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**GOVERNMENT OF PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF WATER RESOURCES**

(13)

BANGLADESH WATER AND FLOOD MANAGEMENT STRATEGY

**FLOOD PLAN COORDINATION ORGANIZATION
Dhaka September 1995**





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PRIME MINISTER
THE PEOPLE'S REPUBLIC OF BANGLADESH

22 November 1995

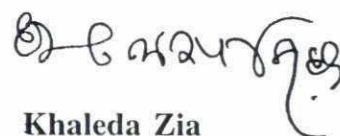
MESSAGE

The annual cycle of water from over-abundance to scarcity is a fact of life in Bangladesh. While much of our life and living have emanated from the water upon and beneath the surface of this earth, the mighty rivers along with their tributaries and distributaries hold our tradition and culture in an unflinching bond.

The acts of Nature by themselves alone have become untenable today when additional food and living space are needed for an increasing population. Moreover, the problem of scarcity has been further compounded by human interventions beyond our borders. Perhaps, nowhere else in the world does water pose such challenge and at the same time offer such potential for development as it does in this riverine delta. It is thus imperative that this resource be developed and harnessed to its optimum for our very survival as a vibrant society in the 21st century.

The report on Water and Flood Management Strategy provides a sense of direction for the integrated development and management of this precious resource, keeping in view the needs of all with emphasis on poverty alleviation, environment and, above all, people's participation at all stages of development which has been the avowed policy of our Government. Only this way, can development be pursued in harmony avoiding unfair competition and conflicts among various water users.

I sincerely hope, pursuit of the suggested strategy will bring about the desired growth and economic emancipation of the people, especially the vast under-privileged rural populace.


Khaleda Zia



Minister

Ministry of Water Resources,
Government of the People's Republic of Bangladesh
Dhaka.

Major General M. Majid-ul Haq (Retd.),


Message from
The Hon'ble Minister, Water Resources

The people, good soil and water are the most important resources of Bangladesh. Our economy is dominated by agriculture which in turn is critically dependent upon occurrence of water. Apart from agriculture, water is also vitally required for pisciculture, for inland navigation, for domestic and industrial usage and most importantly for sustenance of and maintaining the fragile ecology of our riverine delta.

Due to our geographical location, occurrence of water is erratic. We get much more than required in one season which totally disrupts normal life and far less than required in another season restricting water related activities severely. The problem of scarcity has been further aggravated by unilateral upstream withdrawal of river water beyond the borders resulting in severe degradation of life and living. It is, therefore, imperative that water must be managed and utilized prudently to the best advantage.

The report on Water and Flood Management Strategy is the outcome of a five year study initiated in the aftermath of the catastrophic flood of 1988 in order to find a sustainable long-term solution to this recurrent menace of flooding. I am happy, the study wisely widened its horizon from the narrow focus on flood alone to year-round water management. The report sets the stage for high priority interventions and careful planning aimed at optimum utilization of every drop of our water resources to meet the needs of all competing subsectors. Beside its comprehensive nature the study emphasizes and introduces stakeholders' active participation which holds the key to success of all development efforts.

Hopefully, our professionals will now be able to embark upon the formulation of a comprehensive National Water Plan and subsequently a National Water Policy guided by the management Strategy.


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**GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF WATER RESOURCES**

BANGLADESH WATER AND FLOOD MANAGEMENT STRATEGY



**FLOOD PLAN COORDINATION ORGANIZATION
Dhaka September 1995**

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GLOSSARY

AFPM	Active Flood Plain Management
BADC	Bangladesh Agriculture Development Corporation
BBS	Bangladesh Bureau of Statistics
BRE	Brahmaputra Right Embankment
BIWTA	Bangladesh Inland Water Transport Authority
BMD	Bangladesh Meteorological Department
BWDB	Bangladesh Water Development Board
CIP	Chandpur Irrigation Project
DAE	Department of Agricultural Extension
DOF	Department of Fisheries
DND	Dhaka Narayanganj Demra
District	The country has been divided into few districts for civil administration
DMB	Disaster Management Bureau
DPHE	Department of Public Health Engineering
EIA	Environmental Impact Assessment
EIP	Early Implementation Project
EIRR	Economic Internal Rate of Return
FAP	Flood Action Plan
FCD	Flood Control and Drainage
FCDI	Flood Control, Drainage and Irrigation
FPCO	Flood Plan Coordination Organization
FMD/I	Flood Management, Drainage, Irrigation
GDP	Gross Domestic Product
GK	Ganges Kobadak Project
GIS	Geographic Information System
GOB	Government of Bangladesh
GPP	Guidelines for People's Participation
LGED	Local Government Engineering Department
LB	Left Bank
M&E	Monitoring and Evaluation
MPO	Master Plan Organization
MOA	Ministry of Agriculture
MOEF	Ministry of Environment and Forest
MOFL	Ministry of Fisheries and Livestock
MWR	Ministry of Water Resources
NEMAP	National Environment Management Action Plan
NGO	Non-Government Organization
NPV	Net Present Value
NWP	National Water Plan
NWMP	National Water Management Plan
O&M	Operation and Maintenance
POE	Panel of Experts
RAJUK	Rajdhani Unnayan Kartipakha
REMC	Regional Environment Management, Research and Education Centre
RRI	River Research Institute
RB	Right Bank
SOB	Survey of Bangladesh
SRP	System Rehabilitation Project
SWMC	Surface Water Modelling Centre
Thana	A subdivision of a district
UNDP	United Nations Development Programme
WARPO	Water Resources Planning Organization
WASA	Water and Sewerage Authority

SYNOPSIS

This report presents a framework for the development and implementation of a strategic national water management plan for Bangladesh. It builds on the extensive programme of work undertaken under the Flood Action Plan (1990-94) and the earlier National Water Plan, Phases I and II. It recommends a five-year programme involving (a) preparation of a national water management plan, (b) strengthening of water sector organizations responsible for planning, construction, operation and maintenance, and (c) implementation of a compact portfolio of high priority projects.

The report is divided into four chapters. Chapter 1 presents an overview of water resource planning in Bangladesh, summarizes the work undertaken under the two phases of the National Water Plan (NWP) and details the evolution of the Flood Action Plan (FAP) and the accomplishments of its 26 planning and supporting studies. Chapter 2 discusses the key issues and options for development and management of water resources in Bangladesh and focuses on key issues (e.g., people's participation; social and environmental assessment) and options that need to be taken into account in water sector planning. Chapter 3 presents short- and long-term strategies for water resource and flood management, and Chapter 4 presents a development programme for the next five years (1995-2000), within the context of likely longer-term activities in the sector.

The three main water resource development options open to the Government of Bangladesh are:

- (a) **minimum intervention:** strengthening the capacity for flood forecasting and disaster management, and improving the operation and maintenance of existing projects, but leaving water sector development to the private sector (e.g., minor irrigation and water supply);
- (b) **selective intervention:** in addition to (a), protecting densely populated urban areas and key infrastructure from floods and erosion, ensuring water supply and providing flood proofing for vulnerable rural communities, possibly with development of water and flood management projects to enhance agriculture and fisheries; and
- (c) **major intervention:** in addition to (a) and (b), implementing large-scale measures such as embankments and river engineering works to prevent flooding and erosion by major rivers, and multi-purpose barrages on the main rivers.

Options (a) and (b) are both feasible and probably affordable in the short- to medium-term, though their successful implementation would require substantial institutional reform of planning and implementing agencies. Option (c) may be a long-term possibility, if the macroeconomic, environmental and other issues could be satisfactorily addressed.

The recommended development programme to the year 2000 would involve:

- **Formulation of a strategic national water management plan** for the first twenty-five years of the next century, which will identify an investment programme that balances the conflicting demands of different water users (e.g., wet and dry season agriculture, fisheries, water transport, water supply, salinity control). Planning criteria and guidelines would be developed to ensure that all programmes and projects are developed with full participation of local communities, and are technically, economically, socially, environmentally, and institutionally sound.
- **Institutional strengthening of water sector organizations**, involving reorganization and strengthening of planning organizations (FPCO, WARPO), enhancing the capacity of the main agencies responsible for designing, constructing, operating and maintaining projects (BWDB, LGED, WASA, DPHE, BIWTA, MOA/BADC, R&H, Railway, DOF, local councils, and increasingly the private sector); and facilitating inter-ministerial and inter-sectoral coordination and cooperation. Emphasis would be given to training and human resource development, upgrading of inter-disciplinary planning and technical skills in key areas, and institutional reforms.
- **Implementation of a portfolio of priority projects** designed to protect from flooding over 10 million people living in urban, coastal and some riverine areas; protect vulnerable industrial areas in Dhaka and other cities and towns; improve flood preparedness and flood proofing, especially for people living in unprotected areas, enhance agricultural and fisheries production in some areas, and implement environmental management plans.

1. WATER RESOURCE PLANNING

INTRODUCTION

The people of Bangladesh have for centuries adjusted their way of life to normal flooding. In most years, measures such as raising homesteads above normal flood level and adjustments in farming systems, can mitigate flood damage. But, with the increase of population, growth of infrastructure and other economic development, the intensity of flood damage has increased. Every few years, catastrophic floods cause enormous damage and loss of life. The severe floods in 1987 and 1988 killed about 1,500 people and caused damage to crops, infrastructure, schools and houses, estimated at about \$2 billion, and severely disrupted the economy, reducing potential GDP by about 4 per cent. The nature of flooding varies between different regions (see Box 1). Periodic droughts also cause severe crop losses and hardship to farmers and labourers. Besides, progressive reduction of dry season flows of transboundary rivers like the Ganges, the Teesta and many others due to increasing upstream withdrawal across the borders is causing severe strain on the agro-economic condition and the overall eco-system in large areas of the country.

The purpose of this report, which builds on the earlier FPCO reports, is to present a strategic framework for the development and implementation of a national water management system for Bangladesh. The strategic framework is based on GOB's water sector goals, examination of past experience and critical review of the issues and options for water resource development in the future.

HISTORICAL PERSPECTIVE

National water planning in Bangladesh dates from the 1960s. The predecessor of the present Bangladesh Water Development Board (BWDB) prepared in 1964 a Master Plan comprising 58 large-scale projects for flood control, drainage and/or irrigation projects. Many of these projects were implemented between the mid-1960s and late-1980s. These projects were mostly justified in terms of increased crop production and did not fully take account of the potential impacts on fisheries, navigation, forests, domestic and industrial water supply, biodiversity and salinity management.

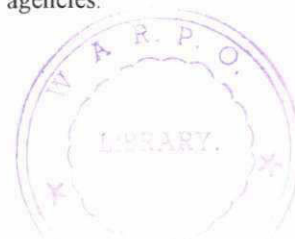
The World Bank's 1972 Land and Water Sector Study advocated smaller-scale development, especially minor irrigation. Through the 1970s and 1980s, small-scale irrigation spread rapidly, initially under government agencies and later through the private sector. By the early-1980s, however, the need for a long-term water resources development plan became apparent and the

Master Planning Organization (MPO) was established in the Ministry of Irrigation, Water Development and Flood Control. The MPO produced the National Water Plan (NWP) - Phase I in 1986, focusing on the assessment of water resources and future demand by different users. Phase II of the plan was completed in 1991. The NWP assembled a substantial amount of information, developed a range of planning models and analytical tools, and recommended strategies and programmes, many of which were adopted by the government and endorsed by donors. The MPO also prepared a draft water code and made other proposals to institutionalize the process of water planning and long-term water resource management.

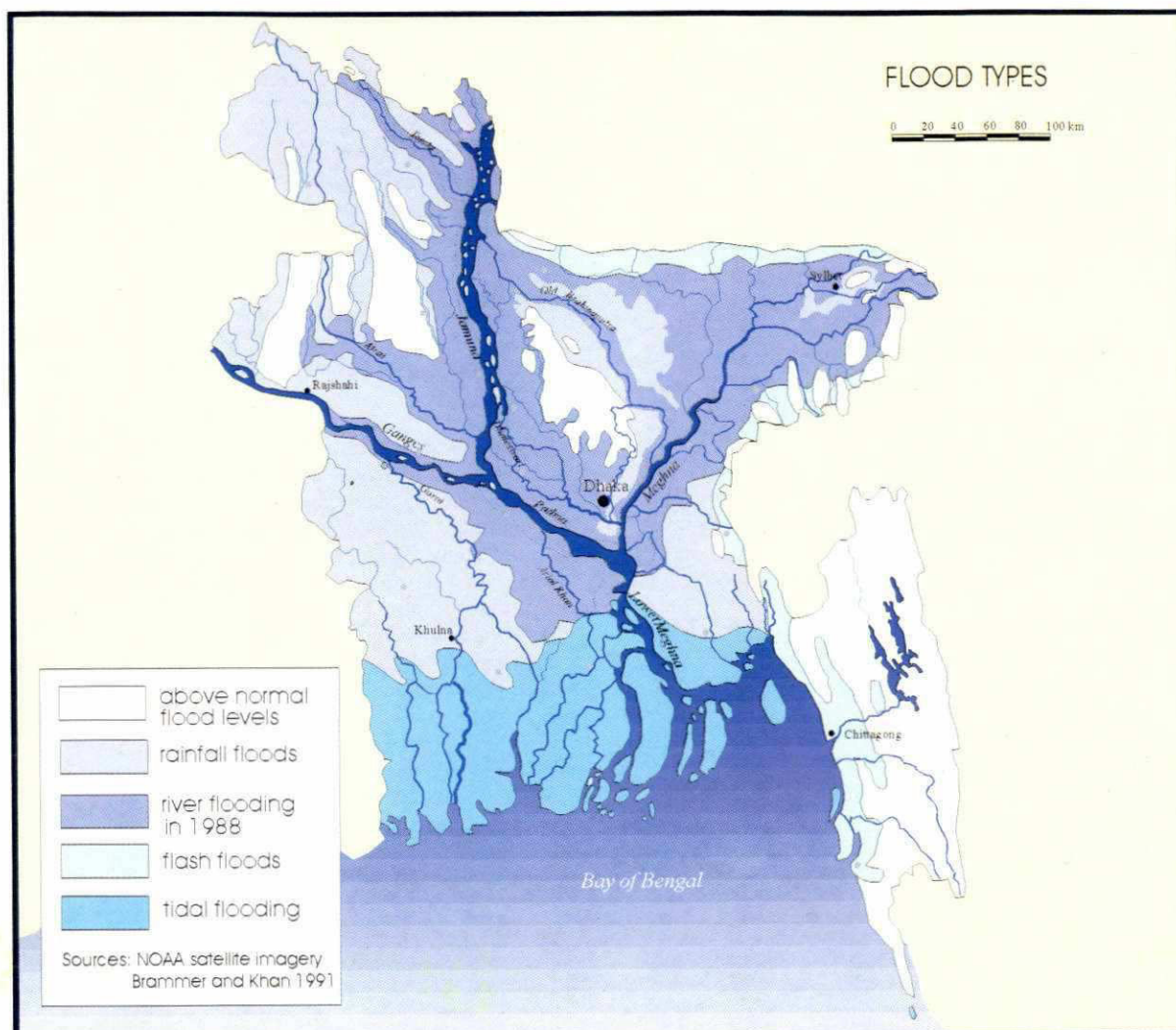
Despite these achievements, the MPO reports fell short of a comprehensive national water plan. First, its perspective to the year 2010 was inadequate for evaluating large-scale programmes, impacts and requirements. Second, it failed to evaluate properly and integrate a number of major projects and programmes within the sector. Third, programmes in other ministries (fisheries, navigation, public health, industries, municipalities, etc.) were inadequately addressed, and their requirements taken as constraints rather than incorporated within an overall water sector demand position. Fourth, in the absence of agreements on international rivers, the plan dealt only tangentially with the different water supply scenarios. Other planning exercises (on international waters, flood control by other agencies) have also taken place independently of NWP, with similar lack of strategic focus on the needs of the entire sector. There is also a real danger that the substantial data gathering and analytical achievement of the NWP will be at least partially lost if they are not followed up and supported on a permanent basis.

