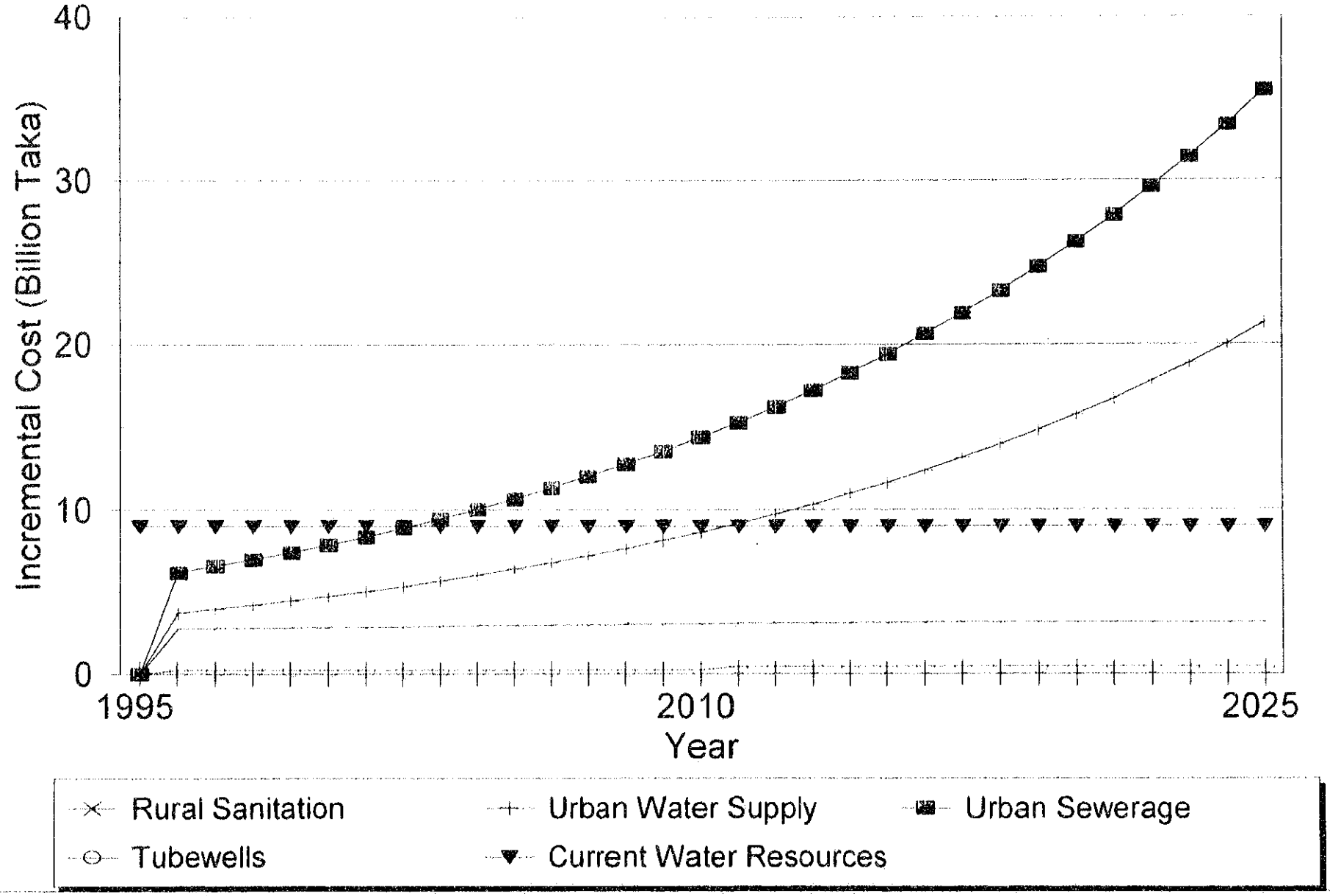
