



Water Resources Planning Organization

Ministry of Water Resources

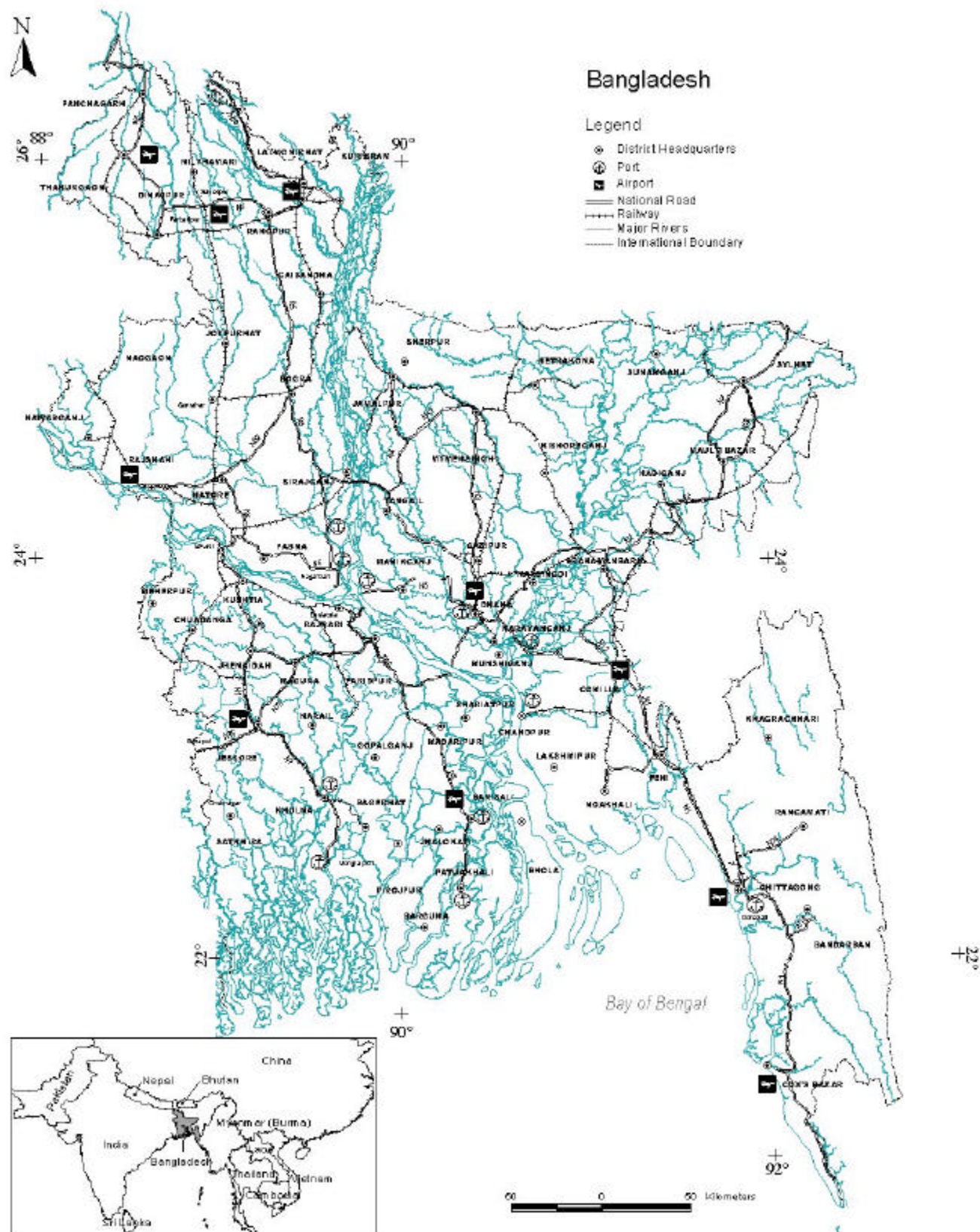
Government of the People's Republic of Bangladesh

National Water Management Plan Development Strategy

June 2001

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1 Introduction

The Ministry of Water Resources published the National Water Policy (NWPo) for Bangladesh in early 1999. The Policy *lays down the broad principles of development of water resources and their rational utilisation under these constraints. It is intended to help guide both public and private actions in the future for ensuring optimal development and management of water that benefits both individuals and the society at large.*

In line with the requirements of the NWPo, the National Water Management Plan (NWMP) is being prepared in a comprehensive and integrated manner, with regard for the interests of all water-related sectors and taking full account of other sectoral policies of the Government. Widespread consultation has been conducted amongst a broad range of stakeholders throughout the country and, following a thorough assessment of development issues, different development options have been carefully considered and debated.

This Development Strategy sets out a framework for action within which the NWMP is to be formulated. It makes clear the steps that Government intends to take to ensure development of effective institutions and legal and regulatory measures and to enable efficient and equitable management of the sector as a whole. It further sets out the main aims and focus of activities within each sub-sector, such that these may proceed in a coordinated manner consistent with achieving Policy objectives.

The Government entrusted the Water Resources Planning Organisation (WARPO) of the Ministry of Water Resources with preparation of the NWMP. The Plan is intended to provide the necessary advice on follow-up actions to be taken for implementing the NWPo, thereby contributing to national economic development through rational management of water resources, in a way that protects the natural environment and improves the quality of life for the people of Bangladesh.

The NWMP will be reviewed and updated every five years and set in the context of development indicators up to 50 years ahead. It will be a firm plan for the next five years, an indicative plan for the subsequent five years, and a perspective plan to 2025. Sector agencies of the Government and local bodies will prepare and implement sub-regional and local water-management plans in conformance with the NWMP and approved Government guidelines.

The planning framework suggested by the National Water Policy (NWPo) is one that addresses (i) national goals, (ii) improved management of the water sector, (iii) effective institutional, legal and regulatory measures, and (iv) efficient and equitable development measures. The main choices that have guided strategy formulation relate to the emphasis or priority to be given to **national goals**, the selection of an appropriate future **institutional framework**, and the selection of suitable sub-sectoral and regional **development measures**, taking account of their social, economic, environmental and technical merits and demerits.

Three main *strategic choices* have been considered, each representing a different understanding of the relative importance of the individual national goals:

- (i) **Balanced Development Strategy**, where, in selecting development measures, equal importance is given to all six national goals:
 - Economic development
 - Poverty alleviation
 - Food security
 - Public health and safety
 - Standard of living
 - Protection of the natural environment
- (ii) **Economic Growth Strategy**, where priority is given to the national goals of:
 - Economic development
 - Poverty alleviation
 - Food security
 - Standard of living
- (iii) **Health and Environment Strategy**, where priority is given to the national goals of:
 - Public health and safety
 - Protection of the natural environment

Each Strategy sets a different path towards the same overall goal that reflects the long-term needs for developing the sector, the differences being in the order and the speed with which activities are taken up.

A wide range of development measures, identified through a participatory process, has been screened and evaluated in a two-stage process that has considered how well each addresses national goals and is applicable to current and future regional needs. The implications of phasing of the selected measures, reflecting the three main strategies, have been considered in the form of alternative short-, medium- and long-term programmes.

It is recognised that there is a need to continue to expand the knowledge of both water resources and system demands, in both cases in terms of quality, quantity and spatial and temporal variations. A key component of the strategy is therefore to address this at an early stage of the NWMP.

The Development Strategy for the Water Sector as enunciated here has been prepared after a review of these alternative strategies and their implications on the many different stakeholders in the water sector. From this, it has been concluded that a **Balanced Development Strategy**, giving equal weight to each national goal, is the most appropriate course to follow at this time.

2 Policy Objectives and Development Challenges

2.1 ***The National Water Policy***

Water sector development must conform to and address the National Water Policy (NWPo) of 1999. Its prime intention is “....to ensure progress towards fulfilling national goals of economic development, poverty alleviation, food security, public health and safety, decent standard of living for the people and protection of the natural environment.” The six formative objectives as determined by the Policy can be summarised briefly as follows:

- To address issues related to the harnessing and development of all forms of surface water and groundwater and management of these resources in an efficient and equitable manner;
- To ensure the availability of water to all elements of the society including the poor and the underprivileged, and to take into account the particular needs of women and children;
- To accelerate the development of sustainable public and private water delivery systems with appropriate legal and financial measures and incentives, including delineation of water rights and water pricing;
- To bring institutional changes that will help decentralise the management of water resources and enhance the role of women in water management;
- To develop a legal and regulatory environment that will help the process of decentralisation and sound environmental management, and will improve the investment climate for the private sector in water development and management; and
- To develop a state of knowledge and capability that will enable the country to design future water resources management plans by itself with economic efficiency, gender equity, social justice and environmental awareness to facilitate achievement of the water management objectives through broad public participation.

The achievement of these objectives requires a comprehensive implementation package involving:

- New legislation and regulations, particularly a Water Resources Act and a regulatory framework for private sector participation;
- Institutional development and strengthening at central and local levels;
- Consultation and participation with the direct beneficiaries in the hand-over and development of water schemes;

- Decentralisation and devolution of responsibility for management and operation of water schemes to local government and local water groups; and
- Private sector participation in the development, financing, management and operation of water schemes at the local and regional levels, as well as in the major cities. This could involve companies with the appropriate qualifications, financial backing and expertise.

together with implementation of a range of structural and non-structural measures designed to:

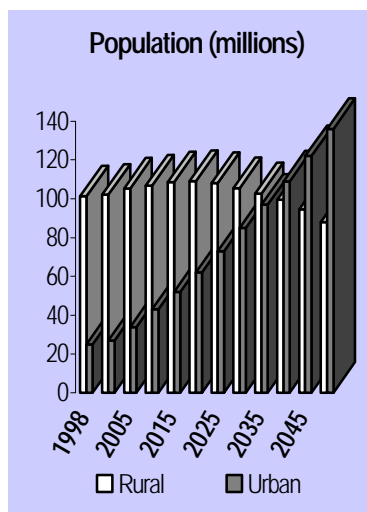
- Improve efficiency of resource utilisation through conjunctive use of all forms of surface water and groundwater for irrigation and urban water supply,
- Facilitate availability of safe and affordable drinking water supplies
- Comprehensively develop and manage the main rivers for multipurpose use
- De-silt watercourses to maintain navigation channels and proper drainage
- Develop flood-proofing systems to manage natural disasters
- Provide desired levels of protection in designated flood risk zones
- Implement river training and erosion control works for preservation of scarce land and prevention of landlessness and pauperisation.
- Reclaim land from the sea and rivers
- Develop mini-hydropower and recreational facilities at or around water bodies
- Implement environmental protection, restoration and enhancement measures consistent with the National Environmental Management Action Plan.

2.2 ***Socio-Economic Challenges***

The package above represents a clear mission statement that the NWMP must address. It is important however, to appreciate that there are also social and economic imperatives that must be taken into account.