MPO was renamed as the Water Resources Planning Organization (WARPO) in 1991. Its objectives are to upgrade the National Water Plan with an intersectoral focus and an interdisciplinary approach, particularly emphasizing environmental issues. One of its main mandates is to evolve national policies and strategies for utilization and conservation of water resources.

The work of the organization has, however, been impeded by budgetary constraints. Besides, staffed mostly by BWDB engineering professionals, it needs to be balanced by the appointment of economists, social scientists and environmentalists. This multi-disciplinary structure is particularly important if the organization is to interface effectively with other agencies.



Box 1: Nature of Flooding in Bangladesh



Flash Flood: In the north-eastern region, the main problem is flash flooding during the pre-monsoon months which causes damage to dry-season boro rice and also to towns and other infrastructure.

River Flood: In the middle of the country, a broad strip of land is flooded by bank overflow from the main rivers - Jamuna, Ganges, Padma, and Meghna, and their tributaries and distributaries. Heavy rains also cause flooding, as drainage is impeded by high stages in the main rivers.

Tidal Flood: The coastal areas suffer from tidal and storm surges that lead to loss of life. Siltation in the tidal channels block drainage, adding to the problem.

Besides flooding and inadequate drainage, river bank erosion is another major problem that renders thousand of families homeless and landless.

The Flood Action Plan

Following the severe floods in 1987 and 1988, a number of studies was undertaken (in addition to GOB's own report) supported by funds from UNDP, French, Japanese and US Governments. It became evident from these studies that critical information on technical, socio-economic and environmental factors, needed for deciding between different alternatives, was lacking. In June 1989, the Government requested the World Bank to coordinate the various efforts, and to prepare a programme of studies and pilot projects to get a better understanding of the flood problems. This approach was endorsed by the G-7 summit in Paris in July 1989. A proposal to prepare the Flood Action Plan (FAP), involving a set of 26 studies and pilot projects, was endorsed at a meeting convened by the World Bank in London in December 1989.

The Government set up the Flood Plan Coordination Organization (FPCO) in 1990 to supervise, coordinate and monitor FAP activities, aided by a Panel of Experts (POE) and specialists. The Government also set up mechanism for the technical review and approval of FAP project proposals and reports. Terms of reference for the 26 FAP components and studies were drafted by FPCO, using multidisciplinary teams of government officials and relevant donor representatives, and were reviewed by the Technical Committee for approval of GOB (see Box 2).

Inception, interim and final reports of each study and pilot project were submitted to FPCO. FPCO and POE reviewed these reports before final versions were forwarded with recommendations to the Technical Committee. FPCO produced quarterly reports to inform the Government and donors of progress. Three international review conferences were held in Dhaka in 1990, 1992 & 1993 (following a number of district and local level meetings during the preparation of different FAP reports), and a draft final report on the first 5-year phase of FAP activities was presented and extensively reviewed, nationally and internationally in 1994.

CURRENT STATUS

The NWP

The National Water Plan was completed in two phases, the last in 1991. One of the objectives of the second phase, which started in 1988, was to develop planning methodology and guidelines for selection of priority projects, and to prepare a comprehensive list of water projects and assess their economic viability and priorities. As noted earlier, the plan prepared by MPO fell short of a comprehensive water plan and no further work was done since 1991. The data collected to assess environmental viability and impacts are, however, inadequate and further studies are needed.

The FAP

Most of the original programme of studies under FAP has been completed (Figure 1). The regional studies identified and evaluated projects at pre-feasibility level, and possible flood mitigation projects have been identified within a regional context. A few priority projects, such as the protection of Dhaka city and a number of secondary towns, erosion protection on the Brahmaputra right bank and the rehabilitation of the coastal embankment, are either underway or ready to commence.

Work still remains to be done on a number of important long-term studies and pilot projects, including the compartmentalization pilot project (FAP20), bank protection (FAP 21), river training and active floodplain management project (FAP22), GIS (FAP19), and river surveys (FAP24). A number of additional follow-up studies are about to begin, such as the Chittagong Coastal Area, Meghna Estuary studies, Morphological Impact Assessment Study on Major Rivers, and follow-up studies of the second phase of the O & M study and a fisheries pilot project, flood forecasting, and environmental and participatory planning for the Jamalpur Priority Project. Follow-up pilot flood proofing projects are being taken up by NGOs, and discussions are in progress regarding the continuation of the environmental, and Geographical Information System (GIS) studies. Completion of these pilot projects and supporting studies is necessary to provide essential data and criteria for future water resource development.

2. DEVELOPMENT AND MANAGEMENT OF WATER RESOURCES IN BANGLADESH: ISSUES AND OPTIONS

ISSUES

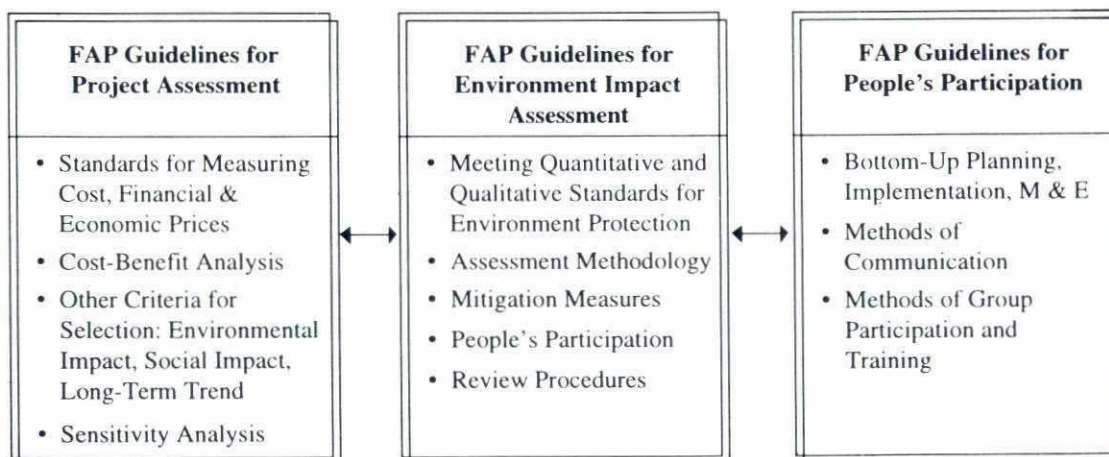
A broad based National Water Management Plan (NWMP) will be guided by the goals and objectives of the National Water Policy, which is yet to be formulated. The water management plan will cover many more aspects than just the issue of flooding. It will have to examine the supply of water in the context of international rivers and groundwater, and the demand from irrigation, fisheries, navigation, drinking and municipal needs, and other important areas. Drought mitigation and water quality regulations will also be very important aspects of this plan.

Box 2 : FAP Evolution and Major Issues

The FAP started with 11 main components and 15 supporting studies and pilot projects. The main components were made up of several regional and urban planning studies, feasibility studies for projects, and special programmes on flood forecasting, early warning, and flood preparedness. The supporting studies were intended to provide the planning principles, criteria and data inputs for the planning studies. These studies indicated the structural and non-structural measures needed to minimize the impact of flood damage. The key structural measures suggested by the five regional studies included (i) in the N.W., sealing of the BRE, Green River intervention in the Lower Atrai River and Teesta Right Bank Protection; (ii) in the N.C., Jamalpur Project; (iii) in the S.W., Gorai Augmentation and small FCDI projects; (iv) in the S.E., Noakhali North Drainage and Gumti Phase-II projects; (v) and in the N.E., forty-four different projects. The major non-structural measures suggested included programmes to mitigate loss of capture fisheries, mitigate health hazards, improve navigation, etc.

During its five years, the FAP evolved from its original focus on physical control interventions to a more comprehensive approach towards water management. Amongst its considerable achievements have been the formulation of standard guidelines for project assessment, participatory planning and environmental impact assessment (see Figure below). A manual for EIA was also prepared. National and international workshops, attended by experts within and outside Bangladesh, academics, NGOs and donors were held. Despite these achievements there are still areas that need strengthening, for example:

- o considerable strengthening and restructuring of FPCO, WARPO and BWDB and improvements in their links to other government agencies will be required before any substantial water development programmes can be contemplated. Future institution building would also require a clear perspective of the role of the private sector. The necessary legal and regulatory environment for inducing private investment in water resource development will have to be ensured;
- o further development and testing FAP's participatory approaches to planning, implementation, O&M, and evaluation are needed;
- o proper emphasis on poverty, employment, resettlement, gender bias, etc. has to be placed for socially acceptable development;
- o the guidelines for environmental impact assessment and research and training programmes, carried out under FAP, need to be built on and expanded in a more decentralized, regional programme for sustainable development; and
- o the different FAP regional and associated project planning studies will have to be brought together into an overall national water management plan.



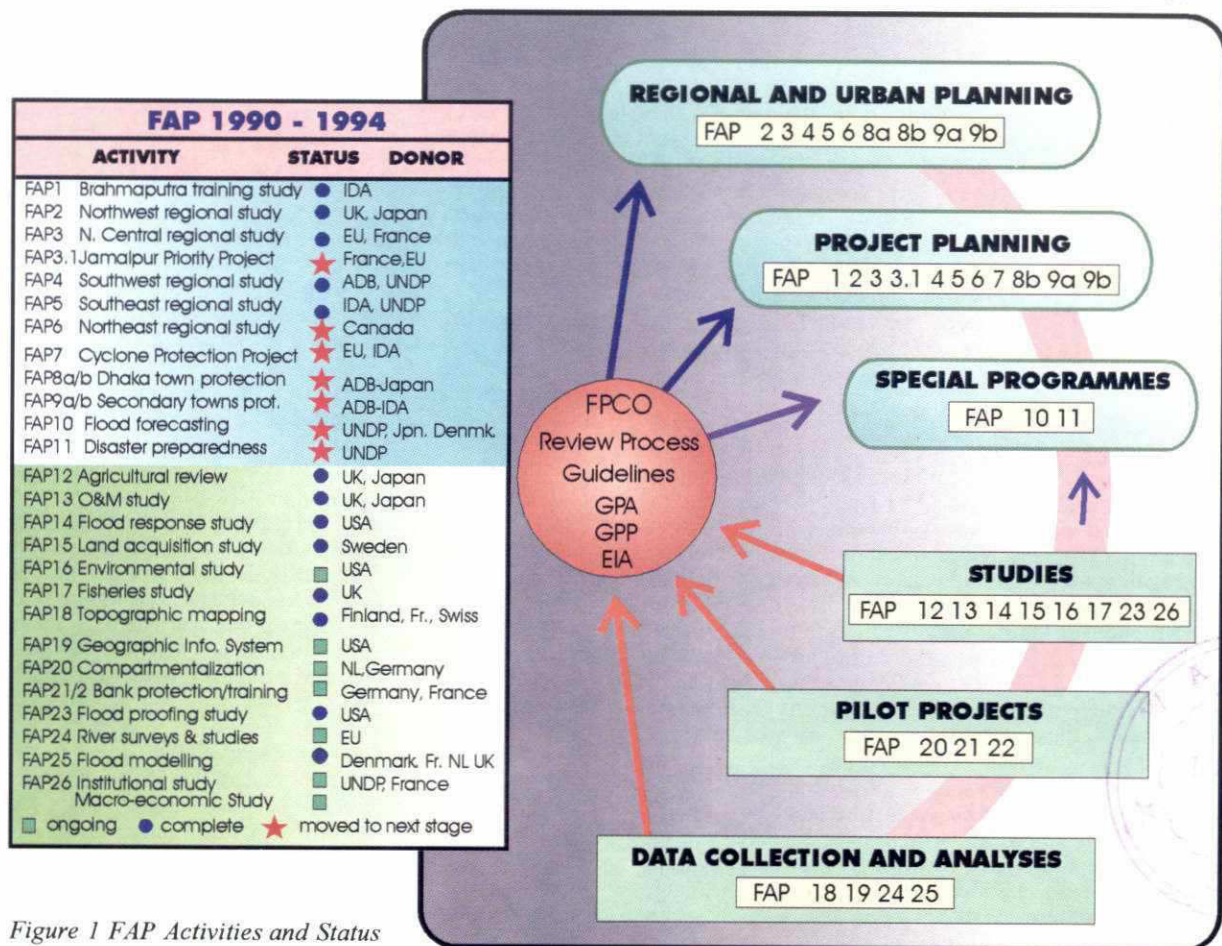


Figure 1 FAP Activities and Status

The major issues in the formulation of macro water plan are:

A. Establishment of Goals and Objectives of Water Resource Management

Many countries in Asia, like India and Thailand, have published statements on national water policy. Others, like China, Philippines and Indonesia, have embedded water policies in legal codes. Bangladesh does not have an approved national water policy, although NWP did prepare a comprehensive set of water sector policies. There have been several attempts to articulate goals and objectives to guide long-term water resource development and management. The 1986 and 1991 National Water Plans set their goals to maximize foodgrain production and to maintain adequate supplies for potable and industrial water needs, navigation, fisheries and salinity management. The previous national water plans, however, have been limited in their scope.

