
Government of the People's Republic of Bangladesh

Ministry of Water Resources

# National Water Management Plan

Volume 1

## Summary

December 2001

WARPO
পানি সম্পদ পরিকল্পনা সংস্থা

Water Resources Planning Organization

Government of the People's Republic of Bangladesh

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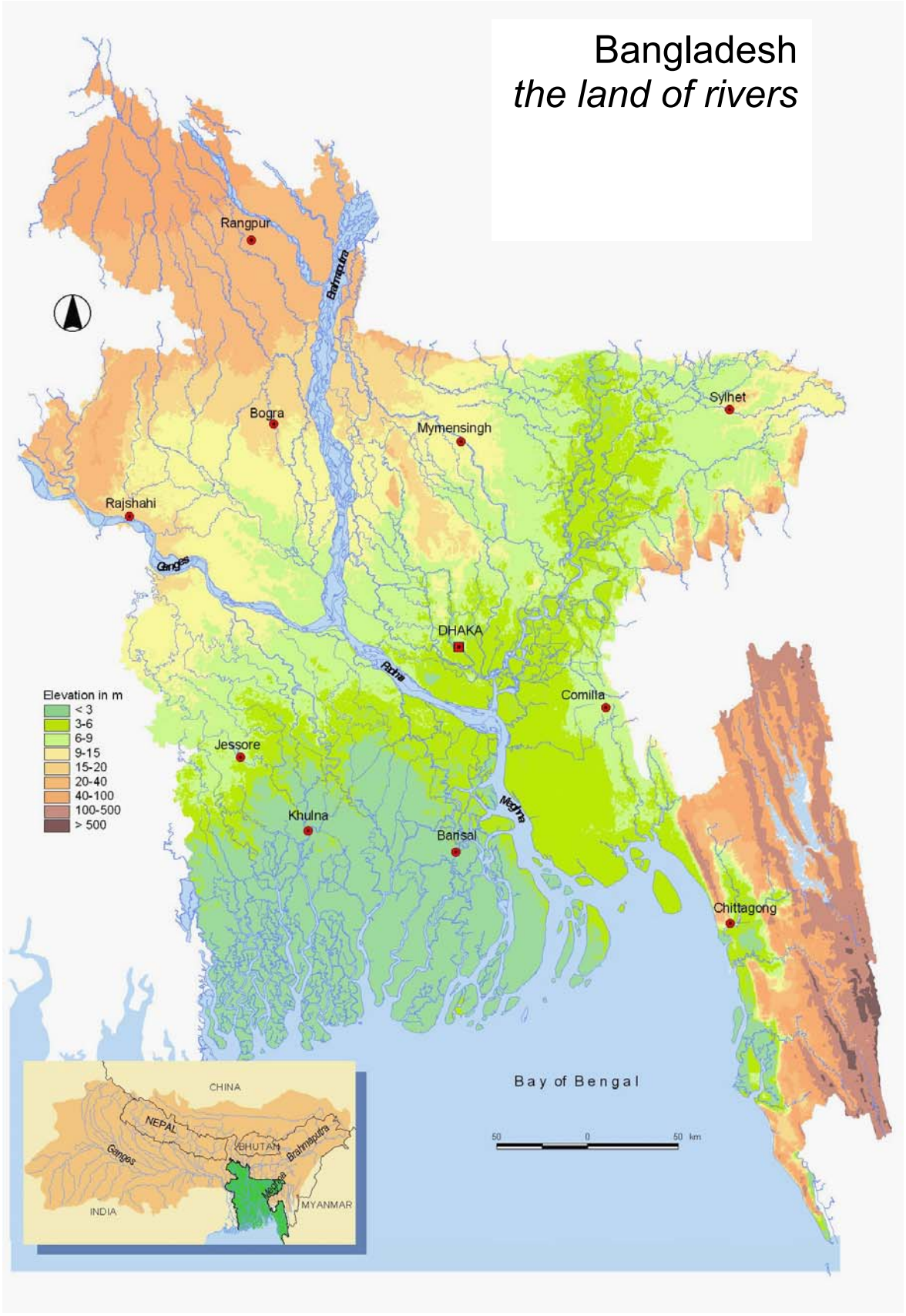
Approved by
National Water Resources Council on March 31, 2004

**Water Resources Planning Organization**


Bangladesh
the land of rivers
Rangpur
Bogra
Mymensingh
Sylhet
Rajshahi
Ganges
Brahmaputra
DHAKA
Padma
Comilla
Jessore
Khulna
Barisal
Meghna
Chittagong
Bay of Bengal
Elevation in m
< 3
3-6
6-9
9-15
15-20
20-40
40-100
100-500
> 500
CHINA
NEPAL
BHUTAN
INDIA
MYANMAR
50 0 50 km

# Executive Summary

*In common with current global concerns over wise use and effective management of water, the Government of Bangladesh is committed to exploring, developing and using its water resources to the benefit of all users. To this end the Ministry of Water Resources published the first* ***National Water Policy*** *in 1999, with the intention of guiding 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. The Policy aims 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. However, the Policy is to be reviewed.*

*In parallel to this, the Government commenced preparation of this* ***National Water Management Plan****, with the intention of operationalising the directives given by Policy. In reflecting the objective of rationalising and decentralising management of the sector, the Plan is a framework plan within which line agencies and other organisations are expected to plan and implement their own activities in a coordinated manner. The Plan is presented in three phases: in the short-term (2000-05) it is considered a firm plan of ongoing and new activities; in the medium-term (2006-10) it is an indicative plan, and in the long-term (2011-25) a perspective plan. Implementation of the plan is to be monitored regularly and it will be updated every five years.*

***Water is central to the way of life*** *in Bangladesh. Indeed, the river systems, many of which emanate from outside the country, have shaped much of the history, economy, literature and rich culture of the people. However, with a burgeoning population of 129 million expected to rise to 181 million by 2025 and to 224 million by 2050, the country faces many challenges ahead in an era of increasing globalisation. Rapid urbanisation is expected with 40% of people living in the towns and major cities by 2025, and 60% by 2050. Poverty is still endemic with over half the population classified as poor. The recent discovery of arsenic contamination of the shallow aquifer has set back past successes in bringing safe water supply to the rural population in particular. Pressures remain on agriculture to intensify production and maintain self-sufficiency in food-grains. Aquatic resources and the natural environment are under severe threat from changes in flood plain management over the last three decades and, more recently, from an alarming rise in pollution due mainly to industrial growth and poor sanitation.*

*Flooding occurs regularly each year over 20% of the country, extending to more than 60% in peak floods. Flooding enriches the fertile soils of Bangladesh, but exceptional floods can also bring severe hardship. The generally low-lying and flat topography presents special challenges to drain the land and control erosion in the main and regional rivers. Climate changes are expected to increase flooding, reduce drainage flows and increase water demands in the dry season. These changes will also exacerbate the frequently occurring natural disasters such as cyclone storms that sweep each year over the coastal areas from the Bay of Bengal.*

*In addressing these and other related issues, the National Water Policy sets* ***new paradigms*** *for the water sector, which include: decentralised water management; cost sharing and cost recovery; private sector participation; community participation; non-traditional financing modalities; regulation separated from supply; and new rights, obligations and accountability. These will have considerable bearing on the existing institutions and the way in which they manage their affairs and inter-act with others.*