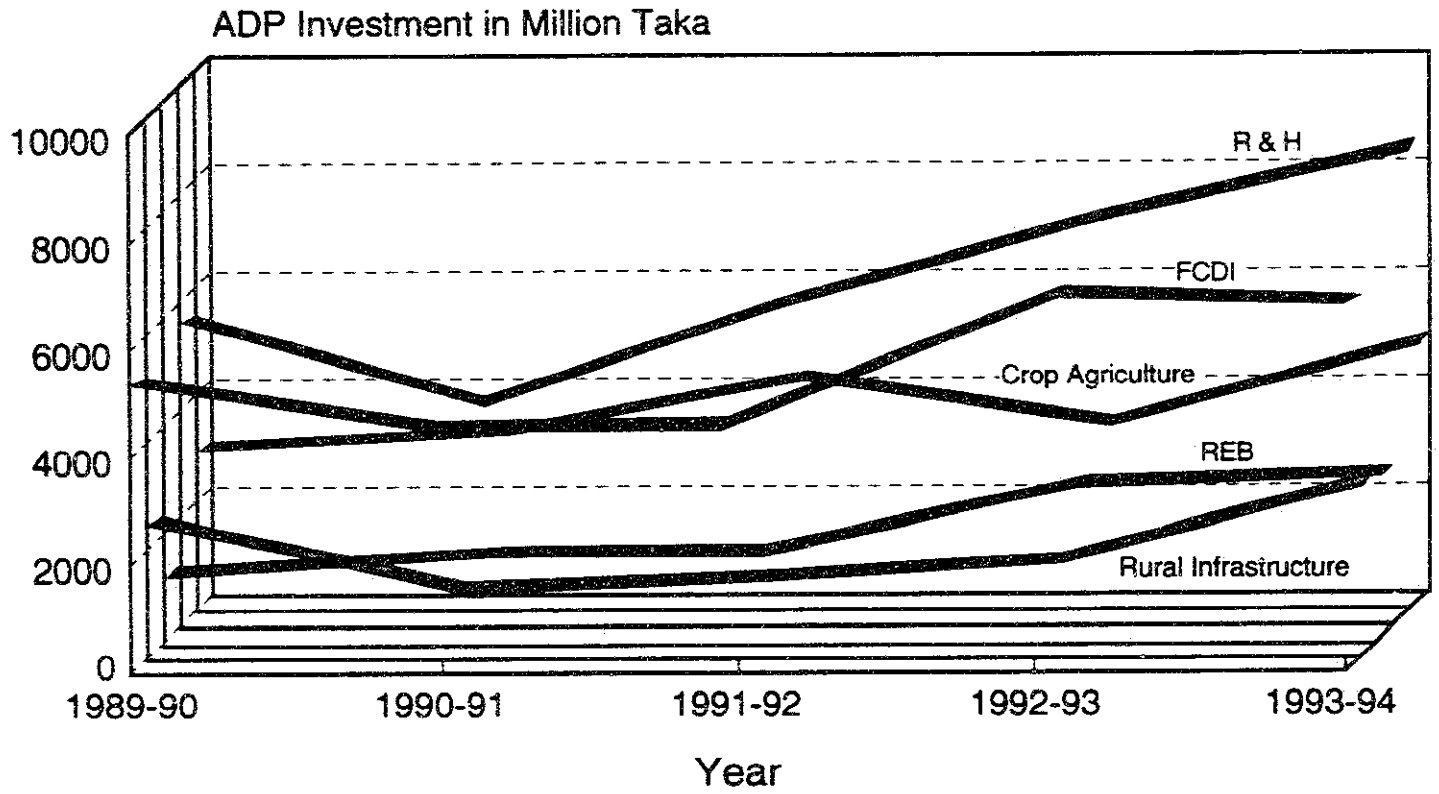