The FAP started in 1990 with the basic objective of minimizing flood damage to life and livelihood, to increase monsoon crop through control of flood water thus providing greater flexibility for crop diversification in the dry season, and to meet the basic water needs of fisheries, navigation and public health. However, flood control was the dominating theme in its eleven guiding principles. This changed over the years, as awareness about environmental issues became more pronounced through studies under FAP and NEMAP. Consequently, a reformulation of the national water planning

goals and objectives has now become necessary to guide future planning efforts and to produce an integrated national water plan.

B. Water Management and Development Issues

Bangladesh's problems as a Lower Riparian in the River Basins: As the lower riparian of the Ganges, Brahmaputra River and Meghna rivers, Bangladesh occupies only about eight percent of the total area of the three basins but is located at the point of concentration for monsoon floods generated by runoff from the Himalayas. Continued development of upstream basins will increase the disadvantages of being the lower riparian and floods are likely to increase because of deforestation of the Himalayas as well as land degradation and erosion. On the other hand, during the October-May lean period Bangladesh receives only the residual flow after diversion and upstream use. Reduction of dry season flows in Bangladesh due to increasing upstream withdrawal is causing severe water shortage across the country and in the south west region in particular, reduced streamflow is also aggravating saline intrusion. If appropriate measures are not taken urgently to restore Bangladesh's rightful share of the Ganges, it may face further morphological and environmental hazards. Similar diversion of water in Meghna at the Barak dam could have effects on the eastern region, including on poor occupational groups such as fishermen. Efficient water and flood management and assured shares of the dry season flows of the trans-boundary rivers have, therefore, become imperative for the survival of Bangladesh.

Flood and Cyclone Hazards: During the June-September monsoon, Bangladesh receives about 80 percent of annual precipitation, averaging 2300 mm, but varying from as little as 1200 mm in the west to over 5000 mm in the east. Runoff from adjacent riparian is generated by rainfall which averages 5000 mm over the Himalayas, and exceeds 10,000 mm over the Meghalaya plateau north of Sylhet. Together inflows and rainfall cause peak floods in the Ganges, Brahmaputra and Meghna rivers in the period July-August, and on average 22 percent of the country is flooded annually. In the eastern regions flash floods from the surrounding hills are a hazard in the early summer and cause extensive damage at the time of harvesting the winter boro rice crop. In coastal areas, tidal floods and cyclonic surges cause serious problems.

Design Implications of Flood Frequency. When the peak flows of the Ganges and Brahmaputra coincide, as they did in 1988, almost 60 percent of the country is inundated. In terms of frequency, the areal extent of 1987 flood was an event to be expected about once in every decade, while the 1988 floods could be expected about once in every 100 years. Protecting against a one hundred year event requires very high capital and O&M expenditures, and its payoff is debatable. In addition, structural solutions take 5-15 years to implement, and temporary non-structural flood proofing are needed as an interim measure. Guidelines, indicating the levels of protection for vital infrastructure, and property and people living in major cities, regional towns, villages and for agriculture are also needed. These levels may vary for different subsectors, depending upon their needs and socially acceptable priority. For example, agriculture may only justify low levels of protection, in which case, in addition to structural flood protection, flood proofing and other mitigation measures would need to be identified for protecting villages, towns and infrastructure.

Drought: Drought is also a problem in Bangladesh, particularly in the North-Western regions during the spring where there are few surface water resources, and agricultural production is heavily reliant on groundwater resources. However, drought is not only confined to the dry season but also scanty rainfall during the monsoon, as happened in 1994, severely affects floodplain fisheries and late monsoon aman rice. Groundwater recharge for the following dry season is also adversely affected. The National Water Management Plan has to address and balance the conflicting needs of too much water in the monsoon and too little in the dry season which would need tapping the resources of both surface and ground water.

Erosion and Sedimentation: River bank and island erosion is also a major issue, and is probably the most important natural cause of landlessness and forced resettlement. FAP 3.1 and FAP 16 studies show that the completely unprotected active floodplains of the Jamuna, Ganges, Padma and Meghna are inhabited by 4.3 million people, of whom 2.2 million live on charland. Erosion caused displacement of more than 728,000 people over the period 1981-93, and in the same period 462,000 permanently emigrated from the high erosion risk areas. Sedimentation, in general is a blessing for a deltaic country like Bangladesh, but at times it becomes a hazard by reducing navigability and by blocking offtakes from main rivers (such as the Gorai). Coarse sediment deposit may

affect soil fertility and other ecosystem. Fine sediment deposit may improve soil fertility, but have adverse effect on fisheries, flora and fauna. Therefore, a thorough study is needed to improve the understanding of the effects of sedimentation.

Feasible interventions in the short- and long-term. Given the high cost and long gestation period of public sector projects, a very important aspect of the national water management plan will be to balance long-term seasonal water availability/excess against various water demand scenarios from all users including quantities required for environmental management and to determine the types and extent of large scale interventions required, and the policies needed to stimulate efficient water use by both public and private sectors.

Operation and Maintenance: Operation and maintenance (O&M) of public sector water projects is a chronic problem. This has been extensively studied, most recently under FAP 12/13, and FAP 26. The problems identified were (a) project formulation, design and O&M do not include stakeholders and project beneficiaries, (b) many projects are partially completed before funds run out, indicating serious design, land acquisition or supervision problems, and (c) insufficient funding.

A major issue is that projects are often approved for construction without the essential O&M budget. The collection of user fees is also poor. The Systems Rehabilitation Project (SRP) for flood control, drainage and irrigation has had some success, on a pilot basis, in collecting water charges in the Chandpur, Karnaphuli and Muhuri surface water irrigation projects where the benefits are obvious to farmers. In contrast, collection has been poor in the G.K. Project because of uncertainty of water supply. Benefits of Flood Control and Drainage projects are more difficult to assess as they vary across the protected areas. Application of uniform rates is also inequitable. The compartmentalization pilot project (FAP 20) is now testing several new innovative approaches whose results will be known within 2-4 years. The development of an efficient monitoring and evaluation (M&E) system is essential for a good O&M system.

C. Social and Environmental issues

The Government of Bangladesh has given top priority to the alleviation of poverty and to the integration of social and environmental concerns into economic planning, at all levels. The impact of potential water sector projects on poverty and on the environment must be key concerns in developing a national water resource development strategy.

Impact of water resource projects on poverty: A prime objective of water development projects in Bangladesh is to enhance economic growth by increasing production. The main beneficiaries are those who own assets (e.g., farmers, businessmen), although the landless poor may also benefit. The rural and urban poor can benefit from water sector

projects through (i) short-term increases in employment (e.g., in project construction and agriculture) and wages, due to increased local demand for labour; and (ii) medium- and long-term employment increases resulting from forward and backward 'linkages' (e.g., in agro-processing, rickshaw pulling and petty trade) and diversification of rural and urban economies. However, flood protection and flood management projects may also have adverse impacts on specific occupational groups (e.g., fishing and boating households) and on the poor generally by reducing the area of common property resources (e.g., floodplain fisheries).

People's Participation: Flood protection and management projects require the full participation of the affected people taking account of their needs and priorities. Enabling local people and communities to participate in project formulation and planning is a key issue in efficient system management.

The Charland Issue: Over four million inhabitants of the chars in the major rivers including active floodplain (Jamuna, Ganges, Padma and Meghna) comprise one of the most vulnerable groups in Bangladesh. These people suffer from seasonal inundation, which often means that they have to leave their houses and move to safer ground, and suffer severe loss of property in major floods. In addition, over 60,000 people a year are made landless by bank erosion along the main rivers, as about 9000 ha of mainland and 5000 ha of charland are reworked each year by erosion. These high risk areas are remote from government centres and are poorly served by public services.

Land Acquisition and Resettlement Issue: Current procedures for land acquisition in Bangladesh are lengthy, bureaucratic, inefficient, and a main cause of delays in project implementation. Results of the Land Acquisition and Resettlement Study (FAP15) show that people whose land is acquired receive inadequate compensation, are often subject to intimidation and fraud, and may receive their payments after delays of many years.

There is a need to revise the laws and procedures for land acquisition and resettlement to reduce fraud and make the process more streamlined and equitable. Besides streamlining procedures, there is also a need to design projects so that land requirements are kept to the minimum. Since FAP15 was completed in 1992, further lessons have been learned from the experience in implementing the Brahmaputra Right Embankment (FAP1), the Coastal Embankments Rehabilitation (FAP7) and Compartmentalization Pilot Project (FAP20).

Environmental Issues: Bangladesh, with a population of 120 million, is one of the most densely populated areas in the world. Over 75 per cent of the people live in rural areas and are dependent of floodplains and rivers for their livelihoods. The poor in urban areas often live in low-lying areas and may also be adversely affected by high floods and poor drainage.

Flood protection, flood management and flood proofing projects are designed to improve the environment for people by reducing flood damage and enabling more productive use of land and water resources. However, such projects may also

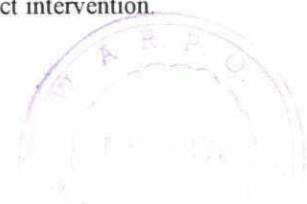
have adverse impacts. Among the most common of these are reductions in capture fisheries. Possible agro-chemical contamination of surface and ground water due to agricultural intensification can be injurious both to humans and fish.

The importance of environment issues was recognized from the outset of the FAP. The FAP16 environment study (i) developed guidelines and a manual for EIA, (ii) undertook research on the impact of flood management projects on soil fertility, vector-borne diseases, fish biodiversity and charland communities, and (iii) trained policy-makers and Department of Environment (DOE) staff in EIA.

Although the regional and other planning studies had to start before the FAP guidelines on EIA were introduced in late 1992, they all carried out environmental assessments, that were reviewed by FPCO and DOE. Some project feasibility studies (e.g., FAP3.1 - Jamalpur Priority Project) were required to undertake additional EIA before completing their environmental management plans. A lesson learned is that thorough EIA for water development projects takes a minimum of 18 months (allowing one full year of fieldwork) and this is now being taken into account in scheduling other FAP feasibility studies.

Navigation: The country is criss-crossed by numerous waterways of various size and capacity. These water courses provide for inland navigation which is yet the cheapest means of transportation, facilitate surface drainage during monsoon, conserve water in dry periods as well as harbour the riverine fish population. Unfortunately, all these activities have been severely disrupted by siltation of the rivers over time. BIWTA carries out dredging on some specified routes to maintain navigability which is meager compared to the need. This issue merits serious consideration, specially because channel improvement for navigability will also expedite surface drainage relieving drainage congestion, promote the fish resources, as well as help push back saline front near estuary. FAP 6 has taken up a pilot dredging scheme on Kalni-Kushiyara in North East region with these ends in view. The canal digging programme of the government is also a part of this important issue. Future water plans would address the issues of navigation, fisheries development, water conservation and drainage in a consolidated and cost-effective manner.

Fisheries: Fisheries is one of the most controversial aspects of modifications to annual flooding of the floodplain. Open flood plain capture fisheries are a common pool resource and an important source of nutrition for the very poor (providing on an average about 80 percent of animal protein). Fish migrate along the rivers and during the annual floods disperse across the floodplain to feed and breed. Embankments, constructed for roads or flood control, prevent the movement to the floodplain, which results in a reduction of catch, a decrease in biodiversity and increase the risk of disease. FAP 17 study of several FCD projects has shown contrasting impacts on fisheries, some positive and some negative, and their findings highlight how little is known about the floodplain fisheries ecosystem in Bangladesh. Unless more is known, caution must be exercised in planning and implementing new flood control and drainage projects. Economic studies by FAP 12 of existing FCD projects show that project benefits are sensitive to fisheries losses caused by project intervention.



D. Institutional Issues

Institutional arrangements for developing and managing water resources are the critical link between policy objectives and field-level performance. Institutional frameworks are established by legislation that provides basic operative norms, and its various elements (customs, laws, regulations, organizations) are closely interdependent. Deficiencies frequently arise from inconsistencies between them. Institutional deficiencies can take many forms, such as lack of effective linkages among various agencies, lack of staff training and incentives, absence of legislative procedures for implementing specific tasks, etc. Institutional changes may be made incrementally, but they must be made in the context of the entire water resources sector. The three primary areas of government institutional involvement are legislation, regulation and operation.

Water legislation has two basic functions:

- (i) conferring necessary powers over water and land on the government, while preserving or granting such rights to individual users as are consistent with the goals of the country; and
- (ii) establishing a basic administrative framework and necessary institutions to execute the various functions assigned.

The regulatory area comprises the enforcement and monitoring of established laws, agreements, rules, regulations, and standards. Typically, this includes water and land-use rights, water quality, pollution and environmental considerations, etc. Unfortunately, the FAP studies have not adequately covered areas of water legislation and regulation. For example, there is an urgent need to revise the laws and procedures for land acquisition and resettlement to streamline the process and make it more equitable. Disaster management laws are yet another area of development. These and other regulatory issues need to be addressed in the continuing FAP programme.

The operational area includes data collection, planning, design, construction and operation and maintenance (O&M). In Bangladesh, as in most other countries, sectoral integration is limited and sector-specific agencies at different levels of government dominate the operational area. There is a need for movement towards both integration and decentralization of responsibilities to local authorities, for-profit private enterprises, and non-profit beneficiaries. FAP 26 has extensively reviewed the operational aspect of institutions, including the major water sector institutions in terms of their capabilities for efficient water resource management, linkages between multiple government agencies, facilities for people's participation in planning, disaster management, flood proofing and other non-structural activities. Restructuring of institutions is the next step of the study.

Institutions for Planning

The national capacity for sectoral planning with inter-sectoral priorities, particularly at WARPO, is weak. For feasibility studies, reliance on the private sector is important because of the multidisciplinary nature of water development projects. The planning division of BWDB has a significant role in the supervision of these studies.