*The National Water Management Plan has been prepared to respond to these challenges and paradigms, with* ***three central objectives*** *consistent with Policy aims and national goals. These objectives are:*

- *Rational management and wise-use of Bangladesh's water resources*
- *People's quality of life improved by the equitable, safe and reliable access to water for production, health and hygiene*
- *Clean water in sufficient and timely quantities for multi-purpose use and preservation of the aquatic and water dependent eco-systems*

*The* ***Development Strategy****, agreed in the course of Plan preparation, requires that equal importance be given to each national goal. The Plan is structured in a manner that the objectives of* ***84 different programmes*** *planned for the next 25 years contribute individually and collectively to attainment of both the overall objectives as well as to intermediate sub-sectoral goals. The programmes are grouped into eight sub-sectoral clusters and spatially distributed across eight planning regions of the country. Information on each, together with a wide range of planning data, is held on the National Water Resources Database, accessible through a Management Information System. The three main categories of programmes are Cross-Cutting Programmes, National-level Programmes and Regional Programmes.*

***Cross-Cutting Programmes*** *are applicable to all activities in each sub-sector and region. They embrace the necessary actions for institutional development and creation of an enabling environment conducive to efficient and equitable management of the sector as a whole. Other than the introduction of new regulatory bodies for the water supply and sanitation services sector, existing organisations will be strengthened to fulfil their obligations within a rationalised and decentralised institutional framework. Emphasis is given to expanding community participation and the role of the private sector. Action will be taken to fill knowledge gaps and improve information management. A National Water Code will provide the basis to a comprehensive legal and regulatory framework.*

***National-level Programmes*** *will be taken up to address major strategic issues that merit special attention. Building on the research programmes included above, a long-term strategy for securing water supplies for Bangladesh will be developed. First priority will be given to making optimal use of the Ganges waters. Second priority will be given for the utilization of the Brahmaputra river water and integrated development of the Meghna River. Reviews will be made of options for dealing with main and regional river erosion and of hydropower based on current experience, and actions will be taken accordingly. A long-term pollution control plan will be drawn up and, within this,*

*immediate steps taken to clean-up existing pollution. Restoration of flood-plain and river fisheries and improved management of environmentally critical areas will be taken up as soon as possible.*

***Regional Programmes** fall into the sub-categories of generic and region-specific. Generic programmes are those that are applicable to all or most regions, for which there are three main themes. Firstly, an integrated approach to river system development will be introduced with management plans for each reflecting the full spectrum of user needs, environmental requirements and water conservation. Development of main, regional, sub-regional and community-managed systems will be coordinated. Secondly, management of existing public flood control and drainage and irrigation schemes will be enhanced and devolved in line with Policy directives, with special attention given to environmental issues. In addition, continued support will be given to minor irrigation, and where appropriate and feasible, this will be supplemented by public investment in river augmentation and irrigation schemes. The third major theme addresses the back-log in rural and urban water supply and sanitation, overcoming the arsenic problems and meeting future evolving demands for rural and urban water services, including urban flood protection and storm drainage.*

*The second sub-category of Regional Programmes is made up of those programmes that are specific to one or two regions only. They will be taken up to meet particular local needs, such as cyclone protection, flood-proofing in charland, Haor, rural areas, improving the coastal embankment system, relieving drainage congestion, erosion control, and specific environmental management measures in the Sundarbans and the Tanguar Haor Basin.*

***The programmes have been scheduled** in a manner to smooth investment flows. Priority is given to the institutional development, enabling environment, water supply and sanitation, rationalisation of FCD&I management and key elements of the natural environment programmes. The former two are fundamental requirements for efficient and effective of all other programmes. Rationalisation of FCD&I is a central tenet of Policy and the latter two are necessary to start immediately to avert crises in public health and irreversible environmental degradation.*

***The investment cost** of the entire Plan is estimated at a little under one trillion Taka (US $ 18 billion). As presented overleaf, the Base Case scenario assumes that the Development Strategy targets for water supply and sanitation will be achieved from 2010 onwards. This requires substantial investment in the short to medium terms in order to catch up on the back-log and position investment ahead of demand. An alternative scenario is that these targets will not be fully met until 2025, defraying costs into the long term.*

*The domestic private sector is already active in the water supply and sanitation sub-sector, as well as in minor irrigation. It is reasonable to expect that these activities will expand as demand grows. Similarly beneficiary contributions to capital costs, whilst negligible now, are forecast to provide in the region of 6-7% of overall costs in the long term. The balance of funding will have to be provided by Government unless alternative*

*sources (domestic and foreign banks, investment bonds, multinational companies etc.) can be mobilised in the medium to long term.*

| **Programme Capital Costs** *Taka billion (mid-2000 prices)* | No. of Progs | Short 2000-05 | Medium 2006-10 | Long 2011-25 | Residual From 2026 | **Total** |
|---|---|---|---|---|---|---|
| Institutional Development | 10 | 3.8 | 6.7 | 8.0 | 1.5 | **19.9** |
| Enabling Environment | 13 | 0.8 | 0.9 | 1.8 | - | **3.6** |
| Main Rivers | 12 | 8.4 | 14.3 | 155.2 | 45.3 | **223.2** |
| Towns and Rural Areas | 8 | 29.5 | 88.3 | 133.7 | 13.4 | **264.9** |
| Major Cities | 17 | 22.1 | 93.9 | 185.6 | 10.3 | **311.9** |
| Disaster Management | 6 | 5.0 | 7.8 | 13.7 | 0.7 | **27.2** |
| Agriculture & Water Management | 8 | 1.7 | 7.2 | 29.5 | 7.2 | **45.6** |
| Environment & Aquatic Resources | 10 | 3.1 | 5.5 | 9.7 | - | **18.2** |
| **Totals** | **84** | **74.4** | **224.7** | **537.1** | **78.3** | **914.6** |
| *Equivalent US$ billion* | | *1.5* | *4.4* | *10.5* | *1.5* | *17.9* |

*Residual costs are those relating to programmes started, but not completed, by 2025*

*In the short term, Government funding needs to remain on average at around current levels of 0.6% of GDP, rising at the start of the medium term to at least 0.8% (comparable with 1995-96 level). If alternative funding sources are not by then starting to be mobilised, this level of 0.8% would have to be maintained through the medium term to meet targets by 2025, or to 1.3% to meet these by 2010.*

*Implementation of the Plan will bring* ***multi-dimensional benefits*** *to Bangladesh consistent with national goals. The cross-cutting programmes will bring about decentralised management, responsive to user demands, with greater accountability and transparency. The burden on Government funding will have been reduced through increased cost recovery and mobilisation of alternative funds. Management of the water resource system will be enhanced through comprehensive and coordinated development of the river systems at all levels. Water-related constraints to agriculture and fisheries will have been minimised and safeguards introduced to protect the quality of water for human and environmental purposes. Access to safe and reliable water supply and sanitation services will have been greatly extended to all segments of society. People will be better able to cope with natural disasters.*