Population growth - The rate of population growth has slowed to less than 2% per year, but in absolute terms this still means that the population is projected to increase by 40% from about 129 million in 2000 to 181 million by 2025, and 224 million by 2050.

Urbanisation - Most of the predicted population increase is expected to be in urban areas, where, partly due to rural-urban migration, the population is expected to increase by 46 million in the next 25 years, from 27 million (21% of total) in 2000 to 73 million (40%) by 2025, and 136 million (60%) by 2050. Therefore, substantial investment and improved provision of social and economic infrastructure will be required in the urban areas.



Poverty alleviation - 57% of the population in rural areas and 51% in urban areas is classified as poor. Poverty is the country's most pressing socio-economic issue, and must be addressed within a comprehensive planning framework that facilitates interventions which directly assist the poor.

Economic growth and development - Sustained high-level economic growth is a key target in order to address the most pressing development problems. It is expected that the current economic growth rate of 5.5% will increase to at least 6% per year over the next 25 years. In a global market place, this will require further economic liberalisation and greater private sector participation (domestic and foreign).

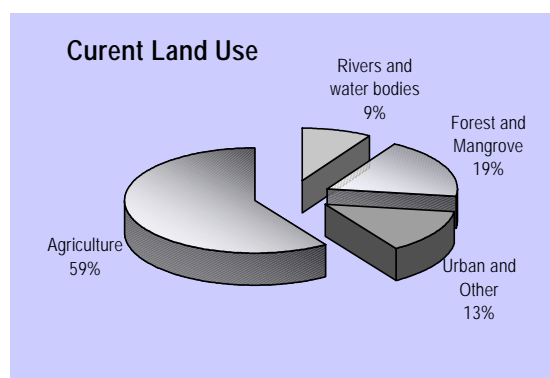
Employment generation - Job-creation, particularly in the urban areas, will become a key policy issue. The projected growth in urban population means that some 14 million new employment opportunities will be needed in the next 25 years - and a further 21 million by the year 2050.

Democratisation and development - Demand is increasing for full consultation and participation at all stages in the planning and implementation of sector programmes and project interventions.

Education and public health - Major investments will be required in education and public health to eliminate illiteracy, develop new skills and ensure the well-being of all the people. Additional investment will be needed to manage the adverse impact of arsenic contamination.

Food security - The Government's target of rice and protein security to 2025 will require continuing yield improvements as well as the intensification and expansion of irrigation by private sector farmers.

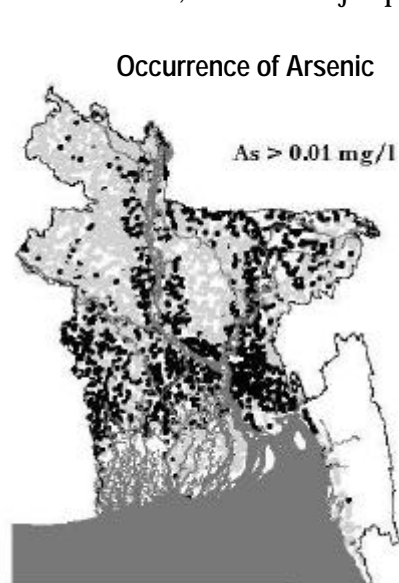
Agriculture land availability - Pressure from urban expansion and other land uses will reduce land available for agriculture, and significantly reduce agricultural land per capita, imposing additional requirements for crop production.



2.3 **Environmental Challenges**

Major concerns have emerged relating to the natural environment and water-related impacts on fisheries. These already require urgent attention, and will become much worse, if left unattended.

Surface water quality – Severe problems are arising in industrial areas, particularly around Dhaka, and faecal contamination, mainly in urban areas, village ponds and small streams, is also a major problem. There are indications that aquifer pollution is



also occurring in some of these areas. Major efforts are needed to arrest and reverse these trends.

Groundwater quality – The presence of arsenic in the shallow aquifer is a major threat to human health, as it is both toxic and carcinogenic. Current understanding is that about 25% of the population are exposed to contamination exceeding Bangladesh standards, with a further 21% with supplies that do not meet the more stringent WHO standards. This dire situation requires priority attention, along with lesser issues of other contaminants.

Fisheries – Capture fishing on the flood plains has been a traditional activity of immense value to the poor. Stocks have declined rapidly in recent

years due to water pollution, impeded migration routes and over-exploitation. Unless urgent steps are taken, capture fishing will become a thing of the past, at great commercial loss and raising major issues of protein security for the poor.

Watershed Management – In the upland and hilly areas, land degradation contributes towards increased soil erosion and impacts on the river systems as sediment loads increase. Forestry plays an essential role in watershed management and efforts are to sustain and expand forest areas in line with the Government's policy.

Environmental conservation and protection - The principal ecologically-sensitive areas of the country are under great pressure, both from encroachment and as sources for subsistence and production. Both the Sundarbans and the Tanguar Haor Basin of the Northeast, being Ramsar sites, merit special attention. There is a real danger that their degradation will become habitual. The key issue is to reverse this trend before there are no sites left worth conserving.

2.4 **Technical Challenges**

The physiography of Bangladesh, coupled with the demographic, socio-economic and environmental pressures, create many technical challenges. Some of these are relatively well understood, and solutions are available either within the country or can be found from elsewhere. However, in a number of strategically important areas,

major challenges exist that relate to the specific circumstances occurring in Bangladesh.

River maintenance – The river systems are the life-blood of Bangladesh, which have shaped the history and rich culture of the people. They are sources both of danger from flooding and erosion, and of sustenance for the water and sediments they contain. They provide an arterial transportation network for people, goods and fish migration, and keep salinity intrusion at bay. The Government is intent on maintaining the rivers to serve these purposes through comprehensive development and management of both the main and local river systems. The strategy to effect this combines the progressive development of barrages and local diversion structures where feasible, combined with dredging programmes to sustain adequate depths of flow to meet multipurpose use. At a local level, community participation in drain re-excavation will be encouraged also. The challenge is to do all this in a cost-effective manner, requiring careful planning of dredging and other works in a manner that effectively minimises re-siltation.

Erosion control – River bank erosion causes immense hardship to those affected and the Government is committed to mitigating this problem. Engineering works, particularly on the main rivers are expensive to build and maintain, and can be subject to high risk. Investigations into lower cost solutions including non-structural measures have been taken up and need to be further developed. A detailed review is needed of experience gained, with individual river plans prepared and/or updated on an integrated basis in the light of recent infrastructure development and changing land values. An *ad hoc* approach is to be avoided to this challenging problem.

Principal water-related issues in the regions

Common issues

- Improved urban and rural services
- Improved environmental management and pollution control
- The arsenic problem
- Improved local drainage and water management facilities

South West Region

- Preservation of the Sundarbans
- Restoration of dry season freshwater inflows to the region
- Maintenance the coastal embankment system
- Alleviation of coastal drainage congestion
- Improved cyclone protection
- Remedial actions for existing FCDI schemes
- Flood proofing needs in the charlands and low lying areas

North East Region

- Environmental management of the Haor Basin
- Remedial actions for existing FCD schemes
- Flood proofing of villages in the Haor Basin
- Erosion of old Brahmaputra left bank
- Drainage congestion in the Kalni-Kushiyara and other rivers
- Local development of hill irrigation

North Central Region

- Bulk water supplies and pollution clean-up for Dhaka City
- Flooding and drainage problems in parts of the region
- Flood proofing needs in the charlands and low lying areas

North West Region

- Erosion along the right bank of the Brahmaputra
- Flooding and drainage problems
- Remedial measures for existing FCD(I) schemes
- Drought in the western fringes, especially the High Barind
- Flood proofing needs in the charlands and low lying areas

South Central Region

- Maintenance of the existing coastal embankment system
- Siltation and drainage congestion
- Improved cyclone protection
- Flood proofing needs in the charlands and low lying areas

South East Region

- Gaseous aquifers
- Improved cyclone protection
- Maintenance of the existing coastal embankment system and drainage congestion
- Protection of newly accreted lands against tidal flooding
- Remedial action for existing inland FCDI schemes

Eastern Hills Region

- Small-scale irrigation development in the CHT
- Mini-hydropower development in the CHT
- Improved cyclone protection in the CCP
- Maintenance of the existing coastal embankment system

Rivers and Estuary Region

- An affordable long-term strategy for erosion protection
- An affordable long-term strategy for regional augmentation
- Flood proofing needs in the charlands and low lying areas
- Improved cyclone protection in the Meghna Estuary
- Erosion of Meghna River
- Timely protection on newly accreted lands

Land accretion - With the increasing pressure on land, accretion is an important issue for Bangladesh, whether naturally occurring as part of the delta building process or in the course of shifts in river alignments. Technical means for securing accreted land, through measures such as the development of the Coastal Green Belt, will remain an important activity where possible. However, greater focus needs to be brought upon socio-economic development, including improvement of land tenure arrangements.

Coastal zone management – Policy recognises that management of water resources in the coastal zone requires further study. These areas suffer from salinity intrusion, cyclone storms, lack of fresh water and impeded drainage. Sites of environmental importance, such as the Sundarbans, are threatened by the diminution of upland flows. The polder systems have created much benefit, but have had side effects, particularly in terms of poor drainage. Development of the shrimp industry has prompted significant social tensions. The Government is committed to help resolve these problems, and has already taken up a number of initiatives in this regard, such as afforestation of the foreshore to protect against tidal surges. From a water perspective, the challenge is to develop comprehensive and sustainable solutions that take account of the inter-action between tidal and upland flows on the water regime.

2.5

Knowledge Gaps

New challenges bring about the need for increased knowledge. Whilst it is recognised that many issues need to be studied in more detail as part of the development process, the following are seen as major knowledge gaps at national level. Filling these gaps is seen as an essential and integral component of the overall Development Strategy.

Climate change – The potential impacts of climate change resulting from global warming are of great importance to Bangladesh. In broad terms, evaporation to precipitation ratios are expected to rise progressively, prompting an increase in irrigation water requirements unless offset by diversification towards dry-foot crops. Whilst groundwater resources may be little affected, dry season transboundary flows may reduce. Main river flooding may increase in duration and flash flooding will tend to be more frequent, as also will cyclones. Surge depths will increase and a sea level rise of 0.5m by 2050 would exacerbate drainage congestion. Accretion of new coastal lands may be slower as a result. Understanding the full implications of climate change for Bangladesh and developing an appropriate response requires further consideration.



Arsenic – The implications of arsenic contamination of the shallow aquifer are substantial and at the centre of many strategic choices. Although much research has already been conducted into its occurrence and possible solutions, there are still considerable gaps in the understanding of both. Key areas of

research are the implications for food safety of irrigating with arsenic contaminated water, the horizontal and vertical extent of contamination, the prediction of whether aquifer contamination will change with time, and cost-effective solutions for immediate mitigation and long-term solutions.

Groundwater utility – The utility of groundwater depends on its quality, the level from which it must be pumped and its sustainable yield. Whilst some information is available about the latter, the implications of varying quality have not yet been fully quantified. Urgent attention is needed to improve knowledge about groundwater.