Institutions for Design and Construction

Construction of physical facilities is mainly carried out by BWDB, though the Local Government Engineering Department (LGED), Water and Sewerage Authorities (WASA), MOA/BADC and Public Health Engineering Department (DPHE) undertake smaller schemes. The private sector is involved in minor irrigation, water supply and some project planning and design. A number of reviews over the past 20 years have pointed to serious weaknesses in the organizational planning and implementation capacity of BWDB, including:

- inadequate project design and poor quality control;
- failure to focus on inter- and cross-sectoral issues;
- problems in project programming and unsatisfactory procurement performance causing serious delays and cost overruns;
- poor project management capacity; and
- poor delegation of decision making power at the field level.

Institutions for O&M

The lack of monitoring of O&M activities by top management has created a relaxed atmosphere for O&M personnel and there are no standards for performance evaluation with which these individuals could be judged. Beneficiary participation in O&M activities is almost non-existent and the sheer volume of the requirement makes it difficult for the government to carry the financial burden alone.

Institutions for Disaster Management

Disaster management in Bangladesh is not a new concept. The Famine and Relief Code, written over 100 years ago, laid down the procedure for coping with major disasters. These codes and procedures are, however, outdated and need modification. At present, there are a number of Standing Orders and Codes laying down procedures to be followed by a large number of ministries and subordinate agencies. They are, to a large extent, not very specific to different types of disasters and do not provide coordination among different agencies. GOB has recently established a Disaster Management Bureau and consolidated the standing orders for disaster relief.

Overall, there is need for (a) expansion of flood forecasting and warning services, (b) disaster management programmes of the Government and NGOs, and (c) promulgation of specific laws and codes for disaster management.

Institutions for Flood Forecasting and Warning, Flood Proofing and Other Non-Structural Solutions

Flood forecasting and flood proofing are measures to avoid or reduce flood damage and disruption without increasing damages to others. The findings and recommendations of the FAP 26 study are:

- considerable institutional and technical resources are available for rapid implementation;
- education of stakeholders (investors and beneficiaries) is necessary for institutionalization of flood forecasting and warning and floodproofing concepts on a national scale;
- it is necessary to develop strong but flexible policy and management leadership, preparation of manuals covering applications for flood forecasting and warning, flood proofing measures and training of government officials; and
- it is necessary to utilize the services of the Thana level staff of BWDB, BRDB, LGED and MOA/BADC, who have been involved in making development plans of roads, irrigation facilities, flood control embankments and water and land use.

Institutions for People's Participation

Given the large number of often conflicting interests in water and land resources in Bangladesh (e.g., farmers and labourers, fishing and boating households, highland and lowland farmers) a participatory planning approach which tries to assess and balance the different needs and priorities is essential. The FAP is the first government programme in Bangladesh to make people's participation a mandatory part of project planning, implementation, operation and maintenance. Guidelines for People's Participation (GPP) were produced in 1993 and evolved from the experience gained in involving local communities and stakeholders in the regional studies. The GPP deals mainly with participation at the project level and BWDB has operationalized GPP. In addition, the FAP has undertaken many district level meetings with local elected representatives and others to understand local priorities and discuss possible projects coming out of the regional studies.

Important lessons from the participatory planning approaches being learnt from FAP are that the process should be (i) genuinely 'bottom-up', with the planning teams spending time listening to the local people and assessing their needs and priorities before identifying projects; (ii) undertaken by interdisciplinary planning teams of social scientists, farming systems specialists and engineers; and (iii) as transparent as possible, with the local people provided with as much information as possible about proposed schemes, in a form that they can understand.

NGOs are generally experienced in working in a participatory way with poor people, and have a potentially important role to play in helping to further develop the FAP methodology, in working with local communities on water sector planning and training. Notable steps in this direction have been made by GOB working with NGOs in resettlement planning in the Riverbank Protection Project (FAP1) and the Coastal Embankment Rehabilitation Project (FAP7).

Public Accountability

It is important that the planning and review process for FAP is open and transparent through various consultation measures. Broad discussion of FAP's findings through three national conferences, involving politicians, journalists, academics and NGOs, and district level consultations with stakeholders, have provided this transparency to a large extent. A public documentation and information centre for water sector planning at WARPO and an information dissemination center at BWDB project sites will be required.

OPTIONS

In the medium- to long-term, Bangladesh will have to formulate and adopt a mix of economic, management and engineering policies to balance demand and supply of water. Water resources development and management have to be planned for future conditions, and over the medium- to long-term. The agricultural sector will be unable to absorb excess labour and the key source of future agricultural growth will be productivity. The only way to increase agricultural productivity will be through intensive agriculture. Planning to meet agricultural demand on water resources, needs of environmental management, as well as ensuring an orderly development of flood free infrastructure and housing, will be a formidable challenge in the future.

Broadly speaking, there are three options as far as management of water resources is concerned:

1. *Minimal public sector intervention:* Government strengthens its capacity for flood forecasting and disaster management, but leaves implementation of water sector projects (e.g., minor irrigation) to the private sector and local councils. The basic premise would be to allow free rein to market forces, which have been successful in meeting demand for minor irrigation in the last decade. Thus further deregulation of government water supply monopolies, and devolution of authority to regional and local levels would be appropriate measures. As the economy grows, there may be increased demand for flood protection and large scale irrigation, which could be financed out of taxation and the local mobilization of resources.

2. *Selective public sector interventions:* In addition, the Government, with local community participation, would provide infrastructure to protect urban areas and key infrastructure from floods, storms and erosion hazards. It would promote flood warning, flood proofing for vulnerable communities, where possible through local institutions, and could involve selective development of FMD/I projects to enhance agricultural and fisheries production.

3. *Major interventions:* In addition, Government would implement engineering measures to manage floods, by stopping flooding from major rivers with embankments and river training works and, in protected areas improved drainage, possibly by pumping. Water shortages in the dry season would be mitigated through provision of suitable structures on the major rivers along with sharing arrangement with co-riparians. Another option could be regulation and augmentation of the main rivers in their upper catchment in India and Nepal.

Options 1 and 2 are both feasible and probably affordable in the short- to medium-term, though their successful implementation would require substantial institutional reform of planning and implementing agencies.

Option 3 was seen early in FAP as a possible long-term strategy. The work under FAP and experiences of other countries have shown that control of major rivers is difficult and needs to be implemented over a long period of time. Such protection may also carry risks of catastrophic breaching during extreme floods that would require sophisticated disaster management system.

Social and Environmental Options

All water sector project feasibility studies should include a thorough social impact assessment and the proposed projects should, on balance, benefit the poor as a whole. Another option may be to include the full cost of any mitigation programmes in the project analysis.

The options for people's participation are:

- maximizing the benefits to the poor, and especially poor women by such means as carrying out earthworks through manual labour, and providing access to resources created by the project, such as borrow-pits for fish culture, social forestry on embankments, involving women's groups in routine project maintenance;
- minimizing social conflicts between different groups such as highland and lowland farmers, people inside and outside the project, farmers and boatmen, etc. so that the project performs effectively and public 'cuts' are avoided;
- minimizing adverse impacts on common pool resources (e.g., capture fisheries by incorporating fish passes) and addressing ways of improving community management of such resources (e.g., remaining areas of wetland); and
- minimizing the number of people being displaced and resettled.

For addressing the charland issues, an option is to take care of the problems by flood proofing and stabilizing the chars and developing techniques for river bank protection. Another option is integrate the river and coastal charland communities into the national development process.

To ensure environmental sustainability, it is necessary to establish institutional capacity for updating EIA, commissioning and supervising research and updating guidelines and manual.

Planning Institutions

WARPO and FPCO would be merged to form a new national water resources planning organization responsible for:

- strategic planning and review of the NWMP;
- interfacing and coordinating with all interrelated water sector institutions for ensuring complementarity of schemes and avoiding potential conflicts (e.g., that a new road does not adversely affect drainage); and
- maintaining and expanding the data bases developed by WARPO and FPCO, BWDB, BIWTA, BBS, BADC/MOA and DOF for water resources planning, and to make these data accessible to all users.

The new organization should, ideally, be established by late 1995 when FPCO ceases to exist. Its location in the Ministry of Planning would be desirable, but if that is not possible in the short-run it could be within the MWR. This new organization will have to collaborate with institutions like the BWDB, RRI, LGED, DPHE, DAE, DOE, WASA, SOB, SPARRSO, BIWTA, MOA/BADC and the private sector.

Design and Construction Institutions

Despite its shortcomings, BWDB has to continue as the lead public sector agency for undertaking major water development projects and programmes. However, its mission, goal and mandate would have to be redefined in view of the accepted role of public and private sectors in the economy, and the role of other institutions in related sectors.

The appropriate mission of BWDB may be to provide large scale engineering support for the implementation of the national water sector strategy and plan. The firm establishment of WARPO, as the national agency for sector planning and development of the NWMP, would provide the macro framework within which BWDB could carry out micro-planning and implement schemes.

The role and structure of BWDB might see the following changes:

- it would not be involved in sector planning, except for providing specific assistance to WARPO;
- feasibility studies would be supervised/undertaken by BWDB with appropriate strengthening for economic, social and environmental analyses;
- BWDB's responsibility for project design should be limited to the design of large-scale schemes developed by WARPO. The actual design work of some project components may be contracted out to the local consulting industry, but BWDB should develop strong capability for supervising and reviewing the consultants' work;
- implementation and monitoring programmes may be prepared by BWDB with the support of a small group of highly qualified experts;
- it would evolve a proper O&M system in collaboration with beneficiaries and stakeholders and develop requisite institutions for involving NGOs, local bodies, and beneficiaries from the start of the project. This would facilitate the latter's preparedness and cooperation during operation and maintenance;
- BWDB's institutional linkages with other Government agencies (e.g., LGED, WASA, PHE, BMD, BIWTA, BADC/MOA, Roads and Highways, Railway and Fisheries Departments, Department of the Environment, SOB), local councils and NGOs, would be strengthened;
- strengthening of the financial management and accounting system and improvement of the management information system would be undertaken to provide transparency, necessary control and accountability within the organization; and
- the new mandate and focus of BWDB may necessitate some restructuring, redesignation of positions, functions, responsibilities; development of incentive packages, recruitment and training of personnel.

O&M Institutions

Some of the options for improvement of O&M performance are:

- keeping implementation personnel in the area until the stipulated benefits are realized;

- devolution of authority to regional and local levels; and
- turning projects over to local stakeholders, right after completion, so that the beneficiaries management committee determines O&M policies and rates through mutual agreement.

Disaster Management Institutions

As proposed by FAP Study 26, the recently created Disaster Management Bureau (DMB) of the Ministry of Relief, could become the focal point for GOB disaster management activities in both normal times and at times of emergency prior to and following a disaster.

Flood Forecasting and Warning and Flood Proofing Institutions

Possible options in this area are:

- establishment of a National Risk Information Centre to provide for rapid release and application of existing data on flood forecasting, flood hazards and a prompt start on educational efforts;
- initiate a pilot project for Flood-Proofed Infrastructure that will include expanded support like standards and training for flood warning and flood forecasting key infrastructure;
- strengthen Flood forecasting and warning centre at central and local level; and
- consider initiation of Flood Emergency Centres at Thana level to lead education and preparedness, as well as to provide floodfighting and relief operations.

Institutions for People's Participation and Accountability

An important option in planning (both sector and project) is to develop people's participation through regular interface with the beneficiaries and other interested parties in the Thanas. A second, but not exclusive, option is to have representation from the local councils and NGOs in the planning and implementation activities of major water sector agencies.

To ensure public accountability, one option is to provide transparency through open annual conferences, direct consultation with the public, and establishment of a public documentation and information centre for water sector planning at WARPO and at field for project planning.

3. WATER RESOURCE AND FLOOD MANAGEMENT STRATEGIES

The issues and options presented in the previous section provide essential guidelines for developing strategies for efficient management of the sector. Bangladesh also needs a clear strategic vision to guide its long-term goals and policies. The basic concepts that underlie such a vision begin with the understanding that water is a unitary resource, and that surface and ground water are an interconnected system, which must be addressed with comprehensive planning. Water is also an economic good, as within each hydrological unit renewable fresh water is limited. Planning for water, therefore, requires intensive cooperation among different users, and objectives and priorities should be set jointly with stakeholders at all levels.

Long-Term Strategies

The fundamental strategies, based upon past experience in water resource management and the medium and long-term plans of Bangladesh, are:

Approach to long-term planning: This would involve (i) formulating a comprehensive set of criteria and time horizons for specific application in water resource planning and management, using a fifty-year time horizon, (ii) full accounting for social cost and externalities and linkages, and improving the quality and implementation speed of schemes; and (iii) evolving policies that meet the requirement of time and adjust to need for decentralization, privatization, stakeholder participation, cost recovery, sustainability and public accountability.

Undertaking Integrated Water and Land Use Planning:

Effective land and water management strategies would involve (i) fully protected, partially protected and unprotected areas, compartmentalization, drainage, irrigation, landuse, cropping pattern, environment, erosion/sedimentation control, fisheries, navigation and salinity management and provision of water supplies, (ii) development of floodplain zoning to accommodate necessary engineering measures and allocate space for habitation patterns, economic activities and environmental assets, (iii) protection against drought and tidal surge, and (iv) coordinated planning and construction of rural roads, highways and railway embankments with provision for unimpeded drainage.

Achieving Intersectoral Balance: This would require (i) reliance on multipurpose projects and programmes for achieving intersectoral balance and assuring water supply for a diversified sectoral needs, (ii) phased implementation of comprehensive water management plans, aimed at controlled flooding for rural areas to meet the needs of crop production, and (iii) fisheries, navigation, urban flushing and recharge of ground water resource with minimum dislocation to the environment.

Managing cross-border flows: This would involve seeking international cooperation with riparian countries to moderate peak flows and share the flows of the common rivers.

Basin wise development: This would be pursued through integrated surface and ground water development for water balance in the river basins.

Balancing structural and non-structural approaches to water management: This would require considering nonstructural measures (e.g., floodplain zoning, floodproofing) for flood damage reduction equally with structural measures.

Setting Environmental Priorities: This would require full integration of environmental priorities (e.g., protection of life and property from flash flood and cyclone damages, minimization of forced resettlement caused by erosion, etc.) with water development programmes in accordance with EIA guidelines and promotion of formal and non-formal environmental education and linkages among concerned institutions.