***The NWMP programmes are to be implemented*** *by line agencies and others as designated. Each organisation is responsible for planning and implementing its own activities and projects within the NWMP framework. Projects may be designed to implement only part of a programme or aspects of one or more programmes. This is a matter for the agency in question to determine on the basis of practical experience, current knowledge and capacity. Sequential and technical linkages between programmes have been identified. All projects will adhere to normal Government administrative procedures and will conform to all relevant rules and guidelines issued by Government. Responsibility for overall coordination of Plan's implementation lies with the National Water Resources Council, who will issue directives as required through its Executive Committee.*

*As secretariat to the NWRC,* ***WARPO will monitor progress and impacts*** *and draw to Council's attention issues that require their particular consideration. At a working level, coordination of project activities will conform with directives as issued from time to time by Government.* ***Issues of prioritisation*** *will be considered by Government in the event that funding is at any time insufficient to meet the requirements for short-term firm programme requirements. Decisions in this regard will be guided by the prevailing state of implementation of the Plan. However, it will remain the prerogative of Government through its democratic processes to assign sub-sectoral budgets each year.*

***Risks have been identified*** *at both Programme and Plan levels. Those considered central to the success of the Plan include:*

- *The willingness of both Government and its agencies to put into the operation the new paradigms (decentralisation, cost sharing and recovery, community and private sector participation, non-traditional financing modalities, regulation, new rights, obligations and accountability). Changing the culture of institutions and evolving new ones, which takes time, requires an immediate start backed by strong political stewardship.*
- *Sustained economic growth is essential if the necessary investments, particularly those in urban and rural services, are to be realised. Government's ability to fund its share of the capital and recurrent costs is dependent upon this growth and the extent to which, through fiscal and regulatory reform, it creates an environment conducive to alternative funding.*

***Important assumptions*** *are that necessary parallel actions will take place in support of Plan implementation. These include introduction of wider civil service reforms, establishment of all tiers of Local Government, preparation of land-use and physical planning strategies notably with regard to managing rapid urbanisation, and promulgation of an integrated transport policy.*

# National Water Management Plan

# Volumes

**1 Summary**

**2 Main Report**

Part A: The Context
Part B: The National Water Management Plan
Part C: Implementation Arrangements

**3 Investment Portfolio**

**4 Regional Plans**

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Annex C: Environmental Assessment
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# Volume 1: Summary

# Contents

# 1 Introduction

At the dawn of the 21st century, the global community has brought into sharp focus the need for effective management of water resources world-wide to ensure water for agriculture, health and nature. As an active participant to the World Water Forum and signatory to many important protocols and conventions, Bangladesh shares fully these concerns.

In early 1999, the Government of Bangladesh published its first National Water Policy (NWPo) that *lays down the broad principles of development of water resources and their rational utilisation*. 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.* The Policy is mindful of the many technical and management challenges that face Bangladesh with its burgeoning population and being situated in the delta of three of the largest rivers in the world.

Almost simultaneously, Bangladesh embarked upon preparation of a National Water Management Plan (NWMP). In the course of this, a Development Strategy for the NWMP was subsequently adopted in June 2001. In accordance with Policy and the Development Strategy, this National Water Management Plan has been prepared to provide a framework at national and regional level within which line agencies, local Government and other stakeholders may plan and implement their own activities and projects in a coordinated manner, consistent with overall national and sectoral objectives.

Prepared on the basis of technical assessments and through extensive consultation throughout the country at different levels, the National Water Management Plan is set in the context of development indicators 50 years hence. It is a rolling 25-year plan in three phases. The short-term (2000-05) is considered a firm plan, the medium-term (2006-10) an indicative plan, and the long-term (2011-25) a perspective plan. Implementation of the plan will be monitored regularly and it will be updated every five years.

# 2 Context of the Plan

## Socio-Economy

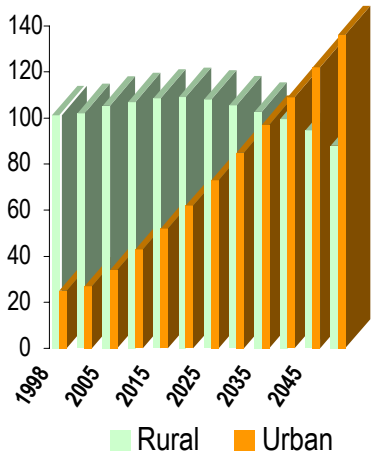
The main socio-economic trends having bearing on the National Water Management Plan are summarised below:

- **Population growth** – total population will increase by 40% from 129 million to 181 million by 2025, and 224 million by 2050.
- **Urbanisation** - urban population will increase to 73 million (40%) by 2025, and 136 million (60%) by 2050.
- **Poverty alleviation** - 57% of the population in rural areas and 51% in urban areas are poor.
- **Economic growth and development** - growth rates of 5.5% to 6% are expected over the next 25 years.
- **Employment generation** - 14 million new jobs will be needed in the next 25 years, and a further 21 million by the year 2050.
- **Public participation** - demand is increasing for extensive public consultation and participation in the water sector.
- **Education and public health** – major efforts will be required in education and public health, with urgent attention to arsenic contamination of aquifers.
- **Food security** – maintaining rice and protein security will require yield improvements and agricultural intensification, particularly as agricultural land per capita is expected to markedly reduce and a large increase in fish production.

Social and economic factors point strongly to the urgent requirements of a rapidly urbanising society. Basic public health will rapidly deteriorate if the necessary services are not provided on a sustainable basis. Food security will remain under pressure as agricultural land is taken up for urban and other uses.

Poverty alleviation is central to the development agenda, and ensuring equity of access to water and sanitation is a critical issue in the efforts to establish conditions favourable to addressing poverty issues.

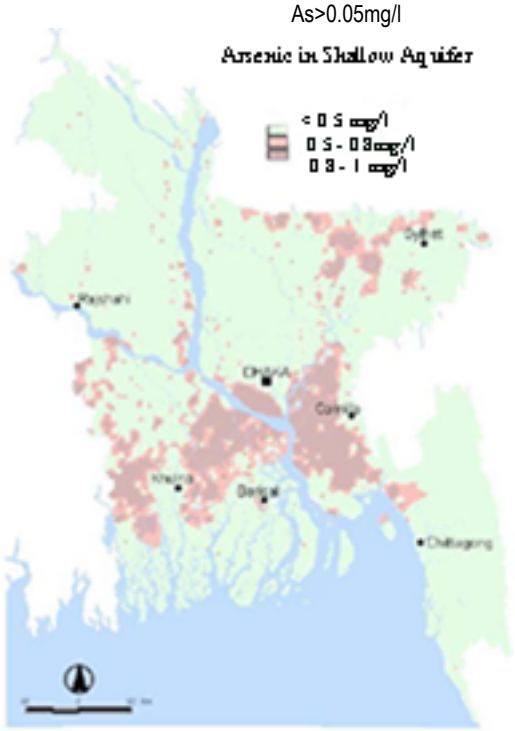
**Population projections** (millions)




Economic growth will bring about changes in consumer preferences, leading to evolving demands upon water services and agricultural production. Increased industrialisation will raise the risk of pollution if this were to remain unchecked. However, sustained economic growth is essential if Government is to have the necessary funds to invest adequately in the sector.