Figure VIII-5
ADP Selected Investment

1989-90 to 1993-94



OBSERVATIONS AND COMMENTS:

From an agricultural point of view, expenditures on rural infrastructure are very important. They provide agricultural markets and rural roads.

Similarly, rural electrification can lower costs of paddy milling and pumping irrigation water.

Large scale irrigation projects have not been very beneficial to agriculture, particularly relative to their costs.

Reallocation of expenditures from FCDI to rural infrastructure and rural electrification should be considered.

Source: Government of Bangladesh, 1994b

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Annex A

List of FAP component studies, with donor andapproximate cost commitments

FAP #	Name of Component	Donor	Amount of Funds Committed (millions of U.S. dollars)		
	MAIN COMPONENTS		Tech Asst	BDG	Total
1	Brahmaputra Right Bank Strengthening	IDA	3.30	0.12	3.42
2	Northwest Regional Study	UK, Japan	4.47	0.24	4.71
3	North Central Regional Study	EC, France	2.25	0.20	2.45
3.1	Jamalpur Priority Project	EC, France	1.85	0.03	1.88
3.2	Bhuapur-Gopalpur Feasibility Study	EC, France			
4	Southwest Area Management Study	ADB, UNDP	3.84	0.15	3.99
5	Southeast Regional Study	IDA, UNDP	2.20	0.13	2.33
5B	Meghna Estuary Study	Netherlands, Denmark	6.18	1.0	7.18
6	Northeast Regional Study	Canada	13.25	0.03	13.28
7	Cyclone Protection Project	EC	1.52		1.52
8A	Greater Dhaka Protection Project	Japan	2.97	0.21	3.18

FAP #	Name of Component	Donor	Amount of Funds Committed (millions of U.S. dollars)		
	MAIN COMPONENTS		Tech Asst	BDG	Total
8B	Dhaka Integrated Town Prot. Project	ADB, Finland	0.57	0.06	0.63
9A	Six Secondary Towns Prot. Project	ADB	0.55	0.06	0.61
9B	Meghna Left Bank Protection Project	IDA	0.81		0.81
10	Flood Forecasting and Early Warning	UNDP, Japan, ADB	5.90	1.82	7.72
11	Disaster Preparedness Program	UNDP	1.1		1.1
	SUPPORTING STUDIES				
12	FCDI/Agricultural Review	UK, Japan	1.60	0.33	1.63
13	Operation and Maintenance Study, Phase I	UK, Japan	0.49	0.03	0.52
14	Flood Response Study	USA	0.92	0.12	1.04
15	Land Acquisition and Resettlement Study	Sweden	0.40	0.03	0.43
16	Environmental Study	USA	4.25	0.21	4.46
17	Fisheries Study and Pilot Project	UK	3.00	0.29	3.29
18	Topographic Mapping	Finland, France, Switzerland	5.33	3.20	8.53

FAP #	Name of Component	Donor	Amount of Funds Committed (millions of U.S. dollars)		
	MAIN COMPONENTS		Tech Asst	BDG	Total
19	Geographical Information System (GIS)	USA	4.62	0.28	4.90
20	Compartmentalization Pilot Project	Germany, Netherlands	9.44	2.00	11.44
21/ 22	Bank Protection, River Training, Active Flood Plain Management Project	Germany, France	41.18	0.86	42.04
23	Flood Proofing Pilot Project	USA	0.26	0.01	0.27
24	River Survey Programme	EC	10.42	1.33	11.75
25	Flood Modelling/Management Project	Denmark, France, Holland, UK	2.58	0.16	2.74
26	Institutional Development Programme	UNDP, France	5.82	1.47	7.29
	OTHERS				
	Guidelines for Project Assessment				
	Macroeconomic Study				
	Guidelines for People's Participation				

Source: Hughes et al., 1994. Updated from FPCO periodic reports, summer 1994.

Annex B

PROPOSAL FOR BANGLADESH INSTITUTE OF NATURAL RESOURCES MANAGEMENT

The Bangladesh Government, Bangladeshi NGOs, and external donors and consultants who have participated in the FAP, and before that in the MPO/NWP, should consider establishing a center, which could be called the Bangladesh Institute of Natural Resources Management, or BINRM, in Dhaka.

In the first instance, BINRM would be a library for the final reports and working drafts and papers of all the FAP studies. It would also assemble all related historical documents, such as the World Bank's Land and Water Study of 1972, the NWP, and newspaper coverage over the years, and as much literature as feasible on kindred problems and efforts in other countries, for example, water management in Egypt and in other parts of the subcontinent. The library would be professionally staffed and would be "active" rather than a passive depository. It would be equipped with modern electronic facilities for communication abroad, and could perhaps provide borrowers with materials in diskette or photocopy form, rather than in the traditional form of circulating printed originals.

Emulating the successful aspects of BARC, SPARSSO, and BIDS, the new BINRM would have a small permanent research staff and a larger number of part-time external associates doing studies in hydrology, geology, meteorology, economics, sociology, zoology, land use analysis, botany/biology, environmental analysis, and evaluation. BINRM would have the capacity to finance the establishment of automated data-gathering systems, such as weather recorders and water level measuring devices, as well as office/library analytical research.

Both the permanent staff and the external associates would be recruited from local and foreign professionals under the concept of BINRM as a center of excellence. There could well be a planned path of 15 years or so to develop additional Bangladeshi professional staff. Liaison with Bangladeshi professionals living abroad would be very valuable.