Institutional Strategies: In the next 10-20 years, a strategic institutional framework has to evolve that supports the sector goals and objectives with optimal efficiency (e.g., harmonizing environmental and social objectives with production and distribution objectives, balancing quantity and quality, etc.). The strategies would involve:

- defining the role of the government in management of both supply and demand for water, recognizing that market failure necessitates public intervention;
- providing and enforcing a legal/regulatory system for judicious use of land and water resources, by both the public and private sectors, that ensures sustainability of the fragile ecosystem dependent on water, in conformity with international agreements;
- rationalizing the function and structure of public water sector institutions to create and maintain public good such as infrastructure;
- providing the right environment and institutions for unobstructed private sector involvement in water resource management;
- increasing people's participation in the management of the system, at different levels of local government (Thana, District, etc.), through appropriate institutional mechanism;
- developing strong coordination among different public sector institutions through inter-organizational linkages and sharing of responsibilities; and
- increasing the operational efficiency and accountability of public sector institutions through appropriate monitoring, evaluation, and performance evaluation, and instituting a transparent reward and punishment system.

Short-Term Strategies (1995-2000)

In order to bridge the gaps in the knowledge about the optimal management programmes for efficient utilization of the water resources in Bangladesh, a short-term strategy has been developed to fully integrate the existing body of knowledge and take priority measures for addressing imminent flood and other water resource problems. The focus of this short-term strategy will be:

- formulation of a long-term national strategy for water resource management and a new National Water Management Plan using the knowledge base of the National Water Plan, FAP, lessons learnt from previous FCD/I projects, groundwater development, and urban and sectoral water need projections;
- enhancing institutional capacity for undertaking upcoming programmes, through development of necessary legislation, policy, organization, professional expertise, training and other necessary infrastructure;
- establishing economic, social and environmental norms and environmental quality standards to regulate agricultural, industrial, navigational, municipal and domestic water use;
- instituting plans for operation and maintenance and creating an appropriate institutional framework for expanded beneficiary participation in the planning, implementation, operation, and maintenance of water management infrastructure and facilities;
- speedy completion of incomplete projects to achieve stipulated targets in the shortest possible time; and
- implementing a portfolio of essential projects and programmes (e.g., flood warning, disaster management, information dissemination, river training, improved drainage, protection of urban, commercial, industrial and public utility centres), that meet very specific criteria, including appropriate analysis with social costs and accounting of externalities and linkages.

4. THE DEVELOPMENT PROGRAMME

As noted in Section 3, the next five years will focus on three main activities: the preparation of an integrated national water management plan, institutional development, and implementation of selected, high priority projects which are environmentally sound and are acceptable to the stakeholders (Figure 2).

Planning will involve completion of outstanding FAP studies and pilot projects, finalization of planning criteria developed under FAP, and production of the National Water Management Plan (NWMP) which integrates the outputs of FAP and the NWP, and provides by 2000 a development strategy and an implementation programme for the future.

Institutional development will involve the merger of FPCO and WARPO to form a new national water resource planning organization and strengthening of BWDB and related government agencies.

Implementation will take place of selected high priority projects, which meet the selection criteria mentioned below, including river bank protection, cyclone protection, urban protection and flood proofing schemes. Water management development would be confined to rehabilitation and improvement of existing projects and other high priority stand-alone projects, which are not dependent on the completion of FAP pilot projects and studies. The rationale for the proposed investment programme is shown in Box 3.

Beyond the next five years, a rolling plan with an updated NWMP will provide a consistent but evolving framework for water sector development. The programmes and projects will evolve with changes in the economy (e.g., patterns of urban and industrial development) and the development of technology.

Following specific projects taken up during the first five years (urban protection, river bank protection on critical reaches, cyclone protection), the programme might shift to overall water and flood management, drainage and irrigation, whose development criteria would have been established by the year 2000. Many lessons would have been learnt from pilot projects during this period and these will have to be incorporated into new project designs. Flood proofing may have to be expanded, together with other non-structural measures, and the private sector would probably come to play an increasingly important role. Protection of secondary towns and priority river works would continue.

SHORT-TERM PROGRAMME (1995-2000)

A. Completion of FAP Activities (1995-2000)

The pilot projects, supporting activities and sub-regional planning, critical to the preparation of a comprehensive NWMP, will be completed by 1998 to provide a sound basis for planning, designing and implementing the future generation of projects and programmes. The timing and estimated costs of this programme is shown in Table 1. This list represents the first stage of a comprehensive action plan. It does not include the existing on-going projects, rehabilitation of existing projects and O&M which are operated by various agencies. The project briefs are given in Annexure.

**Box 3 : Rationale for Completion of FAP Activities
and the Proposed Investment Programme : 1995-2000**

The proposed programme for the next five years would comprise finishing up of the on-going FAP studies to complete the data base required for planning, preparation of the NWMP, institutional development, and planning and implementation of a small portfolio of disaster management projects.

- o The **Planning, Pilot Projects and Supporting Activities and Studies**, started under FAP, would broaden the scope of water sector planning to include all sectors, and identify essential and justifiable structural and non-structural interventions.
- o The **Flood Proofing, Flood Forecasting, and Disaster Management Projects** would improve the flood preparedness of floodplain communities, especially those living in unprotected areas. The flood proofing and flood warning projects on the Jamuna chars and in the north-east would be pilot projects that would develop approaches to flood proofing and flood warning which can be replicated in vulnerable areas throughout the country. Each of these projects would have a strong positive social and environmental impact.
- o The **River Management and Coastal Protection Projects** would protect about seven million especially vulnerable people from severe river flooding, tidal flooding and storm surges. These projects would protect rural communities and agricultural land. They have generally positive social and environmental impacts and acceptable IRRs and NPVs, though these are lower than those for the urban protection projects.
- o The **Urban Protection Projects** would protect about six million people and industrial areas in Dhaka, Chandpur, Bhairab Bazar, Munshiganj, and selected secondary towns. All the projects have overall positive social and environmental impacts and, with the exception of Chandpur, reasonable rates of return and good NPVs.
- o The **Water and Flood Management Projects** would involve feasibility studies for a small number of projects in north-central, north-east and south-east Bangladesh, those are designed to increase agricultural and fisheries production in flooded areas. They all have reasonable rates of return and overall positive social impacts, although some may have negative environmental impacts whose mitigation will be provided for in the project design.

Planning

The **Overall Planning Study** and production of NWMP will be a major exercise extending at least to the end of 2000. The regional and sub-regional plans would provide the building blocks for NWMP. Their upgrading will ensure that the plan components have been assessed and evaluated according to the established social, economic and environmental criteria. The **Institutional Development Study** would utilize the results of the study under FAP 26 Institutional Development Programme and would suggest institutional arrangements of various organizations and would aim at increasing knowledge of local conditions through increased public participation in the planning, design, construction, operation and maintenance of water sector projects. The **Macroeconomic Study** will be continued to assess the impact of flood action projects on economic factors. The **Jamalpur Priority Project** requires refined feasibility study to fully address questions raised about impact on the floodplain, fisheries, and people's participation

in project design, implementation and operation and maintenance. To complete the regional planning coverage and to enhance the existing plans, new sub-regional planning will be started. The first of these will be the **Meghna Estuary Study** which will carry out systematic surveys to assess estuarine behaviour, prepare a master plan for the reclamation and development of the land resource, and recommend mitigating measures for the population vulnerable to cyclones and storm surges. **Chittagong Coastal Area Study**, along with the estuary study and FAP5 South East Regional Study, would complete the coverage of the south-eastern region. It will be primarily concerned with the coastal plains which are subject to frequent floods as well as cyclones. The **North Central Sub-Regional Study** (Jamuna Left Bank Study) will establish a priority plan for year-round water development of the north central sub-region between the Jamuna, Bangsi and

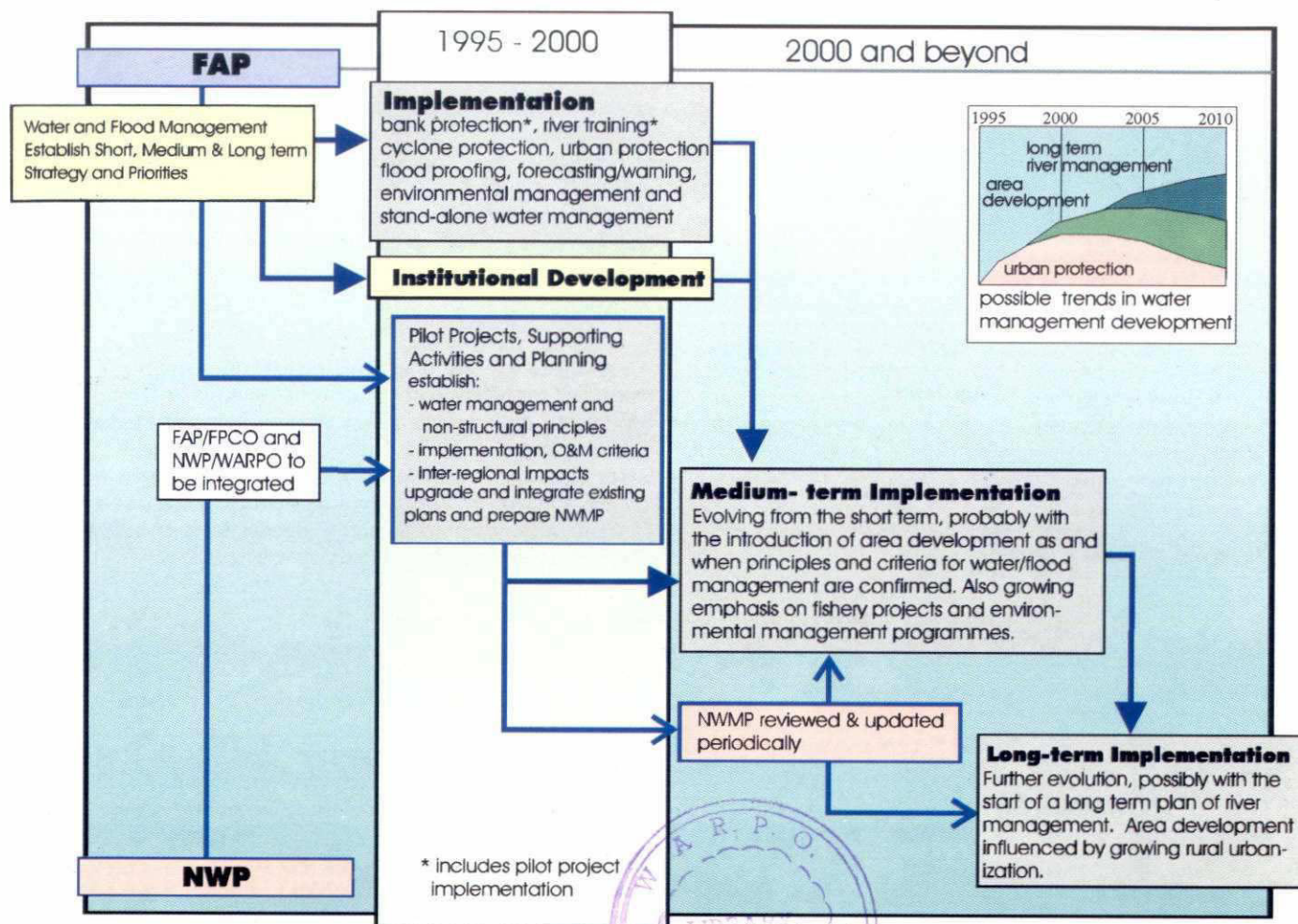


Figure 2 Development Programme

Dhaleswari rivers. The study will also cover flood proofing of the adjacent charlands. On the other bank of the Jamuna, a **North West Sub-Regional Study** is proposed for the Lower Atrai Basin to assess the Green River concept, formulate an integrated plan for Chalan Beel and adjacent polder development, and prepare a feasibility study for priority rehabilitation. The **South East Sub-Regional Study** will assess plans for the development of the Dakatia-Little Feni river basins.

A **South West Sub-Regional Study** will be necessary to address the wider implications of comprehensive water management raised by the unilateral withdrawal of Ganges flows at the Farraka barrage and the effects of saline intrusion in south and the consequent environmental degradation, particularly on water quality and the Sundarbans. The study would investigate various development options, including the **Ganges Barrage** and **Gorai Augmentation**. The output of this sub-regional study will be a vital component of NWMP. The study will also incorporate on-going feasibility studies for rehabilitation works. **Priority Project Feasibility Study** of seven priority projects in the South-West Region is also included in the portfolio for 1995-2000.

B. Preparing NWMP

After the merger of FPCO and WARPO, consultants would be appointed to undertake the planning and preparation of NWMP. The set of projects emerging from the upgraded and completed FAP regional and sub-regional plans will be added to non-FAP projects from the 1991 NWP. Early Implementation Project (EIP), SRP, and similar projects from other agencies will also be upgraded. The integrated planning process would follow the following line (see Fig.3):

- revising the short term strategies, for the medium-term plan period, say upto 2010, ensuring they reflect the national goals;
- formulating project types or categories to accord with the strategies;
- identifying projects for each category;
- evaluating lessons from the first five years of operation;
- consolidating the plan components into a preliminary framework, establishing linkages and dependencies, and assessing cross-sectoral, inter-regional and national impacts;
- establishing and evaluating a range of development options, comparing their outputs and impacts; and

establishing priorities, assessing plan constraints, determining costs and timing, and preparing the draft NWMP, with likely alternatives.

Institutional arrangements would be in place to enable full involvement of other ministries and departments. The planning exercise would be carried out under rigorous and transparent arrangements. A technical review of the NWMP by a panel of experts (national and international) will be carried out.

NWMP should be seen as a rolling plan to be reviewed and updated every five years. It would provide a firm plan for the next five years, an indicative plan for the subsequent five years and a perspective plan for the long-term. In this way, the plan would be sufficiently flexible to accommodate changes in the socio-economic environment and technological advances, while maintaining its direction.