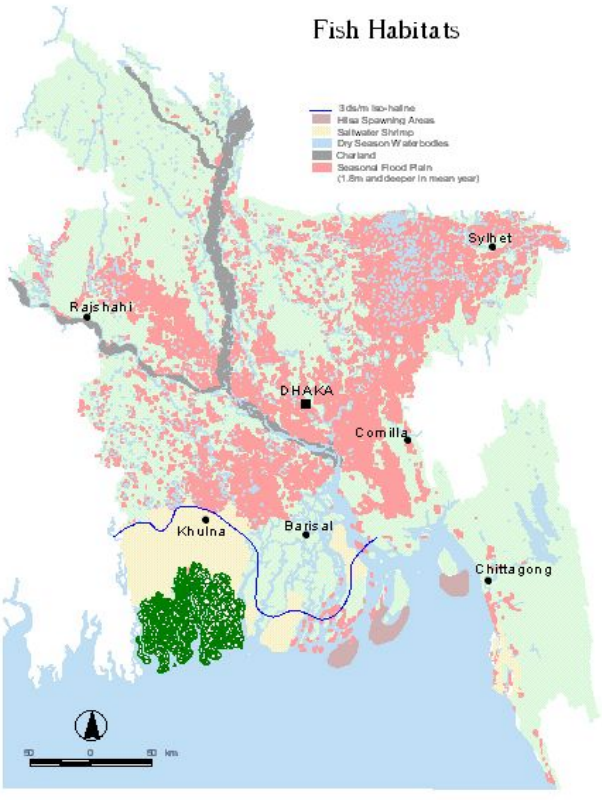
## Environment

**Arsenic in Shallow Aquifer**
As>0.05mg/l




Major concerns have also emerged relating to the natural environment and water-related impacts on fisheries. These already require urgent atten-tion, and will become much worse, if left unattended. Quality of surface water is under increasing pressure from industrial expansion and poor sanitation.

Arsenic contamination of shallow aquifers has recently been identified as a major problem with about 25% of the population exposed to levels exceeding Bangladesh standards (0.05 mg/litre). A further 21% live in areas where evidence suggests that arsenic concentration exceeds current WHO standards (0.01 mg/litre). The presence of iron, boron and other contaminants in groundwater are lesser but still important concerns.




Capture fishing on the flood plains and haor basins, a traditional activity of the poor, is declining rapidly and will disappear altogether unless pro-active measures are taken.

Land degradation in the upland areas and deforest-ation and land slides in the hilly areas contribute to increased soil erosion and impacts on the river systems.

Ecologically-sensitive areas are under great pressure from encroachment and un-sustainable use. The Sundar-bans and the Tanguar Haor Basin of the Northeast, being Ramsar sites, merit special attention.

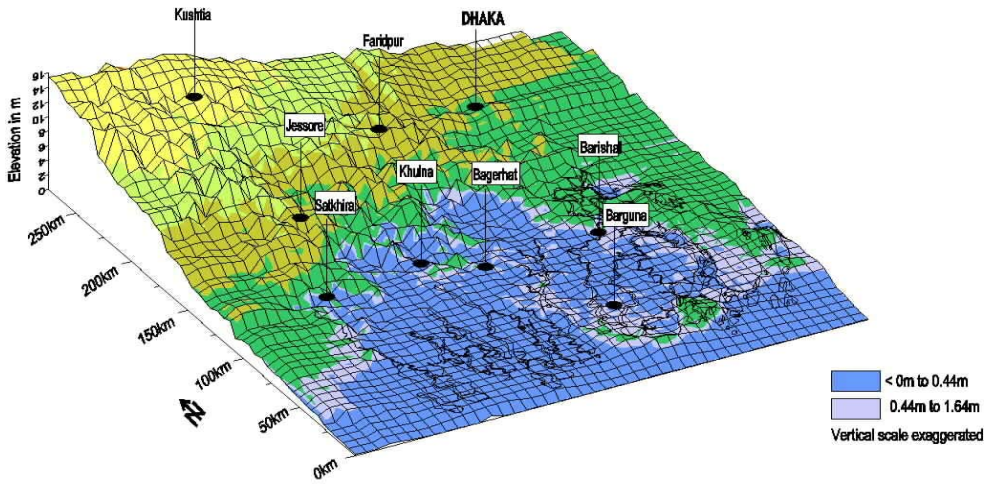
## Water Resources and Demands

The river systems are the life-blood of Bangladesh, which have shaped the history, economy, literature 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 in the coastal areas.

The two main sources of water are the transboundary inflows from the Brahmaputra, Ganges and Meghna rivers, and groundwater.
During the monsoon season, 20% of the country is inundated each year, with over 60% in a peak flood. It is generally these peak floods, which typically occur every ten years, that bring severe hardship to those affected.

Drainage is impeded both by high water levels in the main rivers and by man-made structures. Heavy sedimentation makes navigation difficult after the rivers fall. River bank erosion during floods is locally a major problem to those who live close by. Projected sea-level rise of up to 44cm by 2050, on top of an increasing tidal range of 1.2m since 1960, will worsen flooding and drainage problems, as will the more intense rainfall expected with climate change. Cyclonic storms and surges, which reek havoc in the coastal areas, are also expected to be more frequent.

**Area at risk to sea-level rise and tidal range increase in the Southwest Area**




By contrast, the dry season from November to May brings water shortages. Farmers have turned increasingly to tubewells for irrigation, wherever possible and wherever surface water is not readily available. Seasonal water tables are reaching lower levels, impacting on hand-tubewells, which are commonly used

in the rural areas for water supply. Demands in the dry season will continue to increase as more land is irrigated and as water supply requirements increase. Climate change will exacerbate this.

Dry season water deficits occur in different localities and are most marked in the Southwest and extreme west, where rainfall is lowest, and in the Eastern Hills region around Chittagong where both groundwater and surface water are in limited supply. Opportunities exist to overcome these by diversion from the main rivers, except in the Eastern Hills region where particular efforts are needed to make best use of the available resources.

## Knowledge Gaps

There are many different technical issues to address in improving water resources management in Bangladesh. Significant challenges exist in dealing with such issues as river maintenance, erosion control, land accretion and coastal zone management. There are also some fundamental issues that impact on medium and long-term planning, and further research is urgently needed.

- **Arsenic**: Assessing the current and future extent of contamination and the implications for food safety of irrigating with arsenic contaminated water and the effectiveness of treatment method for domestic water supplies
- **Groundwater resources**: Fully understanding the sustainable limits of groundwater use and the impacts that quality has on its utility, and the long-term strategic implications
- **Climate change**: Understanding the full implications of climate change and developing appropriate responses
- **Natural environmental water requirements**: Understanding the relationship between water and the natural environment and establishing key indicators and thresholds for environmental health and sustainability
- **Long-term implications for water management**: Promoting dialogue amongst the co-riparian countries and developing appropriate long-term strategies for Bangladesh in response to the increasing demands on the overall system
- **Devolved and decentralised water management**: Determining the most appropriate management models for Bangladesh to follow.
- **Promotion of private sector participation**: Assessing how best to promote private sector participation in major infrastructure development and management

## Institutional and Legal Framework

Over 40 different agencies, organisations and categories of organisations are involved in the water sector, of which 35 are organisations related to central Government. At least 13 different Ministries are involved directly or indirectly.