Natural environmental water requirements – The relationship between water and the natural environment is not well understood, and in few cases readily quantifiable. Particular issues relate to appropriate water management of wetlands, the impacts of changing salinity and morphological regimes on the coastal environment, requirements to sustain fish migration, and pollution control requirements. Establishing key indicators and thresholds for environmental health and sustainability is an early requirement

Long-term implications for water management

– As the lower riparian state of three major river systems, Bangladesh intends to work with its neighbours towards overall basin management, with an early focus on the different hydrological regions and promoting information exchange. Signature of the Ganges Water Treaty in 1996 is an important milestone, and continued efforts will be needed to secure Bangladesh's share of the flows of the other 53 transboundary rivers. Though many of these rivers contribute only a small proportion of the overall balance, locally they are important. In the longer-term there will be increased competition for water and greater environmental risks. A continuing dialogue amongst the co-riparian countries and extensive further studies will be needed to develop appropriate long-term strategies in response to the increasing demands on the overall system.



Devolved and decentralised water management – A major challenge set by Policy is to devolve and decentralise management of water resources and services. A variety of approaches have been adopted in different countries, often on the basis of historical precedence and cultural preference. It is not possible as yet to be certain what will be the best approach for Bangladesh, and a period of experimentation is required, most notably for management of flood control and drainage schemes, and more generally for water supplies. In view of the emphasis given by Policy to this, a substantial effort is called for to investigate, test and assess the options.

Promotion of private sector participation - Similarly, increased private sector participation is a major Policy platform where there are considerable uncertainties as to what would work best in this country. Whilst there is room for optimism over the

development of small businesses, increased participation in major infrastructure development and management is less certain. Again, there is a considerable body of knowledge in other countries, which have seen both success and failure in this regard, as well as early experience in Bangladesh's energy sector. Understanding PSP in the Bangladesh context, and the benefits it could bring in terms of improved efficiency and alternative funding sources, needs to be addressed at an early stage.

3 Institutional Development

3.1 ***Main Aims***

The Government intends to follow sound institutional principles and thereby to separate policy, planning, and regulatory functions from implementation and operational functions at each level of government, whilst at the same time holding each institution accountable for financial and operational performance.

The main aims for developing water sector institutions are determined by the NWPo and the changes envisaged to the institutional framework are intended to bring about:

- The progressive withdrawal of central Government agencies from activities that can be accomplished by local institutions and the private sector, in line with Government's commitment to decentralised decision taking through transparent mechanisms with emphasis on stakeholder participation.
- To the extent feasible and warranted, contracting out of central Government agency functions
- Activities at Zila level and below being carried out by a mix of LGIs, community-based organisations (CBO) and the private sector
- The municipalities progressively taking over full responsibility for providing their own water-related services, supported by the private sector.

Local institutions and organisations need to be developed and/or strengthened to fulfil their established mandates. They need to be financially sustainable and be given direct access to funding to exercise their responsibilities. While they will be accountable to the tax-paying electorate, there will also be a need to ensure that appropriate standards are met. The role of central agencies will change over time and some restructuring will be required responsive to evolving needs, involving changes in staff mixes, re-training and the way in which business is conducted.

3.2 ***Future Institutional Framework***

In adhering to these principles, the future institutional framework will contain the following main features:

- The National Water Resources Council, under the chairmanship of the Hon'ble Prime Minister, will continue to coordinate all water resources management activities in the country, including formulation of Policy and oversight of NWMP preparation and implementation. The Executive Committee of NWRC will support the Council through issuing directives required by NWRC and guiding institutions at all levels in formulating and implementing policies and plans for improved water resources management.

- The sector will be managed through national and regional framework plans that reflect both the Government's policies and the demands of the people. In time, national planning will be increasingly driven by consolidation of local plans. WARPO will retain responsibility for national planning and Local Government, with advice and overview from WARPO, will be the focus for local planning.
- Activities will be coordinated at a national level by Planning Commission according to advice given by WARPO. At a local level, the present DLIPEC system will be phased out and replaced by District Committees under Local Government with support from BWDB.
- The sector will be regulated under law. DoE will continue its mandate to protect and enhance the environment. New independent regulatory bodies will be formed to ensure water service delivery meets appropriate standards cost-effectively. It is anticipated that NGOs will continue their advocacy role at least until regulation becomes fully established.
- The river systems and coastal embankments will be managed and developed by BWDB, which will be encouraged to operate on a regional basis.
- Groundwater will be monitored and managed by BWDB but will continue to be largely developed by the private sector.
- Local Government will be strengthened and will increasingly take on management of local water resources, water supply and sanitation developments, urban and peri-urban services and cyclone protection shelters. DPHE and LGED will support this effort and become progressively more accountable to LG at zila level and below.
- The recently constituted Haor Development Board will ensure integrated development and management of haors and wetlands in accordance with their mandate
- Existing FCD infrastructure (up to 5,000ha), currently operated by BWDB and LGED, will be handed over to local Government and/or community groups as soon as sustainable mechanisms to effect the transfer are established. Ownership of schemes up to 1,000ha will be transferred to Local Government.
- Management of existing and new public irrigation projects and FCD over 5,000ha will be progressively restructured in line with Policy in a manner to be determined through trial and testing.
- MoA, through its agencies such as DAE, BADC and BMDA, will continue to promote efficient and productive use of water amongst farmers through various appropriate measures.
- Disaster preparedness and relief operations will continue to be a key element of sector management, and under the continued direction of DMB. Disaster forecasting responsibilities will remain with BWDB and the Meteorological

Department. Local Government, in concert with NGOs, will support flood proofing and bari-level cyclone protection measures.

- The private sector will be encouraged to participate in all water sector activities in varying ways. The main target areas of engagement are minor irrigation and water supply and sanitation services in both rural and urban sectors. Other areas of possible involvement include management contracting and river dredging, in addition to existing construction and consultancy services.

In addition, Government will continue to support the capacity development and training of staff in all its organisations through in-service training programmes. From its position of neutrality, WARPO will be the instigator of sector-wide integrated water resources management programmes covering multi-disciplinary and inter-sectoral skill development. Most actions are seen as short-term requirements to initiate as quickly as possible the development of the water sector institutions, whereas training and capacity building of Local Government Institutions are seen as continuing into the long-term. Significant progress on FCD and FCDI scheme transfers cannot be expected in the short term until appropriate mechanisms have been tried and tested.

4 Creation of an Enabling Environment

4.1 *Main Aims*

An enabling environment is essential if all elements of society are to perform efficiently. The emphasis placed in the NWPo recognises that many of the activities hitherto carried out by central Government can be equally or better performed by others, provided that opportunity is given and the risks are acceptable. At the same time, rules and standards need to be observed and enforced.

The Government will progressively develop an enabling environment consistent with sound institutional principles and policy objectives through a series of measures aimed at providing a coherent and comprehensive set of documents that will make clear the rights, obligations and rules of business required for the sector as a whole.

4.2 *Main Focus of Activities*

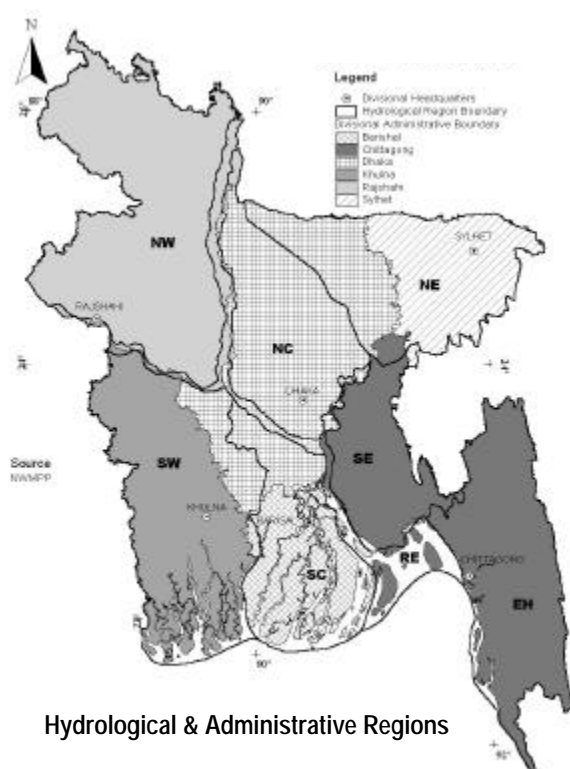
The measures summarised below are of fundamental importance to implementation of the NWMP.

Legislation - Existing legislation will be reviewed and a National Water Code will be drawn up covering all aspects of water rights and management.

New legislation should provide GoB with adequate powers over water resources, whilst still being practicable enough to enforce. In doing so, the new Act will clearly define the responsibilities and powers of all relevant agencies, and define the means of co-ordinating activities within the sector. Powers to stop encroachment in rivers, for instance, will be clarified and strengthened. Legislation must also provide for securing and safeguarding the rights of the individual and the community, and govern the development of common property resources, to encourage and protect private sector investment and to provide for the transfer of public sector assets to LGIs and beneficiary groups.

Documents for Enabling Environment	WR Act	Under-laws & rules	Guidelines	Manuals
<i>Institutions</i>				
• Institutional framework (constructs)	■			
• Legal framework for organisations	■			
• Rights & obligations of organisations & individuals	■	■		
• Constitutions/mandates for organisations	□	■		
<i>Process/ Preparation</i>				
• Steps required in development process	□	■		■
• Consultation process to be followed	□	■	■	■
• Mobilisation of grass root interests	□	■	■	■
• Transfer of assets/management responsibilities	□	■		■
• Mobilisation of private sector	□	■		■
• Gender requirements and audit	□	■	■	■
• Environmental requirements and audit	□	■	■	■
<i>Regulation and Economic Instruments</i>				
• Technical standards	□	■	■	
• Service supply standards	□	■	■	
• Social standards	□	■	■	
• Environmental standards	□	■	■	
• Cost recovery	□	■	■	■
• Zones applicable to special powers	□	■		■
• Enforcement of standards	□	■		■
• Tariffs, taxes and subsidies	□	■	■	■
■ Fully deals with subject				
□ Umbrella reference to subject, for other instrument(s) to elaborate				

Research and information management - Research and information management are necessary for effective planning and monitoring in the water sector. Adequate funding for the NWRD will be provided. Major efforts are required to improve data availability and quality. Administrative barriers to the exchange of data will be removed. An effective data pricing policy will be drawn up. Data collection will be rationalised and appropriate and unified data standards adopted. Investment will be made in processing, archiving and dissemination.



Zones, guidelines and procedures - Zones are to be defined by WARPO in co-operation with relevant agencies both for planning and regulatory purposes. However, in many cases they can only be defined in detail at a local level. Zones for planning purposes are water-stress zones, drought-prone zones, four types of flood management zones, and river channels used for navigation. Regulatory zones are water scarcity zones, industrial zones, fisheries and wildlife zones, water body zones and brackish water zones. The Water Resources Act will provide for special powers in regulatory zones to enable Government to intervene in prescribed circumstances.