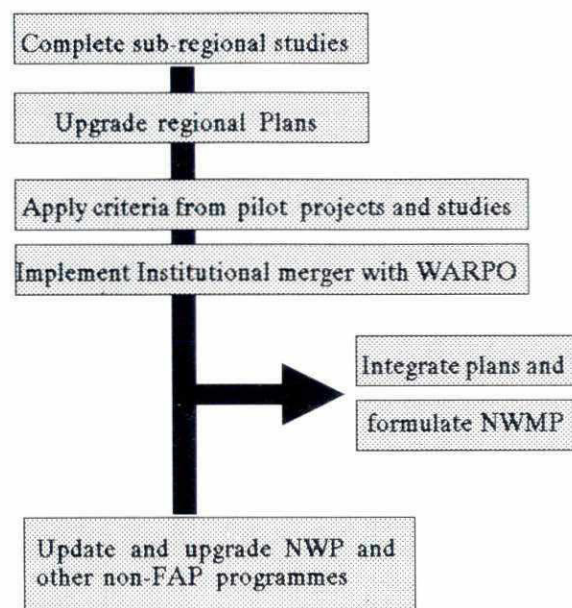


Figure 3 Preparation of NWMP

Pilot Projects

Pilot projects will constitute the major continuing FAP effort during this period. **FAP20 Compartmentalization Pilot Project**, if found to be economically and institutionally feasible, will provide the criteria needed for planning and designing water management systems in areas protected by embankments. It is testing the controlled flooding and compartmentalization concepts in the field under real operating conditions with management in the hands of local people. An effort was made for comprehensive people's participation to provide the essential base for designing the structural and non-structural measures. Public committees at various levels have been set up and the work for the first three sub-compartmentments should be completed in time for 1995 operations. The first test of the project concept and the experience of people's participation for part of the project will take place in 1995-96 and will help in future design of similar projects.

River bank erosion is a persistent, continuous and severe environmental hazard for people living on and close to the river banks. In some cases, erosion can lead to a radical change in a river's course with dire consequences. The sheer size and instability of the rivers and the lack of quarried rock or boulders in Bangladesh, make it difficult to find a cost-effective method of river training. **FAP21 Bank Protection Pilot Project** has been set up to develop technically sound and cost-effective bank protection methods. Valuable lessons will also be learnt from the river training associated with Jamuna Bridge.

An alternative to the traditional method of fixing the river banks by applying 'hard' measures, such as groynes and revetments, is to work with the river to induce it to change direction by training with 'soft' movable structures. **FAP22 River Training & AFPM Pilot Project**, to be completed in conjunction with FAP21, examines and tests the various ways of training the river in its active floodplain to stabilize its planform to the benefit of the riverine people.

Supporting Activities and Studies

The objective of **FAP24 River Survey Programme** is to enhance the data base by collecting reliable all-season hydrological and morphological data at key locations on the major rivers, emphasis being given to measurement of flood discharges and introducing improved technology, equipment and vessels. Special studies on the behaviour of the main rivers will be completed; the programme includes an important training element.

A new activity under consideration is the study of the inter-regional effects of project interventions such as embankments, bank protection and river training on river morphology. The **Morphological Impact Assessment Study**, is planned to start in 1995-96 and last for about three years. The aim is to assess and analyze historical data, produce morphological predictions for future development scenarios and build up national capability to undertake such assessments.

FAP13 Operation & Maintenance Phase I, completed in 1992, examined the constraints on effective O&M of FCD/I projects and recommended a range of social, technical, institutional and financial remedial measures. **O&M Study Phase-II** will evaluate these proposals, and others that may emerge from BWDB's System Rehabilitation Project, and pilot projects in existing schemes, and produce manuals for improved O&M practices.

FAP17 Fisheries Study, established baseline data on fish population dynamics and carried out impact assessments for a range of FCD/I interventions. The first phase, completed in 1994, will be followed by the **Fisheries Study Phase-II** which will complete a series of pilot projects to examine and demonstrate promising measures to mitigate the loss of capture fisheries.

National and regional water resource planning and design, flood forecasting, surface water modelling and geographical information systems all rely on a sound hydrological data base and as such **Extensions** of data collection programme are proposed. **Environmental Study under FAP 16** has provided important inputs to the regional plans and developed a manual with EIA guidelines. The work to expand its activities to all planning levels would continue. **FAP-18 Topographic Mapping** will continue to oversee the production and supply of aerial photography, maps and satellite imagery to meet planning and design needs. **FAP19 Geographical Information System** will continue until mid-1995. Its service will be maintained, in some form, using the trained unit with its hardware and software, to prevent loss of the valuable assets. **FAP25 Flood Modelling and Management** has provided FAP with a modelling capability and has developed a flood management model for simulating the effects of interventions on the flood regime. It was transferred to the Surface Water Modelling Centre in 1994.

C. Implementation

The criteria for selecting projects for implementation over the next five years are that they should:

- conform with national goals and strategies;
- satisfy a demand for urgent implementation;
- be technically sound, economically justified and financially viable;
- be socially acceptable to the intended beneficiaries and be planned in partnership with them, and also have no significant adverse internal or external environmental impacts;
- not perpetuate previous designs and practices which have proved inadequate and inappropriate;
- not prejudice future developments, either externally through future plan linkages, or internally allowing future adoption of concepts currently under development; and
- have adequate institutional capability and capacity for implementation.

Table 2 has listed the ongoing projects and programmes and the ones that are ready for implementation. These will form the core of 1995-2000 implementation activities and, subject to confirmation of viability, will be supplemented by projects and programmes from the candidate list shown in Table 3. The project list which meets the above criteria, is broken down into specific categories. It does not, however include some other high priority environmental and institutional programmes which are not yet ready for implementation. For such programmes and any other water sector operation which fully meet the criteria set out herein, GOB in its development programme funds to the tune of Tk.13500 million over the period 1995-2000.

Flood Proofing, Flood Forecasting, Disaster Management

These are basically non-structural projects and programmes to alleviate the conditions of those living in flood-prone and cyclone-prone areas.

Flood Forecasting and Warning is a continuing activity, but at this stage the operational emphasis is on effective dissemination of warnings at the grass-root level. Following the establishment of the Disaster Management Bureau in the Ministry of Relief, the next stage **Disaster Management-II** will be taken up for increasing the capacities of communities and households to cope with disasters, and to increase pre-disaster preparedness and post-disaster recovery. The **North-East Flood Warning Project** is designed to provide timely and readily understood warnings in flash-flood prone areas and initially will be implemented on a pilot basis. The **North-East Village Homestead Pilot Project** undertakes improvement of homestead platforms in deeply flooded areas initially on a pilot basis.

Flood proofing activities - a combination of structural and non-structural measures - represent the start of an extensive programme for flood alleviation for people in flood-prone areas. Initially pilot projects **Jamuna Right Bank (RB) char flood proofing project** and **Jamuna Left Bank (LB) char flood proofing pilot projects** will be set up to test flood proofing measures in and along the Jamuna RB and LB concentrating on char dwellers. Works include flood proofing public buildings, assistance to households to raise plinth levels and providing shelter areas above flood levels.

River Management & Coastal Protection

These are mainly emergency and high priority works for the mitigation of potential disasters and to prevent further deterioration. **Cyclone Protection I & II** (renamed as Coastal Embankment Rehabilitation Project) involve the repair and strengthening of sea-facing embankments to protect lives from storm surges and agricultural land from saline tidal intrusion. As a first step in future river stabilization, the **Brahmaputra Bank Protection Project** comprises priority works to control bank erosion, particularly on the Jamuna right bank to prevent a breakthrough to the Bangali river at Sariakandi and to protect Sirajganj town. The **Kalni-Kushiyara river improvement pilot project**, is a river channel improvement project to reduce pre-and post-monsoon flood levels and to improve year-round navigation. The project will start with a pilot drainage programme.

Urban Protection

This set of projects comprises high priority town and infrastructure protection, the major emphasis at this stage being on Dhaka city and its industrial areas. The main part of the **Dhaka Integrated Flood Protection Project** is almost complete. The **Secondary Town Flood Protection Project**, covering six priority towns (Panchagar, Dinajpur, Kurigram, Khulna, Moulvibazar, Habiganj) and includes drainage, solid waste disposal and slum/squatter area improvement. **Greater Dhaka DND flood protection project** has been selected because RAJUK, the city development authority, has already started with some elements of the projects and because settlement is increasing rapidly. **Meghna Protection I** project has been identified as the priority for protection of two priority towns: **Bhairab Bazar** and **Munshiganj**.

Table 1: Completion of FAP Activities (1995-2000)

ACTIVITIES	Status	Cost (Million Tk.)			Annual Cost (Million Tk.)				
		Total (Est.)	Pre 1995-96	1995-2000	1995-96	1996-97	1997-98	1998-99	1999-2000
Planning									
Overall Planning/NWMP Study	B	750		750	50	200	200	150	150
Institutional Development Study	B	100		100	10	20	20	25	25
Macro-economic Study	A	16	12	4	4	-	-		
Jamalur Priority Project Study	A	189		189	40	80	69		
Meghna Estuary Study	B	260		260	60	100	100		
Chittagong Coastal Area Study	B	200		200	-	100	100		
North Central Sub-Regional Study	B	210		210	60	100	50		
North West Sub-Regional Study	B	100		100	20	40	40		
Southeast Sub-Regional Study	B	68		68	-	34	34		
Southwest Sub-Regional Study	B	300		300	50	150	100		
Priority Projects Feasibility Study	B	191		191	41	100	50		
Pilot Projects									
Compartmentalization Pilot Project	A	985	440	545	245	300			
Bank Protection Pilot Project	A	1570	500	1070	500	300	200	70	
River Training & AFPM PP	A	160	20	140	50	50	30	10	
Supporting Activities & Studies									
River Surveys Programme	A	530	230	300	200	100			
Morphological Impact Assessment	B	550		550	100	250	200		
Operation & Maintenance Study II	B	220		220	30	90	70	30	
Fisheries Study II	B	120		120	20	50	50		
Extensions (FAP 16,18,19,25)	B	900		900	100	180	220	200	200
Total Activities		7419	1202	6217	1580	2244	1533	485	375
Status : A. Ongoing B. Planned									

Table 2: Implementation (1995-2000)

PRIORITY PROJECTS AND PROGRAMMES	Cost (Million TK.)			Population Benefited (Million)	EIRR %	NPV (MTK)	Probable Impacts		Status
	Total (Est.)	Pre 1995-96	1995-2000				Soc	Env	
Flood Proofing, Flood Forecasting, Disaster Management									
Flood Forecasting Expansion	331		331	-	-	-	++	n/a	OG
Disaster Management II	160		160	n/a	n/a	n/a	++	n/a	OG
NE Flood Warning	101		101	5.20	n/a	n/a	++	+	F
NE Village Homesteads Pilot Project	50		50	-	-	-	++	+	PF
Jamuna RB Char Flood Proofing Project	20		20	n/a	n/a	n/a	++	+	do
Jamuna LB Char Flood Proofing Pilot Project	40		40	n/a	n/a	n/a	++	+	do
River Management & Coastal Protection									
Cyclone Protection I	3450	3250	200	1.70	17.5	-	+	-	OG
Cyclone Protection II	3614	-	3214	1.30	18.2	-	+	+	D
Brahmaputra Bank Protection Project	3187	-	3187	0.25	17	287	+	+	D
Kalni-Kushiyara River Improvement Pilot Project	150	-	150	n/a	-	-	+	+	F
Urban Protection									
Dhaka Integrated Flood Protection Project	4516	3916	600	4.20	43	157	+	+	OG
Secondary Town Flood Protection Project	2846	1946	900	0.83	34	1556	+	+	OG
Greater Dhaka DND Flood Protection Project	4594	-	4250	0.45	15	371	+	+	F
Meghna Protection I (Bhairabbazar, Munshiganj)	828	-	828	-	18	522	+	+	PD
Water & Flood Management									
NE Fisheries Engineering Measures-Pilot Project	68	-	68	n/a	n/a	n/a	+	+	OG
Chandpur Irrigation Project Rehabilitation	63	-	63	0.50	78	79	+	+	PF
Total : - million Taka (million US\$)	24018 (600)	9112 (228)	14162 (354)						

1) Total Costs include the costs already incurred pre 1995-96 and those to be incurred during 1995-2000 and beyond.

2) n/a = not applicable; OG= On-going; F=Feasibility; PF = Pre-feasibility; D = Designed, PD = Preliminary Designed.

3) Impacts (social & environmental: indicative only, subject to further analysis); + = positive; ++ = very positive;

4) In some cases, the nature of the pilot project is such that it does not permit quantification of benefits and hence the economic rates of return are not computed. In other cases, only alternative technical options are explored at the pilot project stage without carrying out any cost benefits analysis.

NE Fisheries Engineering Measures represents a new water management initiative, which recognizes the need to improve and sustain fish habitats in existing and new FCD/I projects. The pilot project for the main programme will comprise fish passes, regulating structures and earthworks specifically designed for fish.

At this stage, FCD/I projects will be limited to urgent works, an example of which is the **Chandpur Irrigation Rehabilitation Project** which is suffering from river erosion and embankment breaches. The rehabilitation work (to come under SRP, with full people's participation) will comprise some embankment retirement and remedial earthworks.

D. Candidate Projects and Programmes for further study

Institutional Development

An immediate task will be to merge FPCO with WARPO. This would be followed by the transfer of SWMC from RRI if needed. The new WARPO will also need substantial strengthening. The recently initiated organizational reforms will be the forerunner of restructuring and strengthening of BWDB. The reforms in the first instance will focus on improved O&M of existing projects, better management of implementation and transparency in the accounting system. Since it is often difficult for an organization to restructure itself without bias, it may be necessary to look towards an independent management organization outside BWDB to undertake the task.

Institutional restructuring, reforms, strengthening and development will concentrate initially on WARPO (with FPCO), in its overall planning and data base roles, and on BWDB in its project preparation, design and implementation roles. These programmes, when well established, would ensure proper management of the projects.

Programmes to overcome the present weaknesses and constraints in O&M will be formulated and set in place. Critical review of SRP, FAP20 and the planned second phase of the FAP O&M study will be crucial to establish the criteria and guidelines for all new projects and the improvement of existing ones. The institutional development programme for O&M will cover BWDB's internal O&M structure, LGED and local government's role, local user groups and NGOs, and methods of ensuring full people's participation at all stages.