The National Water Resources Council is responsible for coordinating all aspects of water management, and issues directives through its Executive Committee. Under the NWPo, WARPO has been made secretariat to the NWRC and is responsible for preparing the NWMP and subsequent updates, and monitoring implementation. Agencies are responsible for preparing their own sub-regional plans within the framework established by NWMP.

The National Water Policy aims to increase involvement of Local Government in local water resource management, and seeks to expand private sector activities. Local Government institutions however are only partially developed and under-resourced. The private sector is well established in low-cost minor irrigation and rural water supply and sanitation markets. Local and international NGOs are very active in Bangladesh, as are many donor agencies.

Relevant legislation dates back to 1859, and there is no shortage of laws, although enforcement is often lacking. Many laws now need reviewing and a new National Water Code is being prepared that will align with Policy requirements.

# 3 Policy and Strategic Framework

The National Water Policy (NWPo) and the Development Strategy constitute the main policy and strategic framework for the NWMP. Besides these, a wide range of policies for various sectors has direct or indirect bearing on the water sector. These include:

- National Environment Policy (1992)
- National Forestry Policy (1994)
- National Energy Policy (1996)
- National Fisheries Policy (1998)
- National Policy for Safe Water Supply and Sanitation (1998)
- National Agricultural Policy (1999)
- Industrial Policy (1999)

All these policies and the Development Strategy together provide an extensive framework for management of the water sector. However, a policy for land use planning had not been approved during the NWMP preparation. The efficient design of water services will depend on the principles established for management of the massive urban expansion expected over the next 25 years. There is also as yet no integrated transport policy that would better guide investments in navigation.

The NWPo, through its stated goals, lays the foundation for the Development Strategy for the NWMP. This Strategy, agreed by Government as guideline for the Plan, places equal importance on each of the national goals of:

- Economic development
- Poverty Alleviation
- Food Security
- Health and Safety
- Standard of living
- Environment

Furthermore the Strategy, which embodies an approach that fully reflects modern-day principles of integrated water resource management and which conforms to sound institutional practices, also elaborates the main aims for the Plan, as described below.

**Institutional Development**: Sound institutional principles are to be followed to separate

**National Water Policy Goals**

- 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.
- Ensure the availability of water to all elements of society including the poor and the underprivileged, and to take into account the particular needs of women and children.
- 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.
- Bring institutional changes that will help decentralise the management of water resources and enhance the role of women in water management.
- Develop a legal and regulatory environment that will help the process of decentralisation, and sound environmental management, and improve the investment climate for the private sector in water development and management.
- 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.

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. Adjustments will be made and support provided 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.

**Enabling Environment**: An enabling environment is to be created consistent with the institutional principles above and other policy objectives through measures that will make clear the rights, obligations and rules of business required for the sector as a whole. These measures will embrace legal and regulatory reform, research, improved information management and dissemination, application of economic instruments and introduction of alternative funding mechanisms.

Dry season scarcity of water is a major impediment which adversely affects drinking and domestic water supply, fisheries, forestry, navigation, irrigation, industries and above all the natural environment in large areas of Bangladesh. Food security is a top priority, for which Government's only feasible medium term strategy is to increase the food production through irrigation, In recent, years remarkable growth in irrigation has been achieved through deregulation and privatisation of groundwater use, This has led to a situation where the country's dry season irrigation is heavily dependent on groundwater, It is now widely accepted that future irrigation based mainly on groundwater would not be sustainable as, the amount of groundwater recharged each year is finite, and the dangerous phenomenon of arsenic contamination of groundwater.

The Government has a responsibility to ensure that the country's long term development needs are met through appropriate policy measures and prudent infrastructural investment. The Government recognises that over-dependence on groundwater is not wise. The NWPo envisions improving efficiency of resource utilisation through conjunctive use of all forms of surface and groundwater for irrigation and urban water supply. Increased emphasis must be given now to harness and develop the nation's surface water resources so that in the long run a balance can be struck between the use of surface and groundwater.

The development challenges for Bangladesh is to ensure that nation's surface water resources available in the main and medium rivers are developed and managed effectively to meet all future needs and to do so in a socially

equitable, environmentally sustainable and economically viable way. In line with the NWPo objective, steps would have to be undertaken to develop the water resources of not only the main rivers like the Ganges, Brahmaputra, and Meghna but also of the other rivers like Dharla, Dudhkumar, Manu, Khowai, Gumti, Muhuri etc. Investment in this regard must be timely in the face of needs of an ever-growing population.

**Main Rivers:** 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 structural and non-structural measures. Comprehensive planning of the main and subsidiary river systems will be undertaken by the responsible agencies, integrating the needs of all users with sound environmental principles. The Government also intends to work towards international river basin planning to realise the full potential benefits of these rivers.

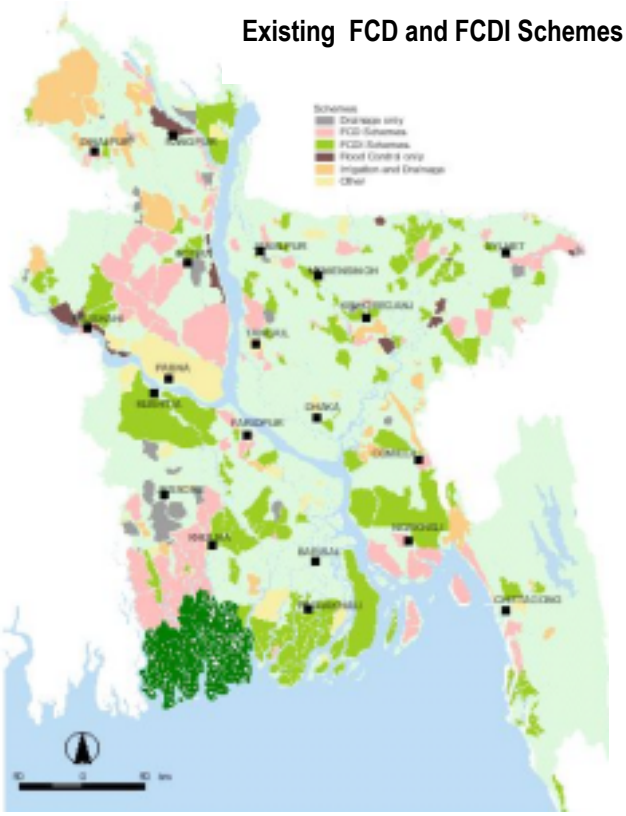
**Towns and Rural Areas**: To the extent feasible and affordable, safe and reliable supply of potable water and sanitation services are to be provided to all people on an equitable basis, to safeguard public health and protect the environment. In towns of economic importance, flood protection will be provided as a priority, and phased implementation of reasonable flood protection facilities will be introduced in Zila and Upazila towns. Sustainable improvements will be targeted in operational efficiency and service delivery, and affordable and financially sustainable services are offered to all levels of society, with particular emphasis on the poor and disadvantaged.

**Major Cities**: One of the major challenges is to address the development requirements of the urban sector. As in the Towns, the main aims for these major cities (Dhaka, Chittagong, Khulna and Rajshahi) 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. As in other urban and peri-urban areas, measures will be taken up with particular emphasis on the poor and disadvantaged.