Guidelines and procedures are required to ensure appropriate standards are met and practices followed. Where appropriate, agencies must be fully empowered to set and enforce standards. Manuals will also be required to assist agencies and individuals in understanding how to meet the requirements of both Guidelines and standards. Manuals can also be aimed at promoting best practices. In most instances, guidelines and manuals should be thoroughly field-tested before adoption, but even so will need to be periodically reviewed to ensure that they are serving their intended purpose.

Priority will be given to establishing and testing guidelines associated with participatory management and mobilisation of grass root interests, along with development of a comprehensive set of environmental standards and guidelines. Attention will also be given in the early stage to identifying and promoting steps to broaden private sector participation and formalising consultation requirements. Approaches necessary to ensure a gender-balanced development and management process will be looked into further, and appropriate measures taken up in this regard.

WARPO will be entrusted with supporting development of each of the above in co-operation with all relevant agencies and with full public consultation.

Participatory planning and management - The Government will strengthen Participatory Planning and Management in the water sector. Alternative stakeholder-driven models need to be considered and field-tested first for management of different types of FCD schemes, public irrigation projects and rural village water supply and sanitation schemes. Policy directives must be adhered to and, as appropriate, different arrangements will be considered involving line agencies, Local Government, community-based organisations and the private sector. The different models will be tested over an initial five-year period and evaluated before replication. During this period, the GoB will assess the possibility of introducing new local taxes to fund O&M and will also identify the circumstances by which centrally funded emergency relief is provided to the scheme operators. Adjustments to legislation may be required accordingly.

Promotion of women's participation - Increased women's participation in the water sector is a requirement of the NWPo and will be explored in the fields of project preparation and planning; employment in water schemes; training in the management and operation of local water supply and sanitation schemes; and increased involvement in the financial aspects of local water schemes (eg tariff billing and collection, book-keeping, etc). Changes in legislation will be introduced as required.

Media and awareness raising - Public awareness campaigns by all relevant agencies in the water sector are to be seen as an important vehicle for the active promotion of all the key components in the NWPo and the NWMP, fostering increased consultation and participation, and increased awareness of all water sector issues at local, regional and national levels.

Promoting private sector participation

- Active private sector participation (PSP) in the water sector, particularly water supply and sanitation, will be promoted through the introduction of a regulatory framework and appropriate incentives and pricing policies, and improved provision for credit and access to investment resources. Important current initiatives to stimulate domestic

and foreign investment in industry and power generation will be extended to cover the water sector and promote more local investment in the rural and peri-urban water sectors, including community-based initiatives and a fund to support low-cost appropriate technology solutions.



Regulatory and economic instruments - Regulatory and economic instruments are an important part of modern demand management in the water resources sector, and their utility and effectiveness need to be increased.

Registration of tubewells may be progressively established, but regulation of groundwater would be limited to control of over-abstraction, and particularly to restricting deep tubewell irrigation development in the coastal zone to limit saline penetration of the deep aquifer. Provision will be made to restrict surface water abstractions, other than for drinking and sanitation uses, in specific areas where there is a conflict in water resource allocation, and surface water diversions and damming of streams and khals where these create adverse impacts on downstream users.

Whilst a system should be introduced to monitor independently wastewater discharges to both surface and groundwater from municipal and industrial sources, pollution charges will be raised and imposed on those not meeting standards. For existing industry, a limited investment fund will be established to assist polluters in reducing wastewater pollution to within acceptable limits.

In addition to this support for existing industries, subsidies will be introduced and/or adjusted to support investment in appropriate measures in arsenic-affected areas (rural and urban). Support for the installation of Tara pumps will be phased out and replaced with other more appropriate measures targeted at areas with severe seasonal water-table decline. A fund will be created to stimulate introduction of rural and peri-urban piped water supplies by small and medium private sector developers.

Cost recovery tariffs and procedures will be reviewed and new systems progressively introduced to properly reflect operational costs in the short-term. In the medium and longer terms, cost recovery will be introduced in accordance with the National Water Policy, other than for FCD. These may include: water charges in public irrigation schemes based on the crops grown and hours of pumping on DTW schemes; water charges for rural water supply schemes covering all operation and maintenance costs as a minimum; tariffs for urban water supply and sanitation providing for full cost recovery based on an increasing block tariff structure with expansion of metered supplies; and introduction of effective billing and revenue collection procedures in all schemes.

Development finance - The availability of and access to adequate investment resources will be one of the major challenges for the effective implementation of the NWMP. The government will explore all options with an open mind and with a clear commitment to make the water sector financially robust, viable and sustainable. Specific attention will be given to mobilising local capital sources through bonds and other means with the active involvement of communities and the private sector, the establishment of water and environment funds, and the active encouragement of the international private sector. Following a study of the range of possibilities, Government will take up measures to promote alternative sources of finance.

The importance in establishing an effective enabling environment means that the main thrust of the activities will be taken up in the short-term. Some activities will run over into the medium-term, as it will take time to develop all the necessary measures.

5 Main River Development

5.1 *Main Aims*

In line with NWPo, the main aims for the main river systems are to ensure that they are comprehensively developed and managed for multipurpose use through a variety of measures, including a system of barrages, and other structural and non-structural measures. The Government also intends to work towards international river basin planning to realise the full potential benefits of these rivers.

5.2 *Situation Assessment*

The main river systems are of great strategic importance to Bangladesh and have deeply influenced the culture and ways of the people over the centuries. Transboundary monsoon flows are a major contributing factor to flooding and



drainage congestion, and also the cause of significant hardship by bank erosion. On the positive side, the rivers provide an effective arterial system for transportation of goods and people and for fish migration, reduce saline intrusion in the estuary and are a major strategic reserve of

fresh water in the dry season. However, it may take some time to formulate an overall long-term strategy for the main rivers as there are a number of fundamental issues for which major studies and research efforts are required. Some are already in progress, others need to be taken up in the short-term to provide guidance to medium-term actions.

5.3 *Main Focus of Activities*

The key areas of further study and research, in addition to improved resources estimation, are:

- To investigate the options and the feasibility of a range of identified **inter-regional potential developments** that would make multipurpose use of the main river dry-season flows. An ongoing study of the Options for the Ganges Dependant Area is expected to establish the most appropriate method of utilising the Ganges waters secured under the Ganges Treaty. An inter-regional study of the potential of the Meghna river to serve the needs of the Northeast

and Southeast regions by means of a barrage and/or by river pumping is required to establish the best choices for these regions.

- To investigate the potential for developing the waters of both the Brahmaputra and the Ganges to meet medium-and long-term strategic requirements. This is required to establish a clear **long-term risk management plan**, taking account of the potentials for augmentation of the Dhaleswari and for integrated development of the Brahmaputra, Ganges and Padma rivers. The study should also update the assessments of the Brahmaputra barrage. In considering bridge projects on large rivers, the possibility of combining them with barrages will be considered to optimise investment.
- To review and update the **master plan for erosion control** in the Brahmaputra and studies for other major rivers to ensure cost-effective development of erosion control measures in the light of experience gained over the last decade and the investments now made in bridge works.

Notwithstanding the need for the studies above, the broad strategy is envisaged as outlined below.

Development of surface water resources for multi-purpose use - Most of the Northeast, Southeast and Southwest regions are dependent upon surface water. Parts of the Northwest and North Central regions would also require surface water. First priority can therefore be assigned to development of surface water resources in the Southwest (to make optimal and expeditious use of the waters established under the 1996 Treaty on the basis of the on-going studies of the Gorai River Restoration Project and of the Ganges Barrage), and second to the Northeast and Southeast regions by utilisation of Meghna waters. Such developments of surface water in the Eastern Hills as are found viable should also proceed, as this region has little groundwater. Medium- to long- term plans will be conditioned by the availability of flows in the Ganges and the updated assessments of other resources, principally for the Northwest and North Central regions. Options to cope with the identified risks in the long run exist through the development of barrages on the Brahmaputra, Ganges and Padma rivers.



River management for navigation and erosion control - Maintenance and/or expansion of navigation routes will be on the basis of well designed and managed dredging programmes. The development of barrages as determined above would alter the conditions of many of the river systems, which may serve to reduce the amount of dredged volumes in

the future. In the short-term, the proposals for development of improved navigation around Dhaka, principally through dredging, may be taken further, but efforts should be made to integrate this activity with the overall development of Dhaka city flood

protection and drainage. In view of the high investment and maintenance costs involved, and acknowledging the strong social need to manage river erosion, an urgent review of experience gained over the last decade is warranted. The affordability of engineering works will be a significant consideration, and must be compared against the merits and demerits of a soft approach involving resettlement and improved local services.

Development of hydropower - The main prospects for hydropower are mini-hydropower in the Eastern Hills and at barrage sites as and when constructed. Each prospect needs to be considered on its own merits, and a strategy adopted that it is opportunistic, since the quantum of power developed is unlikely to be significant at a national level. Projects such as enlargement of Kaptai may be considered, but must be subjected to thorough environmental impact assessment. Mini-hydropower development is very much a local level issue.

With the possible exception of mini-hydropower, all investments are expected to be funded by central Government. Mini-hydropower development is generally suitable for a measure of private sector participation in development and financing. Other than hydropower and possibly some elements of main river pumping, little or no cost recovery can be expected. As a consequence, GoB will take into careful account the revenue funding of O&M that would be needed in determining appropriate solutions.

6 Towns and Rural Areas

6.1 *Main Aims*

In the towns (ie excluding the major cities) and rural areas, the main aims are, to the extent feasible and affordable, to satisfy increasing demands for safe drinking water and sanitation, and within the towns to provide adequate flood protection and stormwater drainage.

To achieve this, the principal objectives will be to provide a safe and reliable supply of potable water and sanitation services to all the inhabitants in the towns and rural areas, along with effective facilities for wastewater disposal to safeguard public health and protect the environment. In selected towns with facilities of economic importance, flood protection will be provided as a priority, and phased implementation of reasonable flood protection facilities will be introduced in Zila and Upazila towns.

Significant sustainable improvements will be targeted in operational efficiency and service delivery with prime responsibility decentralised to local government with active community participation and consultation, and special emphasis given to the role of women. Both community and private sector participation in the provision of water supply and sanitation services are to be promoted with an overall intention that affordable and financially sustainable services are offered to all levels of society, with particular emphasis on the poor and disadvantaged sections of the community.

Indicative service targets are given as shown for provision of water supply, sanitation, flood protection and stormwater drainage in the towns (large and small) and rural areas. Targets for private sector participation have been included as these also have bearing on funding and implementation capacity.