Table 3 Candidate Projects and Programmes for further study

PROJECTS AND PROGRAMMES	Status
Institutional Development	
Institutional strengthening & Development	IDEN
Environmental Management	
NW Wetland Pilot	PREF
SW Environmental Monitoring	PREF
NE Environmental Programmes	PREF
REMC Development	IDEN
Flood Proofing, Flood Forecasting, Disaster Management	
NE Village Homestead	PREF
Jamuna RB char flood proofing	PREF
Jamuna LB char flood proofing	PREF
River Management Works, Bank Protection	
Kalni-Kushiyara River Improvement	FES
Baulai River Improvement Pilot	PREF
Teesta Right Bank Protection	PREF
Urban Protection	
Greater Dhaka East Flood Protection	FES
Meghna Protection (Chandpur)	PRDS
Water and Flood Management	
Jamalpur Priority Project	FES
Upper Kangsha Basin Development	FES
NE Fisheries Programme/Engineering	PREF
Noakhali North Drainage & Irrigation	FES

IDEN - Identified; PREF - Prefeasibility

FES - Feasibility; PRDS - Preliminary Design

The 1995-2000 programme will see a significant shift to the multi-disciplinary approach needed for comprehensive water management and the increasing importance of environmental management. The institutional framework would ensure effective multi-sectoral participation at all stages of water sector development from broad planning right down to O&M in the field. Institutional development programmes during 1995-2000 will also cover the growing role of the private sector.

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The rest of the projects and programmes are subject to further preparation, either by desk, field or pilot study. The fact that they are not as advanced as the priority list does not reflect their urgency. Social, environmental and institutional programmes will have a high priority, particularly the Institutional Development Programme without which there will be little effective water management development.

The overall institutional arrangement for water management will have to be developed during this period. The programme will involve continued strengthening of WARPO, BWDB, RRI, JRC, LGED, BIWTA, R&H, Railway, PHE, DOE, DOF, BMD, MOA/BADC etc. Expected changes in these organizations are shown in Box 4.

Environmental Management

Regional Environmental Management, research and education Centres (REMCs) will be established under FPCO/WARPO, in each of the five FAP regions. These will be based on the FAP-6 proposal for the North-east region and will monitor and research key environmental aspects of water resource development (e.g., biodiversity, water quality, pollution, fisheries impacts, land acquisition and resettlement, social impacts) and ensure feedback for management of on-going projects and the planning of new projects. The REMCs would establish regional data bases for water resource planning and evaluation, which would be open to the public, and would have active environmental education programmes. The programmes of the different REMCs would vary, but would include activities such as:

- strategic planning for biodiversity conservation and surface and ground water quality management;
- conserving biodiversity in important wetland and upland sites with locally based management, with special emphasis on rehabilitating, extending and managing threatened lowland ecology (e.g., reedswamps, floodplain grasslands);
- in conjunction with DOE, making an inventory of major sources of pollution (pulp and paper mill effluent, other sources of industrial pollution) which are likely to have adverse short- and long-term impacts on the biophysical environment and human health;
- monitoring and evaluating the social, economic and environmental impacts of existing and planned water resource development projects (e.g., impacts on social

equity and on the livelihoods of the poor; on capture fisheries and thus the nutrition of the poor);

- participating in all WARPO pre-feasibility studies of water resource development projects; and
- reviewing the implementation of project environmental management plans (e.g., land acquisition and resettlement; design and construction of fish-pass structures).

The REMCs would be appropriately staffed by interdisciplinary teams of experts including social scientists. They would, through WARPO, liaise closely with the DOE and other government bodies to ensure implementation of environmental regulations and laws to protect water and other environmental resources.

Flood Proofing, Flood Forecasting, Disaster Management

The main flood proofing programmes on the Jamuna chars and NE village homesteads will follow the pilot projects set up in 1995/96. People's participation and involvement, and the roles of NGOs and local government in flood proofing will be resolved before any extensive programmes are undertaken.

River Management Works, Bank Protection

The Teesta Right Bank Protection Project will be part of the programme to seal the existing Teesta right embankment to prevent overland flooding behind BRE to Gaibandha. It mainly involves river training to check bank erosion, and as such should await the results of FAP21 pilot trials.

Urban Protection

The next Dhaka project to be taken up is the Greater Dhaka East Flood Protection Project. It is in an advanced state of preparation, but implementation will depend on BWDB's capacity to execute its part of the work. Protection of Chandpur town is extremely urgent, but it is not economically viable. If this work and subsequent long-term protection are not provided, Chandpur town and part of CIP will gradually be eroded by the Meghna river, displacing large numbers of commercial establishments, residents, and destroying its industrial and commercial base. Difficult political and planning decisions need to be faced comparing the cost of town protection with resettlement and relocation costs.

Box 4 : Strengthening of Organizations

Overall Planning and Data Management

- o WARPO: Strengthening capability through training, assistance and provision of equipment and facilities, and back-up support. The Environmental Cell to be established under FPCO will be included.

Project Preparation, Design and Implementation

- o BWDB: Training in people's participation, EIA, land acquisition and settlement, technical methodologies and management procedures (including transparent accounting, consultant procurement and supervision), interdisciplinary water resource development, together with provision of equipment facilities and back-up support;
- o LGED, BIWTA, MOA/BADC, DPHE, WASA, DOE, DAE, SOB, local government organizations and NGOs: Same as for BWDB, but appropriate to local contexts and with emphasis on methods of people's participation;

Operation and Maintenance

- o BWDB: Training and assistance in setting-up and running effective O&M systems for major works, and appropriate systems for water management schemes involving local organization and beneficiary involvement;
- o LGED, local government organizations and NGOs: Same as for BWDB, but appropriate to O&M systems to be managed wholly at the local level.

Monitoring and Evaluation

- o BWDB, LGED, local government organizations and NGOs: Training and assistance in participatory monitoring, designing systems (particularly covering socio-economic and environmental aspects), collecting and analyzing data, reporting and feedback; and
- o WARPO: Training and assistance in establishing a project M&E system which would include specifying/advising data requirements (particularly socio-economic and environmental indicators), methods of data management, analysis, reporting and feedback.



Water and Flood Management

The **Jamalpur Priority Project** comprises strengthening and supplementing the existing embankment system, inlet and outlet structures, drainage improvements, flood proofing of attached chars and a fisheries programme. The compartmentalization component will not be introduced unless FAP 20 or other pilot projects prove successful and guidelines are available from the pilot projects. The feasibility study is being refined to provide for full people's participation and a proper environmental impact assessment. The **Upper Kangsha Basin Development** also involves river and channel improvement to reduce flood levels. Pre-feasibility level studies indicated mild adverse impacts on regional bio-diversity and navigation. These will be addressed in the on-going feasibility study.

The **NE Fisheries Programme/Engineering** comprise activities to improve floodplain fisheries and appropriate engineering measures to improve fish habitat in FCD or stand-alone fishery projects.

The **Noakhali North Drainage and Irrigation Project** aims to relieve drainage congestion and supply irrigation water for low lift pumps through channel improvements and remodelled regulators. The feasibility study indicated that there was an adverse environmental impact on flood plain fisheries through improved drainage; but it had positive economic and social benefits. A special study on fisheries and nutrition in the impacted areas must be made before making a decision to implement the project.

LONG-TERM PROGRAMME (YEAR 2000 AND BEYOND)

The NWMP will form the basis for future water sector development programme. It will provide the strategies for short-, medium- and long-terms, and a programme of activities and an investment plan beyond 2000.

Institutional Development

By 2000, the major restructuring will have taken place and organizational strengthening at the centre completed. Institutional development and strengthening at the rural level will probably continue where people's direct involvement in running schemes is ensured. Opportunities for privatization will be pursued more vigorously. With the increasing emphasis on river management, restructuring of the RRI would be need of the time. Bangladesh has some of the world's major rivers, and RRI could become an international centre for research in river management. Supported by the main international hydraulic research organizations, RRI could attract top professionals.

Special Studies and Updating of NWMP

Although the FAP pilot projects and studies will be complete and will have produced the criteria needed for the NWMP, certain activities will continue. With the shift of emphasis from emergency river works to a longer-term programme, studies and pilot schemes will be needed to provide the basis for future river management. Building on the technologies established under FAP and continued during 1995-2000, river training, particularly works to stabilize river planforms will be taken a step further, and AFPM trials will continue. These advances will be very relevant to flood proofing.

During the preparation of NWMP the need for additional studies will arise; for example, testing FAP20's approach to public participation in other water management situations, extending FAP6's initiative in environmental management to other regions, making a concerted effort to give fisheries engineering the same emphasis as agricultural (irrigation) engineering and further study of the economic, social and environmental impacts of projects.

The improved information technology in WARPO (data collection, analysis, modelling and monitoring systems) will provide a new dimension for planning and designing water development projects and programmes, particularly for WARPO's monitoring and evaluation role.

WARPO's main planning task after 2000 will be reviewing and updating of the first NWMP. The frequency at which the rolling plan will need to be updated is not known, but five years can be assumed to be the maximum interval. With effective monitoring, a good data base, new information

technology and modern evaluation and planning techniques, WARPO should have no difficulty in reviewing water sector performance and updating NWMP, whenever required.

Implementation

The projects and programmes beyond 2000 will have been determined through the comprehensive NWMP process. This will involve careful application of updated FAP criteria and guidelines. Social, environmental and institutional provisions will have been built in to produce a new generation of projects, which are formulated through people's participation, are locally acceptable and environmentally sustainable. The structural projects would probably fall into similar categories as in the short-run, but there would be changes in emphasis.

The new river projects would be the first step in a programme aimed at longer-term river management. New water and flood management projects should be introduced if they are technically, economically, socially, environmentally and institutionally justified.

Non-structural activities would increase as more knowledge is gained on their effectiveness. Flood proofing, which could have a significant structural component, will involve long-term programmes to cover most char lands and other flood-prone areas. Environmental management programmes will be replicated in other regions.

Operation and Maintenance

While rehabilitation of existing FCD/I schemes will continue for some time, special projects will be needed to make O&M more effective. SRP generated initiatives will provide a sound pattern for the improvement of existing projects.

The results of FAP13-II (O&M study), should be available after 2000. Innovative methods tested in the field should include beneficiary management, sinking funds and privatization of BWDB's normal responsibilities. Effective solutions, including those emerging from SRP, will be built into the later projects.

The Future

Socio-political and economic realities are likely to change in the future and technological advances may alter the present thinking on agriculture, fisheries, river and environmental management. However the framework set in the short-term (1995-2000) will provide a basis for the future. The key task is to keep on updating criteria and water sector planning so as to cope with the inevitable changed circumstances.

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**GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
MINISTRY OF WATER RESOURCES**

**BANGLADESH WATER AND FLOOD
MANAGEMENT STRATEGY**

**ANNEXURE
PROJECT BRIEFS**

**FLOOD PLAN COORDINATION ORGANIZATION
Dhaka September 1995**

ANNEXURE - PROJECT BRIEFS

Table - 1 : COMPLETION OF FAP ACTIVITIES (1995-2000)*

1. **OVERALL PLANNING/NWMP STUDY:** The overall planning/NWMP would be a rolling plan to be reviewed and updated every five years. It would provide a firm plan for the next five years, an indicative plan for subsequent five years and a perspective long-term plan.
2. **INSTITUTIONAL DEVELOPMENT STUDY :** The study will help develop an overall institutional arrangement for water development which will ensure maximum people's participation in planning, design, construction and O&M. The study will also recommend steps to consolidate and strengthen WARPO/FPCO, BWDB, RRI and to ensure participation of other institutions such as LGED, BIWTA, MOA/BADC, WASA, PHE, SOB, Local government bodies and NGOs involved in water resources development.
3. **MACRO-ECONOMIC STUDY PHASE-II:** In a country like Bangladesh, where floods, cyclones, storm surge and tidal floods frequently devastate economy, large investment in flood control would seem to improve the overall growth prospects of the economy. The study aims at developing a set of corrective factors with respect to different project return periods by which standard direct benefits derived from controlled flooding may be adjusted upward reflecting the growth prospects due to large scale investment in Bangladesh economy that is likely to happen if floods can be controlled. The phase-II activities have been launched to improve/modify the model with updated data base.
4. **JAMALPUR PRIORITY (REFINEMENT OF FEASIBILITY STUDY AND DETAILED DESIGN):** Jamalpur Priority Project includes construction of embankments, inlet and outlet structures, flushing sluices, drainage works and pilot flood proofing schemes. It also involves a fisheries programme. To support all the above activities, the study will be refined following EIA and GPP guidelines and will use an updated data set.
5. **MEGHNA ESTUARY STUDY:** The outputs of the study are expected to include but not be limited to the preparation of an indicative master plan for the Meghna estuary. The study will provide: approaches and techniques for rapid and low-cost land reclamation, employing local labour and materials to the maximum extent; small scale interventions using locally available facilities; proposals for effective measures to protect existing land and potential reclamation areas against erosion; plans to enhance the security of the population in the coastal area and on the islands; plans to strengthen the technical and institutional aspects of water/land management on the coastal islands and proposals for surveys and studies required for updating the plan for Meghna estuary.
6. **CHITTAGONG COASTAL AREA STUDY:** The aim of the study is to prepare a water management plan at prefeasibility level for the Chittagong coastal plains which is crossed by three main rivers (Karnaphuli, Sangu and Matamuhuri) and by many smaller rivers and streams (Halda, Ichamati, Bagkhali etc.) running directly from the interior hills into the area. While the study will focus particularly on the resources, needs and potential of the coastal plains, it will be necessary to take into account environmental conditions in the upper catchment areas of rivers and streams entering the plains. Feasibility studies would be carried out of water control and development requirements for two broadly representative catchment areas on the plains: one area of the main rivers and the other of minor rivers or streams where small-scale structures and management might be appropriate.
7. **NORTH CENTRAL SUB-REGIONAL STUDY (JAMUNA LEFT BANK STUDY):** The feasibility study will have two-phases, the first of which is designed to establish the field and base line data, derived data and technical models (hydraulic, hydrologic, agricultural and economic) for round the year water management. The second phase will be a feasibility analysis of a selected area of 150,000 ha. to quantify accurately and reliably the benefits and costs of any proposed intervention or improvement of the area.
8. **NORTH WEST SUB-REGIONAL STUDY INCLUDING WATER MANAGEMENT (LOWER ATRAI):** The Lower Atrai sub-region forms a connected river basin system and as such has been considered as a whole. After analyzing different options, the proposed plan for development is based on Green River concept, in which the area close to the river is designed to carry peak flood discharge, whilst farther away are provided with full FMD facilities. The study will incorporate the round-the-year water management issue which was not included in NW Regional Study.
9. **SOUTH EAST SUB-REGIONAL STUDY (DAKATIA LITTLE FENI WATER TRANSFER INCLUDING SONAICHARI IRRIGATION DRAINAGE PROJECT):** The South East Regional Study will analyze the problems of, and suggest remedies for flash floods with heavy sediment load in the eastern area, drainage congestion in other areas, scarcity of irrigation water in the Dakatia and other areas and extension of irrigation in the Sonaichari area and transfer of water from Lower Meghna through Dakatia to Little Feni River for irrigation etc.