BINRM would serve as a training facility in land and water planning and environmental analysis, offering instruction or preparing teaching materials for both officials and private individuals. It could develop programs for radio and television and the public school system to reach a wide public, and offer the national university system its support for both research and teaching. BINRM would stimulate the exchange of information through working relationships with: MOWR, the Planning Commission and Planning Ministry, Department of the Environment, Roads and Highways, Public Health Engineering, Local Government Engineering, and the WASAs; the university and school systems, BIDS, BCAS, BUP, BARC, and the NGOs; and overseas professional and learned societies.

BINRM would publish works in its field, both in journal and book form, receive visiting professors and experts, and send Bangladeshis abroad for short- and long-term exchanges or training.

BINRM would be the national base for mapping and GIS work, would maintain a map production facility, operating under rules appropriate to maximizing productivity, and would maintain links with SPARSSO and the Survey of Bangladesh.

BINRM's budget could come from an endowment fund, like that of BIDS, or from one or several donors who recognized its utility for the development of the country. It could receive ad hoc grants for specific tasks, or be paid a consulting fee, particularly for some GIS work.

If BINRM is funded by several donors, it would be necessary to have one managing sponsor who would arrange for the contributions in counterpart taka and in foreign exchange and would be responsible for the stability of support for the first 10 years or so. This manager could be a foundation, such as the Ford Foundation or the Asia Foundation, which have offices in Dhaka, or the Rockefeller Foundation, which has highly relevant CGIAR experience. Alternatively, one donor with a dominant interest could act as the managing partner of a consortium of donors. BINRM would have a board of both Bangladeshi and foreign directors, who would hire the executive director, the administrative officer, and other senior staff.

Annex C

RESUME OF SUGGESTIONS IN TEXT

Floodproofing:

1. The CARE/LGED pilot flood proofing projects should be funded and go forward and receive a maximum of publicity and exposure, so that they can be evaluated and emulated to the greatest degree possible by localities, and so that appropriate flood proofing measures will attract support and promotion by all agencies involved with development activities.

Agriculture:

2. In light of the important implications of rice production for agricultural and economic growth, rural employment, and reduced rates of rural-urban migration, a team of experts in international rice marketing should assist the BDG in exploring the potential for rice exports.

3. To protect fish life, Bangladesh should be helped to assess and implement integrated pest-management systems and, as needed, to gain access to less harmful biodegradable pesticides such as those used in the United States.

4. The damage to fish breeding cycles from generalized reduction of water on the floodplain due to dry season use of beel and haor surface water by low-lift pump (LLP) irrigation, and to a lesser extent, due to groundwater use, is a difficult problem that requires study, and probably remedial measures.

5. Poor drainage may damage the aman crop as much as floods do. A short-term study of drainage problems, leading to corrective policy suggestions, should be commissioned and could perhaps be attempted by the GIS/flood modeling groups (FAPs 19 and 25) as an innovative challenge to their techniques.

6. Gains in yield can be achieved at little cost by a better balance of fertilizers. Extension efforts should continue to concentrate on demonstrating the difference between N, P, and K and the complementary relationship among them. The price of N, produced in the country, could be increased to offset the import costs of P and K, or a balanced fertilizer could be sold in pre-mixed form to suit local needs.

7. A special study of long-term agricultural strategy, with particular attention to the merits of concentrating on rice versus crop diversification, both for home consumption and for export, would be valuable.

Regional Relationships:

8. With due regard for the strong emotions involved, the BDG could be advised that its case on water sharing with India would be strengthened by detailed study and documentation of the effects of Indian restrictions on the crossborder flows of the Ganges and the Teesta. For example, a comparative analysis of the impact of India's upstream offtakes and Farakka diversions and the regular tendency of the Ganges to move north and east would be useful. To be defensible, it would have to be performed over several years and by an independent body with the requisite expertise, probably an international organization rather than another government.

9. The Ford Foundation, which has offices in Dhaka, Kathmandu, and New Delhi, is encouraging a slow but steady effort on regional water management and development among private study institutions in Bangladesh, Nepal, and India. A valid goal would be a single independent international institute to gather data and lay the technical groundwork for basinwide cooperation.

10. The Ganges-Brahmaputra-Meghna basins, with their several nation-states and states of India, are a major region of poverty in south Asia and the world, marked by low per capita productivity and a population approaching 500 million. The World Bank, in collaboration with the governments of India, Nepal, and Bangladesh, could profitably organize a multidisciplinary conference to consider this troubling situation.