Towns and Rural Areas				
Indicative Targets for Water Supply, Sanitation & Stormwater Drainage				
	2005	2010	2025	2050
Water Supply				
Provision of arsenic mitigation facilities	70%	100%	100%	100%
Access to safe water for basic needs (towns and rural areas)	95%	100%	100%	100%
Provision of household piped water (towns)	50%	70%	90%	100%
Provision of household piped water (rural areas)	10%	10%	40%	90%
Water quality surveillance	40%	60%	100%	100%
Sanitation				
Access to appropriate sanitation (towns & rural areas)	70%	100%	100%	100%
Provision of household waterborne sanitation (towns)	10%	30%	70%	90%
Provision of household waterborne sanitation (rural)	5%	10%	20%	35%
Private Sector Participation				
Town water supply and sanitation	5%	15%	25%	50%
Rural water supply and sanitation	80%	95%	95%	95%
Flood Protection & Stormwater Drainage (towns only)				
Provision of flood protection in towns	50%	75%	100%	100%
Provision of stormwater drainage in towns	25%	40%	70%	100%

Future demands for water supply services will be driven in response to various driving forces, including population growth and economic development. Whilst urban population will rise relatively rapidly, overall population in the rural areas is expected to stabilise, although there will be increased clustering of people into villages and demand for more sophisticated services. Per capita demand will increase as incomes and standards of living rise and services improve.

The shift in the Government's position from provider to that of financing partner, regulator and facilitator of the water sector will require far-reaching institutional changes to be taken up. Consumers will also be expected to accept changes in concept, such as a shift from investing in individual household hand pumps to investing in and contributing to the management of shared systems. An increased emphasis on participatory planning will enable consumers to consider a range of products and to invest personal resources in those facilities they feel to be most desirable. Community-managed low-cost systems are expected to become a major part of future new initiatives.

These same forces will prompt a change from a simple pit latrine to a pour-flush latrine. While modest increases in household water consumption will not create drainage problems, the next stage of urban development is the introduction of water-borne sanitation. This will substantially increase the demand for water and necessitate investment in drainage systems. Low-cost solutions may be adequate in some areas, but sewerage systems and effective treatment will become necessary in more densely occupied urban areas to avoid widespread pollution of surface and groundwater resources.

Seasonal drawdown can be expected to become both more extensive and severe. Present knowledge, which is still insufficient, indicates that the area of arsenic contamination may remain more or less constant over time, although it is possible that it may intensify in the medium-term while reducing in intensity in the long- or very long-term. The demand for flood-free land to build on will continue to grow, due to increased population and expansion of the commercial and industrial sectors. The challenge for the future is how to encourage prudent development in appropriate locations, which does not have adverse effects on existing water resources, drainage or flooding regimes.

The mobilisation of sufficient funds to pay for the water-related components of urban infrastructure is an existing problem that will have to be addressed. Quality of service and willingness to pay are two closely related factors, though willingness to charge is also important. The private sector is already investing in land development in urban areas and, while it is currently willing to include water supply as part of these developments, the private sector rarely provides sewerage and effluent treatment.

Main Focus of Activities

Activities for this sub-sector fall into four categories: water supply, sanitation, flood protection and stormwater drainage.

Water supply - Considerable progress has been made in the provision of potable water supplies in towns and rural areas in the 1990s. However, arsenic contamination of groundwater has become a serious health hazard that must be addressed with the highest priority. Present estimates indicate that at least 30 million people are at risk



and about half the total population face a potential risk. The areas most seriously affected are the South East, South West, South Central and North East Regions. Short-term interventions are being tested (arsenic filters and household removal facilities), and medium- to longer-term solutions are being studied to access safe deeper aquifers below 250-300m. In arsenic-affected areas alternative sources, such as surface water, are to be considered.

In addition to other water quality issues such as the occurrence of iron and boron in groundwater, other important regional water supply constraints that will be addressed are: (a) seasonal draw-down of groundwater causing shortfalls in potable water supplies in the rural areas of parts of the North West, North Central and South West Regions; (b) saline intrusion in ground and surface water sources in the coastal belt of the South West, South Central, South East and Eastern Hills Regions; and (c) inequity of access to safe water sources in the North East, North Central, South West and Eastern Hills Regions.

The main options for water supply in the towns and rural areas cover a mix of technical alternatives that will address the issues of poverty, equity of access, affordability, sustainability and service improvements over the plan period. Local area systems (small piped systems based on water drawn from arsenic- and pollution-free sources and community level systems) for both peri-urban and rural areas should offer medium- to long-term water supply improvements, coupled with a framework for active community and private sector participation with the primary focus on the poor and disadvantaged sections of society. Towns (large and small) should also benefit from the progressive development of municipal water supply systems that will be the responsibility of the local municipality or a regulated private sector operation.

Sanitation - Adequate and appropriate sanitation in towns and rural areas will have important public health, poverty alleviation and environmental impacts. Viable options are expected to be: (a) rural areas - pit latrines and household latrines with septic tanks; and (b) towns - pit latrines, household latrines with septic tanks, community sanitation facilities, and smallbore sewerage systems. Delivery of the required improvements will involve the active collaboration of local municipalities, community based organisations and the private sector in all regions of the country.

Flood protection and stormwater drainage - These options are directed only at towns (large and small) in the medium- to long-term. For flood protection, the main choice is whether to raise land or develop peripheral protection. Land raising is attractive because it limits the requirement for Government investment, but is generally only practicable in areas of urban expansion, new towns or specific urban sites. In most instances, peripheral embankment protection will be the most expedient solution, but will require full stakeholder consultation, and appropriate local revenue raising to ensure adequate maintenance.

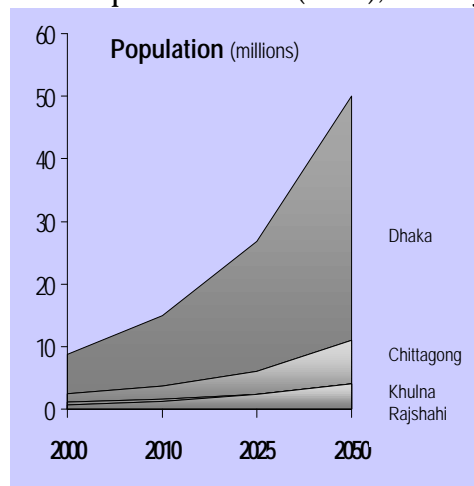
Adequate stormwater drainage should be an integral component in municipal infrastructure, but it is often inadequate or overlooked in the planning process. The Government will address this issue in the medium- to long-term, with a preference for gravity systems wherever possible.

Financing of towns and rural area service infrastructure is expected to come from a variety of sources. Whilst priority needs to be attached to arsenic mitigation measures, in a regional context the satisfaction of demands requires initially a catch-up first, as well as substantial investments for the future.

7 Major Cities

7.1 *Main Aims*

The major cities considered are the Statistical Metropolitan Areas (SMA), namely Dhaka, Chittagong, Khulna and Rajshahi. One of the major challenges is to address the development requirements of the urban sector, particularly Dhaka, which is expected to become one of the megacities of Asia. As in the preceding section, the main aims for these major cities are, to the extent feasible and affordable, to satisfy increasing demands for safe drinking water and sanitation and provide adequate flood protection and stormwater drainage. Options for wastewater management and recycling will be explored.



The overall objectives are similar to those in the towns and rural areas, namely provision of effective facilities to safeguard public health and the environment, attainment of significantly improved standards of operational efficiency and service provision with active community participation and consultation, promotion of

Major Cities				
Indicative Targets for Water Supply, Sanitation and Stormwater Drainage				
	2005	2010	2025	2050
Water Supply				
Access to safe water for basic needs	98%	100%	100%	100%
Provision of household piped water	65%	75%	90%	95%
Sanitation				
Access to appropriate sanitation	90%	100%	100%	100%
Provision of household waterborne sanitation	60%	70%	85%	90%
Stormwater Drainage				
Provision of stormwater drainage	50%	70%	100%	100%

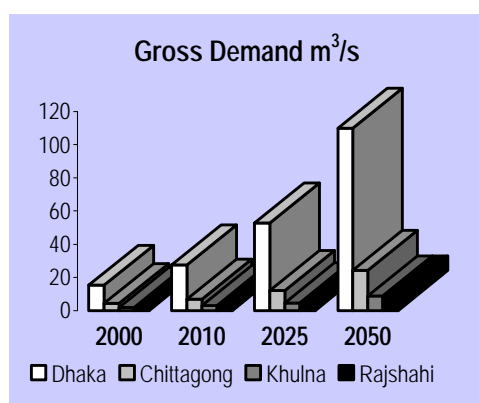
in water supply and sanitation, and provision of affordable and sustainable services to all city dwellers with particular emphasis on the poor and disadvantaged. Indicative targets for levels of service are given here for provision of water supply, sanitation, flood protection and stormwater drainage in the major cities.

7.2 *Situation Assessment*

The main water-related issues affecting these four major cities are concerned with service delivery, institutional development and financial issues, and a bold and innovative, market-led strategy for the major cities is called for reflecting the National Water Policy and providing leadership to the rest of the sector.

All the cities have been the subject of one or more urban development master plans, with expansion forecasts into adjacent areas. However, the historical trend has been

for densification of the existing areas because the infrastructure to support new development has rarely been put in place. Infrastructure constraints are likely to cause development to continue to happen where it is feasible and affordable, which may not coincide with the published plans. Transportation infrastructure and location of employment opportunities, which lie outside the water sector, are two of the key factors that will propel the future growth patterns.



A rapid increase is forecast in demand for water supply arising from the combination of increasing population and rising standards of living. Provision of this water will result in a corresponding need for improved drainage and sanitation arrangements. High land values, the absence of good transportation infrastructure to facilitate commuting, the pressure to maximise the benefits from flood-free or flood-proofed land, and the desire to reduce encroachment on agricultural land all combine to encourage

vertical development. Provision of adequate and reliable water supply and sanitation is essential to make high-rise developments habitable. The demand and the need for these services exist. The challenge for the future is to provide them. Slums already house a substantial proportion of the city populations. Even if the proportion of slum dwellers is held constant, there will be a large increase in their numbers. They will need access to basic water and sanitation services.

While it is feasible for apartment blocks to have their own wells as a source of water (subject to available groundwater resources), local disposal of effluent may not be possible. City supplies are most effectively planned as shared systems with provision for water supply, sewerage and storm drainage. Currently public access to water and sewerage, and roads and electrification, is not arranged in advance of development and developers adopt the easiest available short-term solution. One of the major constraints to the provision of adequate shared infrastructure will be the problem of land acquisition. New urban development initiatives are needed that may involve the development of new sites for cities (and towns), development of dormitory towns and suburbs for the major cities and development of designated and controlled industrial zones. These are key issues for Ministry of Land to address under a National Land Use Policy.

Future consumers will expect not only sufficient water, but also water of a quality that is safe to drink without further treatment. However, while



the quality of water entering the distribution system is under the direct control of the supplier, the quality of water reaching the consumer is more difficult to control, particularly if distribution pressures are low. Therefore sufficiency and reliability of supply are basic requirements for the achievement of a reliable quality.