* All these studies and programmes will be based on the criteria established in the BWFMS report with respect to the social, economic, environmental and people's participation considerations.

10. **SOUTH-WEST SUB-REGIONAL STUDY (GORAI AUGMENTATION PROJECT):** To meet the main problems of water resource management and acute shortage of water during the dry season mainly due to the construction of Farakka Barrage, the sub-regional study will consider the initial work done on the round-the-year water supply and demand for the region and will prepare a detailed feasibility study report on Gorai Augmentation Project in line with GOB development strategy and confirm the viability of the whole scheme including Ganges Barrage Project in terms of technical, economic, social and environmental aspects.
11. **FEASIBILITY STUDY OF SEVEN PROJECTS:** The objective of the study is to prepare detailed feasibility study on the following seven projects -- Chenchuri Beel Rehabilitation Project; Padma-Kumar Scheme; Narail FCDI Scheme; Arial Khan-Bisarkandi Scheme; Swarupkati FCDI Scheme; Barisal Irrigation Rehabilitation Scheme; and Bishkhali FCDI Scheme.
12. **COMPARTMENTALIZATION PILOT PROJECT (FAP-20):** The overall objective of the project is to establish an appropriate water management system for the development of protected areas so that criteria and principles for design, implementation and operation can be made available for the Flood Action Plan. This will entail the testing of the compartmentalization concept in the field under real operating conditions addressing all the relevant socio-economic, institutional and environmental issues, and trying out water control works and water management systems. These activities would be tested at Tangail and Sirajganj.
13. **BANK PROTECTION PROJECT (STUDY AND TEST) AND**
 14. **RIVER TRAINING AND ACTIVE FLOOD PLAIN MANAGEMENT PILOT PROJECT (AFPM) (Study and Test):** Building on the past practical experience on the Jamuna and other rivers of Bangladesh and making the best use of other studies, the objectives of the project are two fold: (a) to investigate ways of refining the design criteria and improving the construction and maintenance of bank protection works, and (b) to investigate methods to stabilize the courses of the river channels and to reduce the risk of violent channel displacements, preferably by employing the river's own forces. The projects are under implementation.
15. **RIVER SURVEY PROGRAMME:** The objectives of the project are: to collect reliable all-season hydrological, morphological and hydrographic data at key locations on the country's main river systems with emphasis on the collection of data during monsoon season and to upgrade the institutional capability in Bangladesh for river hydrological, morphological data collection and study programme.
16. **MORPHOLOGICAL IMPACT ASSESSMENT (MIA) OF THE MAIN RIVERS SYSTEM OF BANGLADESH:** The aim of the Morphological Impact Assessment (MIA) is to develop the capability to conduct MIA as a part of framework within which the technical, social, economic, environmental and other effects of various alternative flood management and river training projects can be assessed. It also aims to develop guidelines for water resources planners on the morphological implications of bank protection and river training works etc.
17. **OPERATION AND MAINTENANCE STUDY-PHASE-II:** The 1st phase study identified O&M problems and constraints of FCDI projects and recommended various options for effective operation and maintenance. The 2nd phase would provide new approaches to development of effective O&M guidelines and operational manual through implementation of pilot projects. People's participation would be emphasized and institutionalized under this project.
18. **FISHERIES STUDY PHASE-II PILOT PROJECT:** The Fisheries Study (FAP-17) is the first study to look into the impacts on fisheries during the planning stage of FCD projects. The Phase-II programme includes a series of pilot projects designed to demonstrate feasible fisheries interventions/strategies which can minimize and compensate the loss of capture fisheries.
19. **ENVIRONMENTAL IMPACT ASSESSMENT (FAP-16) AND GEOGRAPHIC INFORMATION SYSTEM (FAP-19) EXTENSION:** The extension project has been named as "Environment and Geographic Information System Support project for the Water Sector". The objective of the extension project is to preserve the existing FAP 16 Environmental and FAP 19 GIS capabilities. The project will provide the means and a foundation for permanently strengthening the water sector capability to plan, design and implement environmentally sustainable development programmes through the use of spatial information technology and environmental assessment process and will provide support to WARPO.

TOPOGRAPHIC MAPPING (FAP-18) - PHASE II: This include aerial photography (87000 sq km), establishment of GPS, 2nd order levelling topographic survey and maps, spot images etc. and updating of the data collected during the past five years.

CONTINUATION OF FLOOD MANAGEMENT MODELLING (FAP-25) ACTIVITIES AT SWMC: The flood modelling activities are needed to support the new direction of water management in Bangladesh. The emphasis so far has been given to flood modelling. Further development of new models and refinement of the existing ones are needed to meet the new requirements e.g., water management, low flow simulation and forecasting, surface water-groundwater interaction etc.

Table - 2 : IMPLEMENTATION (1995-2000)

20. **FLOOD FORECASTING AND WARNING SERVICE - EXPANSION:** This is an expansion of 1989 project to provide improved, timely and localized information for flood forecasting and warning for disaster preparedness through the use of more advanced equipment such as Telemetry etc. The technical developments will enable to improve and expand the capabilities of the Flood Forecasting and Warning Centre so that it will function as a proper "operations centre"; extend the coverage of flood monitoring and forecasting to a larger proportion of the country with depth/area inundation; and to improve the dissemination of forecast outputs and develop public awareness at the grass-root level.

21. **DISASTER MANAGEMENT-II :** The phase-I of the study has shown that people evacuate to safer sites if they are convinced that their lives are in immediate risk, their land and property will not be stolen in their absence, and if there is time to reach known safer sites. The Phase-I made certain recommendations about disaster management which the Government has accepted and has established the Disaster Management Bureau to implement a Disaster Management Programme. The development objective of Phase II is to enhance national capacity to plan preparedness for disasters and to cope with their consequences.

22. **IMPROVED FLOOD WARNING:** To provide timely, readily understood, warnings to villagers in flood-prone areas of flash floods imminent in their locality and posing danger to them, and to promote their appropriate responses to the warnings. The initiatives to be undertaken on a pilot basis would cover flash flood-prone areas in the north-east region and include detection of rising river water levels corresponding to "moderate", "very" and "extremely" dangerous conditions through recognizably different audio and visual warning signals every 5 km along the flood's path. The pilot project also will include appropriate protective/evasive actions by villagers in response to each level of danger signal.

23. **IMPROVEMENT OF HOMESTEAD PLATFORMS:** The purpose of the project is to finance the earthwork required to enlarge and to raise homesteads, enlarge and repair partially eroded platforms, construction of new homestead platforms etc. above danger level. The present programme is to have a pilot programme for implementation in the north east region.

24. **JAMUNA RIGHT BANK FLOOD PROOFING PROGRAMME ALONG BRAHMAPUTRA RIGHT EMBANKMENT(BRE)+TEESTA RIGHT EMBANKMENT (TRE)-CHARLAND :** The purpose of the project is to mitigate adverse effects of flood in the unprotected areas flood proofing with non-structural or minor structural measures as a long-term solution. Flood proofing aims to minimize loss of human life, reduce disruption of normal activities during and after a flood, and provide people with the security and motivation necessary to make and sustain improvements in their economic and social welfare.
The recommended flood proofing measures include: in the charland areas, raised platforms, flood shelters (to serve as school/health centres), tubewells and pit latrines, relief centres for storage of food, medical supplies etc.; and NGO assistance to improve existing flood proofing effectiveness, particularly in more destitute families, Government initiatives to improve flood proofing effectiveness of public sector facilities.

25. **JAMUNA LEFT BANK FLOOD PROOFING MEASURES (CHARLAND, ETC.):** The main objectives of the project are: (1) to safeguard life and property of the people living in charland through flood proofing measures which include (a) construction of community infrastructure, (b) minor structural flood proofing, (c) engineering and technical assistance for the people living in Charland, and (d) NGO support to assist with implementation of flood proofing programme; (2) to initiate and implement other programmes like different income generating activities including diversification from agriculture to minimize risk. An initial three-year pilot programme featuring additional data collection and studies and construction of pilot flood proofing will lead to detailed definition of project design and implementation procedure. Pilot schemes and studies will cover five representative areas.

- 26/26a **CYCLONE PROTECTION PROJECT (Coastal Embankment Rehabilitation Project):Phase I and II**
The general objectives of embankments of the Cyclone Protection Project are the protection of Polders against inundation by saline water due to high tide and wave overtopping during monsoon condition to minimize flooding and water flow velocities in the polder during severe cyclonic storms and for protection of the Chittagong Export Processing Zone (EPZ) area, adjoining EPZ development areas and other major industrial areas: Patenga and the coastal embankments in greater Khulna, Barisal and Noakhali districts against inundation due to storm surge and wave overtopping during severe cyclonic storms. Phase-I of the project is being completed in greater Chittagong district. The Phase-II of the project will cover the polder/ embankments in greater Khulna, Barisal Noakhali and left-over polder of Chittagong. The embankments should be made motorable round the year for the benefit of communication.

27. **BRAHMAPUTRA RIGHT EMBANKMENT STRENGTHENING:** The Brahmaputra Right Embankment (BRE) is a 180 km long earthen embankment along the right bank of the Brahmaputra and 40 km along the Teesta built in the late-sixties for flood control. The objective was jeopardized due to the rapid and serious erosion of the Brahmaputra right bank. Some 146,000 people have become squatters due to the devastation of the river. The proposed programme under the Master plan will require 30 years to be implemented in stages. Stage one plans to complete the works at Sirajganj and Sariakandi/ Mothurapara to protect the bank erosion and control floods in the urban and rural areas on the right bank of the Brahmaputra river.
28. **KALNI-KUSHIYARA RIVER IMPROVEMENT PROJECT:** Based on the available information on sand and silt deposits a tentative five year programme of channel improvements has been prepared for pre-feasibility level investigations. Channel restoration works include the removal of 12.5 million cubic meter of sediments from the river and excavation of two further loop cuts. Benefits from the work include improved river navigation throughout the year, lower pre-monsoon water levels and faster post-monsoon drainage improved security of existing submersible embankment projects in the central basin, and construction of new village platforms from the dredged spoil. A pilot programme has been drawn up for dredging a portion of the Kalni-Kushiyara river which will help reduce pre-monsoon and post-monsoon flood levels on the rivers, and to improve navigation by a programme of maintenance dredging and loop cuts.
29. **DHAKA INTEGRATED FLOOD PROTECTION PROJECT:** The objective of the project is to provide a flood free and secure living environment, and to improve the urban efficiencies and environmental conditions (particularly for the urban poor) in Dhaka city. It consists of: (a) flood control and drainage works, and (b) environmental improvement programme including low cost water supply, sanitation, slum and squatter area development etc. The project covers, the most densely populated western part of the city comprising about 13,650 ha with a population of 4.2 million (87% of the city population). It covers mainly the completion of the flood protection and drainage programme initiated by the Government following the 1988 floods.
30. **SECONDARY TOWNS INTEGRATED PROTECTION PROJECT :** The project identified strategic secondary towns for priority protection and for each of the selected towns produced an integrated plan for flood control, drainage improvement, prevention of soil erosion, solid waste collection and disposal, and slum and squatter area improvement. The first priority towns are Khulna, Panchagarh, Dinajpur, Kurigram, Moulvi Bazar and Habiganj. The project proposes an integrated development for all the six towns and have been grouped under: Flood Protection Works, Drainage Works, and Environment Improvement Works. The project is now under implementation.
31. **GREATER DHAKA PROTECTION PROJECT (FAP 8A): Dhaka Narayanganj Demra (DND) Project Area:** The objective is to extend flood protection and drainage in the Greater Dhaka Metropolitan Area as per the Master Plan prepared under the Greater Dhaka Protection Programme (FAP 8A). Dhaka Narayanganj Demra (DND) project area, one of the nine areas of development, covers 5680 ha. with a population of 0.45 million. This project is in the priority list of Rajdhani Unnayan Kartipakkha (RAJUK). Feasibility studies for all these areas have been carried out.
32. **MEGHNA RIVER BANK PROTECTION (FAP-9B) (Bhairab Bazar and Munshiganj):** The project proposes protection against erosion at Bhairab Bazar township; railway bridge on the Meghna river and Munshiganj Town on the Dhaleshwari river. The problem of Bhairab Bazar is instability of land areas in Bhairab Bazar Town, deep scour holes near the piers of the railway bridge, and that of Munshiganj is erosion of banks mainly due to wave action during high river stages. The erosion threatens the infrastructure and commercial buildings.
33. **FISHERIES ENGINEERING MEASURES:** The project will specifically maintain or re-establish migration routes by providing fish pass structures in embankments, protect selected beels from sedimentation and increase beel water storage by constructing protective embankments which eliminate critical access between floodplain, beel and river habitats. New and existing FCDI projects can be made less inimical to fish by providing fish passes at key points in embankments. Fish passes will first require a pilot project to verify designs and impacts. The pilot project in Manu Barrage Project is under implementation.
34. **CHANDPUR IRRIGATION PROJECT RETIREMENT AND REHABILITATION:** The Chandpur Irrigation Project (CIP) completed in 1976 as an FCDI project, is located on the east bank of the Lower Meghna and to the south of the Dakatia river. The project now suffers mostly from the erosion problems and the consequent breaches at the most western point of the embankment along the Lower Meghna. Breaches occurring at different times are being overcome by retiring the embankment. The Lower Meghna left bank may stabilize if Eklashpur and Chandpur town are made into hard points. In the meantime, the SE Regional Plan recommended retirement of embankment and excavation of some canals and drainage channels. This will involve retirement of embankment at Haimchar and re-excavation of canals and drainage channels.