**Disaster Management**: Disaster management involves prevention and mitigation measures, preparedness plans and related warning systems, emergency response measures and post-disaster reconstruction and rehabilitation, and is recognised as a necessary element of overall water management. Whilst some people will always remain at risk, the main aims are to provide the means by which, through a combination of structural and non-structural measures, adequate warnings are given, people can survive with most of their assets intact, and can rebuild their lives thereafter.

**Agriculture and Water Management**: The overall agricultural policy objective is to expand and diversify agricultural production and to maintain food security, especially with regard to sustaining self-sufficiency in rice. The water sector has an important role to play by removing constraints that may be caused by either shortage or excess of water. This will involve promoting continued expansion of minor irrigation, water conservation for multi-purpose use, rationalisation of the many existing public flood control, drainage and irrigation schemes, a limited number of new irrigation schemes where needed and feasible, and improved coastal protection works, including mangrove afforestation on the foreshore as well as in the country's upland catchments. In undertaking these works, the potential impacts of climate change and sea-level rise will be factored in.

**Existing FCD and FCDI Schemes**



**Natural Environment and Aquatic Resources**: Key objectives are: to ensure provision of clean water for multipurpose uses; to restore and maintain fish habitats; to ensure provision of water for sustainable use**;** to preserve key features of wetlands; to protect the aquatic environment in the future; and to prevent degradation of upland watersheds. Implicit in these objectives are the institutionalisation of EIA and environmental management procedures.

The chosen Strategy thus sets out a comprehensive implementation package:

**Management**

- 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 beneficiaries in the hand-over and development of water schemes;
- Decentralisation and devolution of responsibility for management and O&M 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.

**Technical**

- 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 river systems for multipurpose use
- De-silt watercourses to maintain navigation channels and proper drainage, including through labour-intensive methods
- 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.

# 4 Overview of the Plan

The National Water Management Plan provides a framework within which all concerned with the development, management and use of water resources and water services in Bangladesh can plan and implement their own activities in a coordinated and integrated manner, confident that in doing so they are contributing to achievement of the national goals.

The Plan's conceptual framework is founded on an assessment of needs, opportunities and constraints throughout the sector. The assessments made during Plan preparation have highlighted the spatial and sub-sectoral diversity of the water sector. To facilitate a fully integrated approach, both the analyses undertaken and the presentation of the Plan are based on eight distinct and defined hydrological regions.

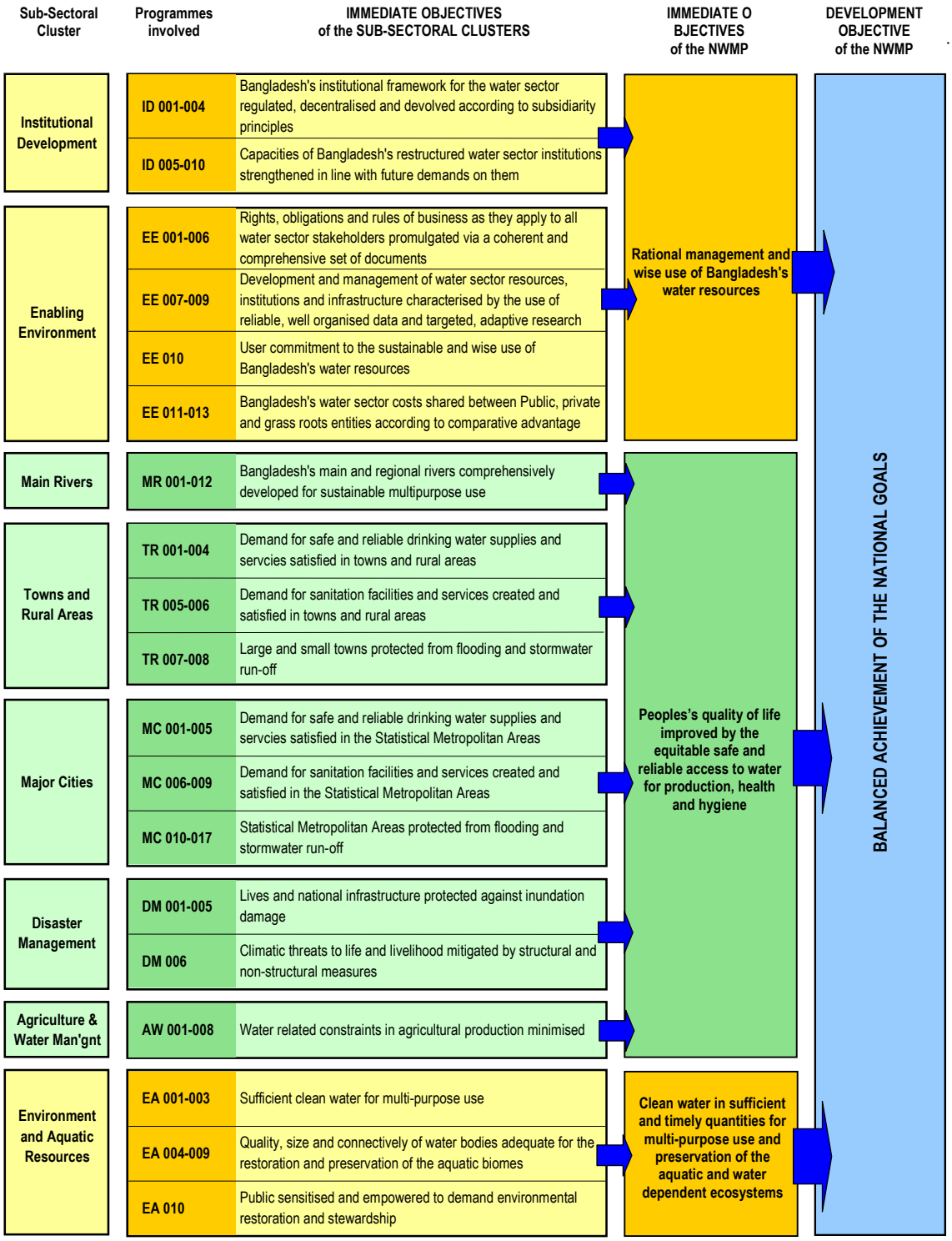
**Hydrological Regions**


The planned activity programmes have been presented in the following eight sub-sectoral clusters:

- Institutional Development (ID)
- Enabling Environment (EE)
- Main Rivers (MR)
- Towns and Rural Areas (TR)
- Major Cities (MC)
- Disaster Management (DM)
- Agriculture and Water Management (AW)
- Environment and Aquatic Resources (EA)

Each cluster comprises of a number of individual programmes, with overall a total of 84 sub-sectoral programmes identified and presented in the Investment Portfolio.

A pyramid of nested objectives at different levels, from cluster up to the Plan and national levels, are summarised overleaf. The individual Programme development objectives that contribute to the cluster objectives are set out in the Investment Portfolio in Chapter 8.




*Note that immediate objectives at one level, represent development objectives for the next level down.*
*Full details of Programme objectives are set out in Chapter 8.*

The sub-sectoral programmes under the clusters can be summarised in the following three broad categories, which are further elaborated in the next Chapters.