Future requirements for sanitation will be largely based on the volume of water supplied (including private wells), most of which will be returned to the drainage system. The location of major water consuming/polluting industries will need to be planned and controlled. Therefore provision for major new industries may not be included under the city water supply and sanitation, but account must be taken of already existing industries.

Investment in storm water drainage will be needed wherever there is new urban development, while infill development will increase the runoff in existing urban areas. Urban expansion may be onto more flood prone land, so that the demand for flood protection can be expected to increase. In addition, sea level rises and other anticipated effects of climate change would reduce the existing level of protection, where it is already provided.

7.3 ***Main Focus of Activities***

Activities for this sub-sector fall into four categories: water supply, sanitation, flood protection and stormwater drainage.

Water supply and sanitation - The four major cities are expected to triple in population over the next 25 years. Dhaka is expected to absorb most of the increase, rising from nearly 9 million in 2000 to 27 million by 2025.

Major efforts will be needed to develop bulk water supplies and efficient delivery systems. Groundwater is already over-exploited in Dhaka and surface water systems will be needed from the Padma and possibly from the Brahmaputra rivers. Future configurations will depend on urban expansion plans, but development of the Dhaka–Tangail axis may be a likely outcome, favouring bulk supply system from near the Bangabandhu Bridge. The other cities will continue with a mix of groundwater and some surface water.

Various options are open for expansion of delivery systems. These may include Local Area Systems (FM hand pumps and small piped systems) to meet water demands in localised and peri-urban areas, particularly poor and disadvantaged communities, and Main Water Supply Systems (distribution systems supplied by, as appropriate, a combination of DTWs, well-fields and major surface water development) that would be progressively developed to serve an increasing proportion of each city's population. Local Area Systems will also provide the focus for direct individual and community participation in financing (partial), owning and operating community based systems.

The growth in urban water demand will stimulate the need for expansion and improvement in the full range of sanitation options throughout the planning period.

The main driving forces will be public health safeguards, environmental protection and the living conditions of the urban poor. The appropriate sanitation options identified for the four major cities are individual and local community facilities (pit latrines, household latrines with septic tanks, community sanitation facilities and small bore sewerage systems) that will satisfy hygienic sanitation requirements in localised and peri-urban areas, particularly poor and disadvantaged areas, with conventional waterborne sewerage systems with wastewater treatment offering the main long-term solution for effluent disposal in the four major cities.

The main constraints to the full development of these measures that will need to be overcome are expected to be institutional and financial.

Flood protection and stormwater drainage - Most of the necessary flood protection structures for the four major cities are in place and adequate for the next 25 years. The only exceptions are the Dhaka Eastern Flood Embankment and modest additional works for the three other cities. However, as the major cities continue to expand, appropriate urban planning along with improved, extended stormwater drainage systems will be necessary to minimise the socio-economic impact of storm water flows. The main options are gravity and pumped drainage systems, although the final choice will be site specific.

Institutional and financial reform - Important issues to address are (a) the pace and focus of institutional change; (b) widening private sector participation in the provision of water and sewerage services; and (c) setting tariffs that more appropriately reflect real resource costs.

A sustained programme to implement changes in the institutional and financial framework is required, based on the principles of effective demand management and improved incentives through appropriate governance, ownership and organisational structures, and through appropriate financing systems. The improved incentives will encourage operational efficiency and improved service delivery; and, coupled with realistic tariffs set at full cost recovery levels, develop sound commercial and financial viability of the urban water sector agencies, enable private sector participation, and attract funding for capital investment in the sector.

The main components of a demand-lead incentive-based strategy may include the following: (a) creation and/or strengthening of autonomous municipal enterprises, allowing in practice full responsibility for the management, operation and financial viability to an autonomous municipal company with its own board of directors and experienced technical managers; (b) commercialisation of the urban water and sanitation sector to encourage and promote private sector participation through management contracts, BOOT schemes and concession agreements; (c) introduction of market-oriented financial systems to promote financial viability and efficiency in the utilisation of resources mobilised on market terms; and (d) establishment of the necessary Regulatory Framework. Financing of major city service infrastructure is expected to come from a variety of sources.

8 Disaster Management

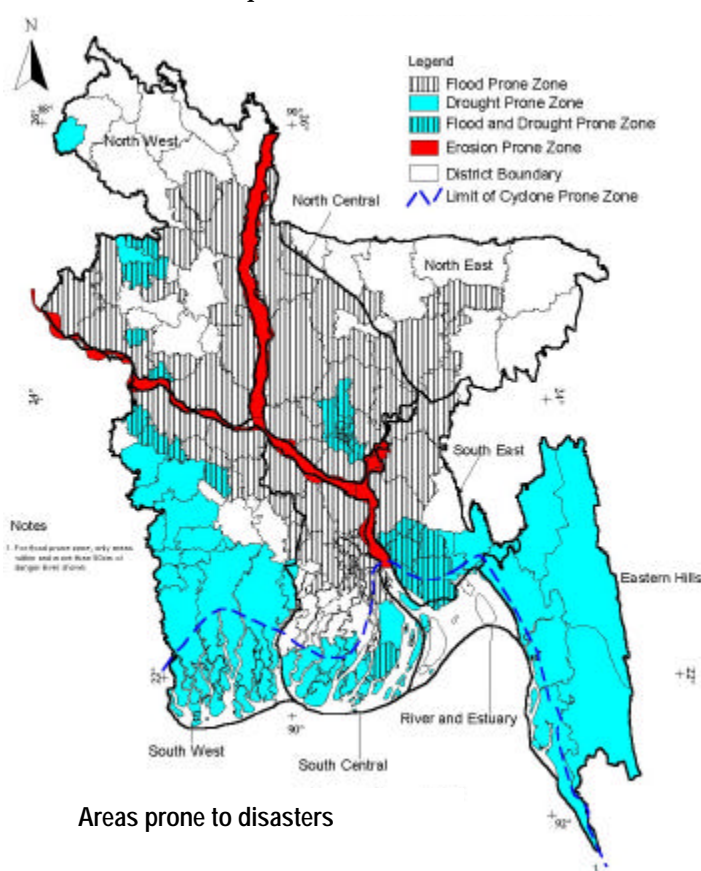
8.1 *Main Aims*

Disaster management (including disaster preparedness) involves prevention and mitigation measures, preparedness plans and related warning systems, emergency response measures and post-disaster reconstruction and rehabilitation. Over the last decade, disaster management has become recognised as both a necessary and legitimate element of overall water management.

Accordingly, in acknowledging that some people will always be at risk, the main aims for water-related disaster management are to provide the means by which, through a combination of structural and non-structural measures and to the extent feasible and affordable, people are adequately warned of an approaching disaster, are equipped to survive the disaster with as much as possible of their assets intact, and are adequately supported in rebuilding their lives thereafter.

8.2 *Situation Assessment*

Water-related natural disasters are a relatively common occurrence in Bangladesh. In this context, they are taken to include floods, droughts, cyclones and riverbank erosion. Each impacts on the livelihoods of those affected, but with different



Areas prone to disasters

severity. However, these days it is generally only cyclones that pose a direct threat to people's lives. Displacement due to erosion and inadequate facilities during and after major floods can create major hardship and health problems. Establishment of the Disaster Management Bureau in 1994 signalled Government's intention to view disasters in a more comprehensive manner. Forecasting facilities, preparedness planning and post-disaster relief efforts have reduced the severity of disaster impacts on those affected. The NGO community has also responded in a major way, building on the

experienced gained in 30 years of supporting community development in the country

at a grass-root level. What is now required is to build upon the collective knowledge and capacity to manage disasters in a more comprehensive and effective manner.

8.3

Main Focus of Activities

Cyclone protection - A major acceleration of the cyclone-proofing programme is required in parallel to separate measures to improve the management of the coastal embankment system. Development of improved conventional shelters-cum-schools will proceed initially in areas of highest risk at an appropriate density to provide access to all. In parallel to this, killas will be constructed in areas unsuited to shelters within the high-risk areas. Also, low cost bari-based schemes will be pilot-tested and evaluated in the short-term.



In the medium-term, a mix of all three options may be envisaged, with an initial target of providing protection throughout the area with a 1:30 year return period. Extension into lower risk areas (up to 1:100 year return period) is foreseen as demand driven and probably appropriately through bari-based systems if these are shown to be effective.

In the meantime, continued efforts will be made to steadily improve the cyclone-warning systems and disaster preparedness programmes. Along the coastal fringe, afforestation with appropriate species will be continued to provide protection against storm surges.

Flood proofing - Flood-proofing of the rural population in the Haor Basin (rather than flood control) and in the charlands and high priority activities will be completed within the medium-term.

Raising of national and regional highways and, to the extent feasible, railways will be expected to proceed as part of the network upgrading programmes and, as such may extend into the long term. Raising feeder and rural roads will be determined in the context of disaster management plans. Flood forecasting and warning systems will be continually upgraded as technologies for data acquisition, processing and dissemination improve.

Riverbank maintenance and erosion control - Efforts will continue to identify cost-effective designs for erosion control on medium and small rivers in the short- to medium-term. A system for erosion forecasting will be developed and tested in parallel to this. Integrated river management plans will be prepared (covering erosion control, dredging and other elements of river maintenance, such as pollution control, abstraction, navigation and environmental needs). Areas subject to a high risk of erosion and those with other urgent requirements will be prioritised in the context of these plans, with more widespread programmes being introduced in the medium-term. GoB will need to take steps in the short-term to identify the basis for funding maintenance works.

Drought management - Development of a reliable drought forecasting and warning system will be viewed as a short-term need. Once established and proven, it will be supplemented by dissemination programmes targeted at promoting supplementary irrigation for aman and aus principally. Efforts to drought-proof rural water supplies will run in parallel, as described above.

Implementation of the strategy will require close co-operation between the Ministry of Disaster Management and Relief, the numerous other GoB entities whose activities are affected by water-related disasters, local government, the ICZM Programme, the development partners, the NGOs and the private sector.

Whilst there is scope for partial beneficiary financing of flood-proofing and low-cost cyclone protection programmes, the majority of the costs will have to be borne by Government with little or no expectation of cost-recovery.

9 Agriculture and Water Management

9.1 **Main Aims**

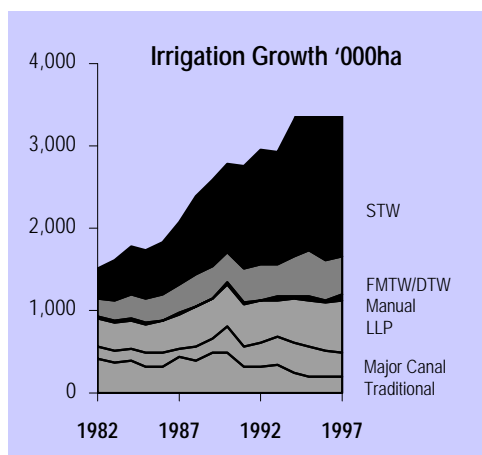
Bangladesh's overall agricultural policy objective is to expand and diversify agricultural production and to maintain food security, especially with regard to sustaining near self-sufficiency in rice. Whilst achievement of these aims is primarily the responsibility of the agricultural sector, the water sector has an important role to play by removing constraints that may be caused by either shortage or excess of water.

9.2 **Situation Assessment**

Irrigation has been, and is likely to continue to be, the major water sector contributor to agricultural growth. In addition to the expansion of irrigated rabi cropping, especially boro, an increase in the supplementary irrigation of aman can also be expected in the future. Past policies of a liberal approach to minor irrigation have paid considerable dividends, and at issue is how long current growth rates in minor irrigation will be sustained. Groundwater irrigation is limited to about 56% of the country and the main concerns are whether this will need to be curtailed due to possible arsenic contamination and the threat of its entering the food chain, and the impacts seasonally lowered watertables have on rural domestic supplies. The former is still being studied, and the latter can be addressed by deepening domestic supply wells and developing other sources.

Bangladesh is signatory to the international convention on Persistent Organic Pollution. The rapid adoption by farmers of high yielding varieties of rice has prompted an increase in the use of insecticides with attendant risks of pollution of water resources. The Government is committed to a policy of promoting integrated pest management. Monitoring of water quality will be strengthened and appropriate measures to counter pollution will be taken where found necessary.

Surface water irrigation in the hands of private LLP operators is the cheapest form of irrigation providing water is available nearby in sufficient quantities. It is applicable to 44% of the country where groundwater is not available and to those parts of the groundwater areas where deficits may be expected due to low recharge or arsenic limitations. Despite its attractiveness, surface water irrigation has developed more slowly than groundwater irrigation in both the public and private sectors. The main constraints had been the non-availability of the required public sector investments and the issue of the availability of water at the



point where it is needed. To overcome this requires a more efficient distribution of water from the main river systems through regional rivers, generally short-lengths of transfer channels, and improved local channel networks, combined with efforts to promote conjunctive use of surface and groundwater where feasible.

Augmentation of regional rivers could enable the entire irrigable area ultimately to be irrigated if required. However, the extent to which irrigation is taken up will depend on the feasibility of individual schemes and the extent to which the future demand for irrigation is off-set by other agricultural improvements, such as the availability of better seeds and varieties and improved husbandry.

Past experience with flood control has been mixed on the other hand, and Government's policy is to discourage further development and to rationalise the large stock of existing schemes and improve their management. Over the last forty years, much of the flood plains have been brought under flood control schemes and there are only a few areas left. These are generally either too deeply flooded or are adjacent to particularly unstable rivers. In the coastal zone, embankments have made an important contribution by providing protection against tidal flooding and mitigating the impacts of cyclones, but suffer similar management problems. In much of North East Region, submersible embankments provide partial flood protection, which has produced clear benefits, despite the high maintenance costs. Policy requires that an environmental audit is conducted on all flood control and drainage (FCD) schemes, that all remedial work and future management are conducted on a participatory basis, and that management of all but the largest schemes should be progressively transferred to local Government and community organisations.

Poor drainage is a severe problem throughout most of the country, but due to high outfall levels during the flood season there is no major generic solution (partly because pumped drainage is not justifiable for most agricultural land). Consequently, improvements to drainage have to be considered on a case by case basis, both at regional and local levels. Improved drainage would shorten the duration of flooding and would allow post-monsoon cropping to start earlier.

9.3 ***Main Focus of Activities***

These activities below need to be considered in the context of institutional changes and improvements to the enabling environment, both considered earlier.

Expansion and support to minor irrigation development - Expansion of tubewell irrigation will continue to be encouraged in all areas where over-exploitation is



not an issue and where arsenic contamination is not considered to be a health-hazard if the water is used for irrigation purposes. Study of the implications for public health of irrigating with water contaminated with arsenic is a vital area of research. Some increases in seasonal drawdown can be anticipated and a mitigation programme for rural water supplies is a more cost-effective solution than attempting to limit tubewell irrigation. Future growth of tubewell irrigation will be better assured through Government-supported promotion of cheaper force-mode pumps.

Government will take steps to support expansion of LLP irrigation by increasing the availability of water at the farm boundary (see Public Irrigation Development below). Improved on-farm water management (OFWM), which has attracted little attention in the past, in the form of improved farm channels is a potentially useful measure where savings in irrigation water use per hectare will result in expansion of irrigated crop area. OFWM will be supported mainly for LLP irrigation in the coastal zone and other water-short areas of Bangladesh

Public irrigation development - Activities involving public investment in surface water irrigation fall into five main sub-categories. Firstly, actions are required to improve the performance and management of existing BWDB irrigation schemes to avert the progressive deterioration of scheme infrastructure and performance that otherwise will occur. This will entail a mix of structural improvements combined with steps to both improve scheme management and cost recovery on all BWDB schemes.



Secondly, new works will be required to develop regional river systems to distribute water when diverted from the main rivers to augment surface water supplies for LLP irrigation. This is being studied for the GDA at present, but may also be applicable for the NE/SE regions from a Meghna Barrage, and for the NW/NC if a Brahmaputra Barrage is found necessary. These channels would generally require a measure of re-profiling, some cross-regulation and to the least extent possible, new inter-river transfers.

Thirdly, new lower-cost major irrigation schemes may be taken up where feasible. Larger pumped schemes are expected to be applicable in the South East in particular. Rubber dams, commanding normally much smaller areas, are appropriate for schemes in the coastal and other areas where they will not interfere with downstream users.

Fourthly, in certain areas where groundwater is available but too costly to attract private investment and surface water is not available nor planned to be made available in the future, then Government may consider development of subsidised DTW schemes. These may arise in and around the high Barind where depths to

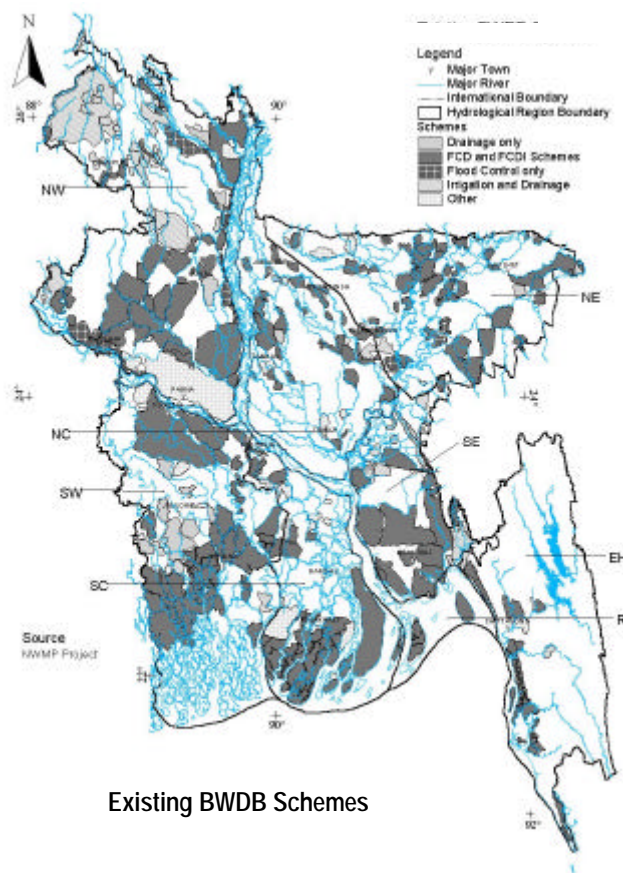
groundwater are great, and in the far Northwest where drilling costs are high due to the boulder-strewn sub-soils. Support may be provided through provision of direct subsidies to private investors, or by development along the lines of the Barind Integrated Area Development Project (BIADP).

Fifthly, there are currently some limited opportunities to develop locally available surface water resources in a manner that will promote further expansion of LLP irrigation. However, this will substantially increase with the measures above to develop inter-regional transfers and improved flows in the regional rivers. Such local developments will fall under the purview of Local Government, whose capacity to implement such programmes in an orderly and cost-effective manner will need strengthening.

River maintenance - River improvement programmes will be prepared in an integrated manner giving due importance to all users and environmental and fish migration requirements. The plans will identify dredging and erosion control measures, taking account of new flood protection requirements for areas of high economic importance as defined by Policy. Potential and actual sources of pollution will be identified along with areas of encroachment. In formulating programmes, actions will be prioritised taking account of social, environmental and economic criteria. Activities on regional river systems will be coordinated with improvements to local channel systems in a manner that leads to cost-effective and sustainable improvement of the surface water resource system by all concerned.

Regional drainage improvements will require case by case consideration and justification. It is improbable that all those so far identified by the concerned agencies will prove viable. Dredging and desiltation by mechanical or manual means nevertheless can be particularly effective where it is combined with other measures that will effect a regime change in the river and thereby reduce maintenance dredging. BWDB will continue to be responsible for the main and regional river systems, whilst local drainage and local improvements to water management generally will remain the responsibility of Local Government. Although in some instances local works can proceed without consideration of wider developments, in general far better solutions can be achieved if planned in a manner compatible with regional augmentation and drainage improvements.

Flood control and drainage - Four main areas of activities have been identified related to flood control and drainage. The first and foremost is the rationalisation of the existing FCD schemes in line with policy requirements. To achieve this, will require a long-term management plan with four distinct phases: (i) full development of a scheme inventory, initiating a programme of environmental audit and preparation of a Management Plan, (ii) development and pilot testing of procedures for scheme assessment and future management arrangements along with completion of environmental audit, (iii) evaluation of second phase and update of management plan, and (iv) a full programme to complete rationalisation of schemes and bring them under revised management arrangements.



Existing BWDB Schemes

Rationalisation of schemes will be considered case by case and may include rehabilitation, remodelling or pro-active disengagement from certain sick schemes. Emphasis throughout will be on participatory planning and management of the schemes with the long-term aim of achieving improved overall scheme performance, eliminated or properly mitigated adverse environmental impacts, and financial sustainability.