**Cross-Cutting Programmes**: These programmes relate to the actions necessary to evolve and strengthen the institutional framework and to create an enabling environment conducive to efficient and effective management of the sector. They are central to the Plan as a whole and have bearing on all sub-sectoral activities and through the regions. They fully embody the key tenets of the National Water Policy and are considered priority actions.

**National-level Programmes**: In addition to the cross-cutting issues above, certain issues need to be dealt with at a national level in order to fully address the problems. These mainly relate to long-term strategic security of water supplies to Bangladesh, pollution control, restoration of flood-plain and river fisheries, and other environmental management issues.

**Regional Programmes**: These fall into two sub-categories. Firstly there are those that are generic in nature and applicable to all or most regions (eg rural water supplies and arsenic mitigation). The second sub-category is made up of those programmes which are specific to one or two regions only (eg cyclone protection).

# 5 Cross-Cutting Programmes

## Institutional Development

For many institutions, the future will bring into focus new responsibilities, requiring changes in the way their day-to-day operations are conducted. With the exception of the new bodies planned for regulation of the water supply and sanitation services, these changes will be effected through developing the existing agencies. Experience indicates that this will require a sustained effort over many years to fully achieve. The speed with which wider civil service reforms are introduced will have bearing on this also.

Two immediate objectives for Institutional Development have emerged to serve the wider development objective of ensuring rational management and wise use of the nation's water resources.

The first relates to bringing about changes in the institutional set-up that will ensure effective regulation, decentralisation and devolution according to the principles of subsidiarity. To achieve these aims, four programmes are planned with a focus on identifying the needs of Local Government to fulfil their responsibilities in the water sector, establishment of independent regulatory bodies, rationalisation of management of flood control infra-

### Key Aspects of Future Institutional Framework

- **WARPO**, as secretariat to NWRC, is to take an apex role in national planning and monitoring plan implementation. It will assist NWRC in coordinating all activities and will provide assistance to Planning Commission and IMED, as and when required, in assessing compliance of agency programmes and projects with the Plan.
- **Bangladesh Water Development Board** (BWDB) will continue as manager of the water resource system, and will be directly responsible for maintenance and development of the main and regional rivers. Management of FCD&I schemes will be rationalised.
- **Local Government** with support from **Local Government Engineering Department** will manage and develop local systems, interfacing between BWDB and the small-scale systems managed by communities and individuals. In concert with NGOs, LG will support flood proofing and cyclone protection measures. **Municipalities** will take increasing responsibility for urban services and **Department of Public Health** will support development of water supply and sanitation systems.
- Disaster preparedness and relief operations will continue to be directed and coordinated by **Disaster Management Bureau**, with forecasting responsibilities assigned to BWDB and the **Meteorological Department**.
- The recently constituted **Bangladesh Haor & Wetland Development Board** will ensure integrated development and management of haors and wetlands in accordance with its mandate.
- **Ministry of Agriculture** through its agencies will continue to promote best practice amongst farmers. **Department of Fisheries** will continue to support flood-plain and culture fisheries and **Department of Forests** remains responsible for afforestation programmes.
- **Department of Environment** will continue to expand its activities in environmental monitoring and regulation.
- **Private sector** activities will continue in minor irrigation and increased participation in water supply and sanitation will be encouraged. **New regulatory bodies** will be established in support of this.
- **Non-Government Organisations** are expected to continue their work at grass-roots level with a focus on promoting community participation and engagement of the poor and disadvantaged. Advocacy of environmental and other important issues will continue to be an important feature of NGO operations also.

structure and development of new structures within BWDB to effectively implement regional and sub-regional programmes.

The second group of programmes is targeted at developing institutional capacities with particular attention given to Local Government, WARPO, Department of Environment, Bangladesh Water Development Board, Disaster Management Bureau and the Department of Meteorology.

## Creation of an Enabling Environment

Institutional restructuring and capacity will be greatly enhanced by a parallel strategy to establish an enabling environment, particularly given the new paradigms for:

- Decentralised water management
- Cost sharing and cost recovery
- Private sector participation
- Community participation
- Non-traditional financing modalities
- Regulation separated from supply
- New rights, obligations and accountability

Four main areas of activity will address the immediate objectives associated with establishing a coherent framework of rights, obligations and rules of business, with increasing the knowledge base through targeted research and improved data management, with promoting user-commitment to sustainable and wise use of water, and with developing an appropriate mix of public and private sector funding and operations.

Programmes to meet the first objective include those associated with developing an appropriate approach to participatory water management, a programme to revise and improve regulatory instruments, and measures to introduce new legislation, rules and guidelines.

To address the gaps in the knowledge base, a series of research programmes will be taken up in parallel with efforts to rationalise and improve data collection, management and dissemination.

Raising public awareness of water issues and promoting wise use of water is seen as the responsibility of all agencies involved in the sector, and actions are planned to support this effort through well designed media campaigns.

Innovative approaches are called for in promoting private sector participation and developing new funding mechanisms to overcome the limitations of traditional methods. Following more detailed study, the necessary steps will be taken to catalyse and promote these new initiatives.

# 6 National Programmes

In addition to those programmes related to institutional development and creating an enabling environment, other programmes of national strategic importance will be taken up.

## Main rivers studies and research programmes

Development of the main rivers requires careful consideration in view of both their strategic importance and the size of individual investments. A sound basis for strategic decision-making is called for. Four main themes are embodied. The first is to investigate the scope and viability of developing the Ganges, Brahmaputra and Meghna rivers. The second is to consider, within the international context of wider regional developments, the ways by which Bangladesh can maintain overall a secure and sufficient supply of fresh water to meet all its needs in the long-term. The third is to review and determine a viable and affordable plan to deal with the problems of river erosion in the light of experience gained. Finally, a review will be made of the limited prospects for further hydropower in the context of national energy development plans and competing uses for water.

**Studies and Research Programmes for Main Rivers**

- GDA Integrated Development Project Feasibility Study
- NE & SE Regional Development Options Study for Meghna and follow on Feasibility Study
- Brahmaputra Barrage Study
- Review and update of Master Plan for major river training
- Hydropower Development Master Plan

## National Environment Programmes

Similarly, actions are necessary at national level to address the major environmental concerns over pollution and diminishing flood plain and river fish catches. A National Pollution Control Plan and associated water quality monitoring programme are to be taken up, along with preparation of a National Fisheries Master Plan. ECAs will be studied in depth and appropriate measures for integrated management set out. Each will lead to follow-up actions and investments. Efforts will also go into raising public awareness and empowerment on environmental issues throughout the country, to stimulate and bring focus to preservation and restoration of the water-related environment through public demand.

**National-level Environment Programmes**

- National Pollution Control Plan
- National Clean-up of Existing Industrial Pollution
- National Water Quality Monitoring
- National Fisheries Master Plan
- National Fish Pass Programme
- Environmentally Critical Areas and Integrated Wetland Management
- Environmental Responsibility Public Awareness Raising and Empowerment

# 7 Regional Programmes

## Generic Programmes for all Regions

Some actions are required that are common to all regions. They are not necessarily needed throughout each region, and their precise locations will be confirmed at detailed programme design stage. The National Water Resources Database holds much valuable information that will facilitate this process (eg areas associated with different levels of arsenic risk, the locations of different FCD schemes, fish habitats etc.).