The principles above will apply equally to coastal embankments as to that inland. However, the expectation is that all coastal schemes will be retained in principle due to their particular importance. Nevertheless studies are needed to assess ways by which drainage congestion in the

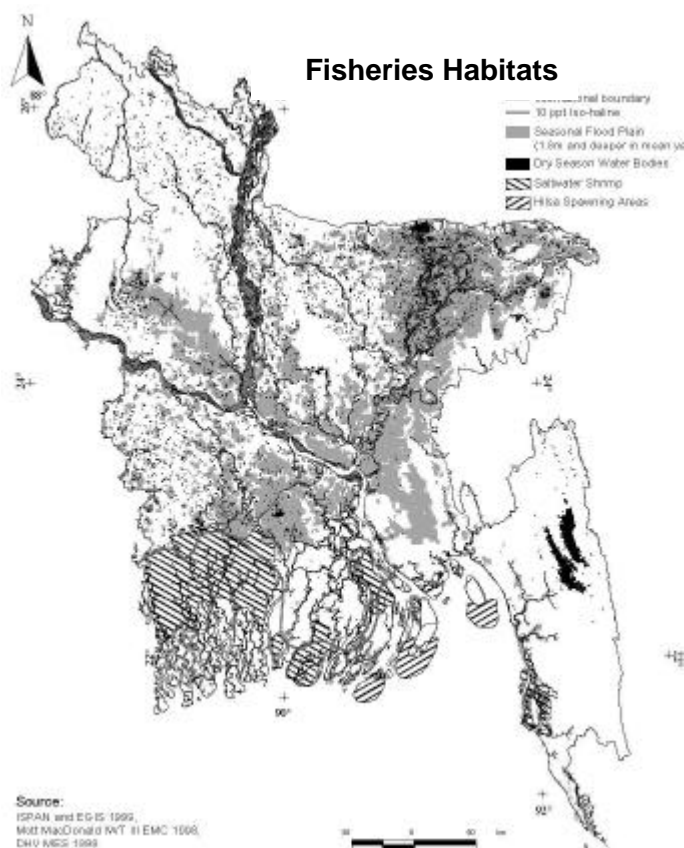
coastal areas can be alleviated, which will have bearing on the way in which individual schemes are rehabilitated. Some new coastal embankments are envisaged on newly accreted land (although premature empoldering should be avoided), and the process of afforestation of sea-facing embankments will be continued.

Financing of all minor irrigation development and structural aspects of on-farm water management would be borne by the private sector and farmers. Otherwise, implementation of minor irrigation support programmes is expected to be the responsibility of DAE's Water Management and Agricultural Engineering Wing. Local works programmes would come under Local Government with the support of LGED. MoA, possibly with assistance from BADC, would be responsible for development of the DTW schemes described above. BWDB would be responsible for the remainder of the programmes. Close coordination between Local Government and BWDB will be essential in developing improved access to surface water and improved drainage.

10 Natural Environment and Aquatic Resources

10.1 *Main Aims*

The NWPo contains substantial provision for protection and improvement of the



natural environment and aquatic resource management and there are numerous national environmental rules and guidelines. The key objectives in relation to the natural environment and fisheries are: to ensure provision of clean water for multipurpose uses; to restore and maintain fish habitats; to ensure provision of water for sustainable use, and preservation of key features of wetlands; and, to protect the aquatic environment in the future, especially by institutionalisation of EIA and environmental management procedures.

Forestry is also an important element of the natural environment, and is an effective means of preventing

degradation of upland watersheds. The Government is committed to massive afforestation, including development of the Coastal Green Belt.

However, environmental interventions are not merely confined to water management, but must include the full range of supporting activities, including people's sensitisation and empowerment and institutional reform and strengthening in the water sector. Most of the environmental actions in the water sector are closely linked to actions needed in other sectors.

The fulfilment of these objectives will need dedicated application by all the institutions and individuals active in all sectors. They will involve significant changes in the way environmental concerns are treated and, not least, substantial investment in water pollution clean-up.

Situation Assessment

Water quality is an issue of increasing concern. In addition to the pressing issue of widespread arsenic contamination of the shallow aquifer and other pollutants in groundwater, surface water quality has deteriorated in recent years mainly as a result of man-made pollution. Whilst faecal contamination is often found in and around settlements, industrial pollution and inadequate waste treatment are causing a major problem in certain “hot-spots” around the country. Dhaka, and the rivers downstream, is the worst affected, but concerns exist in almost all towns and cities. In Dhaka, there is evidence that the aquifer is also becoming polluted. Laws and standards have been established, but are so far proving ineffective by themselves to combat these problems.



Fish and fisheries resources, both as part of the natural environment and as a resource for human exploitation, are of major importance to the country, especially for the very poor. They are under serious threat from over-exploitation and water pollution. With capture fisheries facing the possibility of effective extinction within the next 10 to

15 years, there is an urgent need to address the issue in a comprehensive manner.

Water management for sensitive areas (essentially the wetlands) is complex, given the wide variety of ecological conditions they represent, but a major planning constraint is the lack of knowledge of the basic aquatic ecology. The ecologically sensitive areas are under great pressure, both from encroachment and as sources for subsistence and production, and there is a danger that their degradation will become habitual. The key issue is to reverse this trend.

Bangladesh is signatory to various international conventions and protocols, including the Convention on Biodiversity, Ramsar Convention, Framework Convention on Climate Change, and Convention on Combating Desertification. The Government is committed to fulfilling its obligations under these conventions.

Main Focus of Activities

Water pollution and control - Urgent action is needed both to clean-up pollution hot spots and to prevent (re-)pollution of cleaned-up locations and ecologically sensitive areas, with the relative emphasis depending on local priorities. The latter will be determined on the basis of the benefits to people (eg potable, bathing/household water supplies) and to important ecological - mainly aquatic -

sites, especially those providing the habitat for major fisheries as well as fish migration routes.

In national terms, the priority is to prepare a National Industrial Pollution Control Plan, with the aim of tackling the major polluters over a 10 to 15 year period and subsequent follow-up of lesser polluters. In order of national priority the actions will be carried out in the NC Region, focussing on Greater Dhaka, the Chittagong area of EH Region and the SW Region (Khulna and Mongla), followed by the NW, NE, SE and SC Regions, and lastly the Chittagong Hill Tracts.

The programme will consist of a mix of regulatory and non-regulatory measures with full support of the Government. Regulatory measures will form a significant part of the strategy.

Main elements of Regulatory Measures for Environmental Protection and Improvement

Land zoning of industries, with supporting measures such as communal treatment of wastes and including both inclusion and exclusion zoning and incorporation of the measures into plans for new and expanded Export Processing Zones and the development of industrial parks;

Enforcement of the DoE WQS, EIA and environmental audit regulations and strengthened Ambient Water WQS against which to evaluate effluent emissions. Specific supporting measures include expansion of the environmental courts and new fixed-rate penalties linked to concentrations of specific pollutants in discharges. These options, in turn, imply the development of specialist environmental lawyers and forms of legal aid or self-help actions to allow access to legal services by the public. Enforcement action will be essential.

Clean-up and Hot-spot Pollution Prevention will involve a nation-wide programme to reduce pollution emissions and rehabilitate water bodies, including contaminated bed sediments, with the urban ponds and river reaches a priority. The aim will be to make the water bodies once again suitable for multipurpose clean water use, with an emphasis on the prevention of pollution. Industry will be required and encouraged to install the necessary processes and facilities to reduce harmful emissions to acceptable levels, with loans and other financial incentives as well as regulation and other measures. Continuation of the DAE programme of IPM will help to prevent excessive pollution by agrochemicals. Implementation of the programme will require a major strengthening of the capabilities of the DoE and other GoB entities involved.

Re-focussed National Water Quality Monitoring Programme will need expanding to include discharge ('end-of-pipe') sampling and/or identifying the sources of specific pollutants found in receiving waters.

Water management for fisheries - There is an urgent need for a national capture fisheries study leading to a Fisheries Master Plan. Both overlap the interests of the water sector and are seen as essential steps to enhancing the value of the water resource system.

The prime concern with capture fisheries is the provision of suitable habitats for maintaining biodiversity as well as fish production, for which good quality water is essential. In addition, two key sets of water requirements are vital: provision of sufficient areas of water in the dry season water bodies and provision of appropriate river and floodplain flows, plus adequate and fish-friendly hydraulic connections between the floodplains and the main river system. A major water management issue is the great damage done to capture fisheries by past interventions (notably by FCD/I works).

Based on the Fisheries Master Plan, an important NWMP requirement is therefore for a National Fishpass Programme with the aim of urgently appraising the effectiveness and practicalities of mitigation measures and, especially, of constructing fish passes. This will be followed by implementation of appropriate measures at selected sites. With the problems of land-use conflict and soil salinisation resulting from salt-water shrimp (bagda) production, zoning of bagda shrimp production will also be introduced.

Water management for ecologically-sensitive areas - In the context of the water sector, there are two ecologically-sensitive areas of outstanding importance, the Sundarban mangrove area and parts of the Haor Basin wetlands, the former as a World Heritage Site and both as Ramsar Sites. The many other water bodies in the country are also ecologically sensitive, but are individually smaller and subject to much more intensive pressures of encroachment and exploitation. A programme for improved water management for the Haor Basin will ensure the aims of both waterfowl conservation under the Ramsar Convention and the conservation of mother fish stocks for both commercial and subsistence fishing. Similarly a programme to improve water management for the Sundarbans concerns the increased future inflows of fresh water through the Gorai River system (currently under study) in order to maintain or improve the Sundarbans' productivity and biodiversity.

Sustainable development of the country's wetland resources implies application of broad water management options for water bodies as a whole. A programme will be taken up to identify, and define management conditions for, ecologically critical areas and for combining these into a National Integrated Wetlands Management Programme.

Supporting environmental measures - In themselves, the above measures will not be sufficient. The extent, variety and local variation of the many environmental problems mean that GoB is unlikely ever to have the full resources to 'safeguard the environment' solely through government bodies. Even with the support of the many environmentally-concerned organisations, NGOs and individuals, action is unlikely to be successful without two essential major changes: (i) considerably increased public awareness of the environmental issues and how they affect people's lives, and (ii) in response to the demands of the people, the development of genuine commitment to take action by all agencies of Government.

Mass mobilisation through a public awareness and empowerment programme and community participation will be built in to all the future environmental programmes, to help ensure that the planning and implementation is sustainable and responsive to all levels of society, from senior managers in national technical organisations and administrative bureaucrats, through their regional and district personnel to village and small communities. It will involve both government and non-government organisations. Mere awareness raising will not be sufficient and the means to ensure access of people to effective remedies must be included. Many different agencies, government and non-government, will participate. The programme will be nationwide, and will have to be long-term, continuing for at least 25 years with the aim of establishing environmental protection as a political reality in the country and a real force for change.

Institutional reform and strengthening - institutional reform and strengthening are needed to address fundamental environmental weaknesses in the present institutional set-up, including: the lack of an holistic approach to environmental issues; the lack of mechanisms to incorporate genuine 'bottom-up' environmental initiatives into planning and implementation of developments, and the lack of

environmental appreciation within institutions, leading to poor inter-agency co-ordination and co-operation. The component will include improved inter-agency communications particularly with regard to strategic planning and project preparation and implementation. Improved communications and sharing of expertise and information will be a major feature.

The main thrust for pollution clean-up will lie with the concerned municipalities in co-operation with BWDB and DoE. Measures to promote more effective management of fisheries will require co-operation between Department of Fisheries and BWDB. Management of local water bodies is generally a responsibility of Local Government, but in the specific cases above, they will need support from DoFi, BWDB and LGED. Special measures will also be taken up for the Sundarbans and the Haor basins of the Northeast. Promotion of environmental awareness will be a responsibility of DoE, but all agencies will be concerned with this issue, both internally and externally.

All measures above will require central Government funding. Pollution control measures for industry beyond the initial clean-up will be expected to be borne by the concerned industry, as also will a portion of the initial clean-up costs.