A central theme of the NWMP is to develop and manage the river systems on an integrated basis. BWDB will be responsible for the main and regional rivers, and community groups and individual farmers will be mobilised to improve water management and conservation in small khals, lesser channels and drainage lines. Local Government will interface with both BWDB and the communities, manage the intermediate channels and, along with others, help promote community-based developments. Programmes are planned to provide the necessary support at each level throughout the system.

These programmes will be separate to, but coordinated with, efforts to rationalise the condition and management of the large number of public flood control and drainage schemes and irrigation schemes. Many are now under-performing in technical and environmental terms and O&M funding has become a major issue. Policy sets out the directions in this regard. Programmes in the institutional development and enabling environment clusters will provide tactical guidance and necessary legal and regulatory support. The process will be participatory and will involve environmental audit as required under the environmental policy and regulations. Where found feasible and affordable, new public irrigation schemes will be taken up in those areas where irrigation expansion would otherwise be constrained. Continued support will be given to small-scale and minor irrigation, and actions will be taken to promote increased use of force-mode technologies and to improve efficiencies generally.

Another central theme to the NWMP is the importance attached to provision of sustainable services for urban and rural water supply and sanitation. An essential prerequisite is preparation of a thorough inventory and asset management plan for each location and across the whole sub-sector. This will enable a structured and efficient approach to be adopted in the investment programmes in the urban areas. In the rural areas, private sector activities will be encouraged to expand. The institutional development and enabling environment programmes will again provide tactical support in both urban and rural areas particularly in relation to operational and financial management and fund raising.

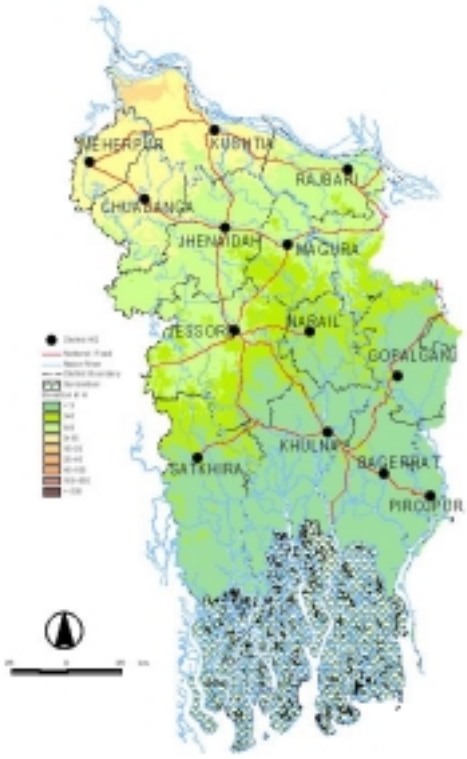
Whilst other contaminants can be found in groundwater (the main current source of water for domestic use) the presence of arsenic in the shallow aquifer in many locations poses a major threat to provision of safe water supplies. Action is already being taken to mitigate against this through different treatment methods, and this programme will be expanded and receive highest priority to achieve sustainable and affordable solutions in all areas where arsenic is a problem.

A third area of widespread applicability under the Plan is the environmental programmes aimed at clearing up existing pollution (particularly industrial), reinstating connectivity of the flood plains with river systems to facilitate fish migration, and site specific actions to address the needs of environmentally critical areas and to promote integrated management of wetlands.

## Southwest Region

The SW region has been identified as one that needs urgent attention. Major issues specific to the region are:

- Preservation of the Sundarbans
- Restoration of dry season freshwater inflows to the region
- Maintenance of 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



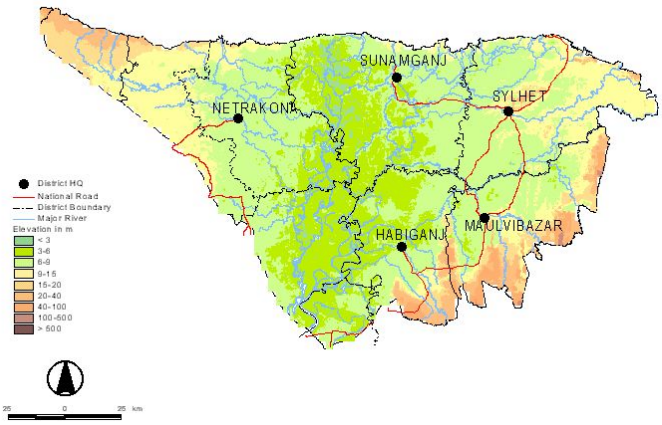

Studies to make use of the Ganges flows under the 1996 Treaty are ongoing, but are expected to lead to an overall phased development programme of the region's river systems utilising water diverted from the Ganges. These measures will be taken up in concert with efforts to restore the drainage capacity within the coastal polder systems.

Special efforts will be made to determine appropriate water management conditions favourable to the Sundarbans' eco-system and these will be factored into river restoration and improvement programmes. Cyclone protection will be expanded in risk areas and flood-proofing as required. Special attention will be given to Khulna City water supply, sanitation, storm drainage and flood protection.

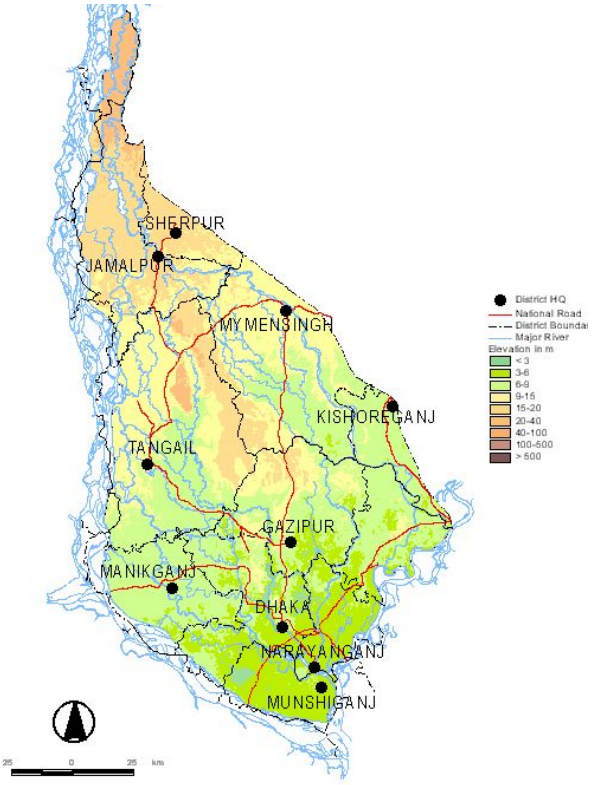
## Northeast Region

Much of the NE region is taken up by the environmentally important *haor basins*, and efforts are needed to sensitively manage these in the context of the wider development requirements. Major issues specific to the region are:

- Environmental management of the Haor Basin
- Flash flooding and 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




Studies will be conducted to investigate whether a barrage on the Meghna River would bring multi-purpose sufficient benefits to this and the SE region. Otherwise the main region-specific programmes will focus on improved water management of the Haor Basins, relieving drainage congestion and promoting flood-proofing within the area.



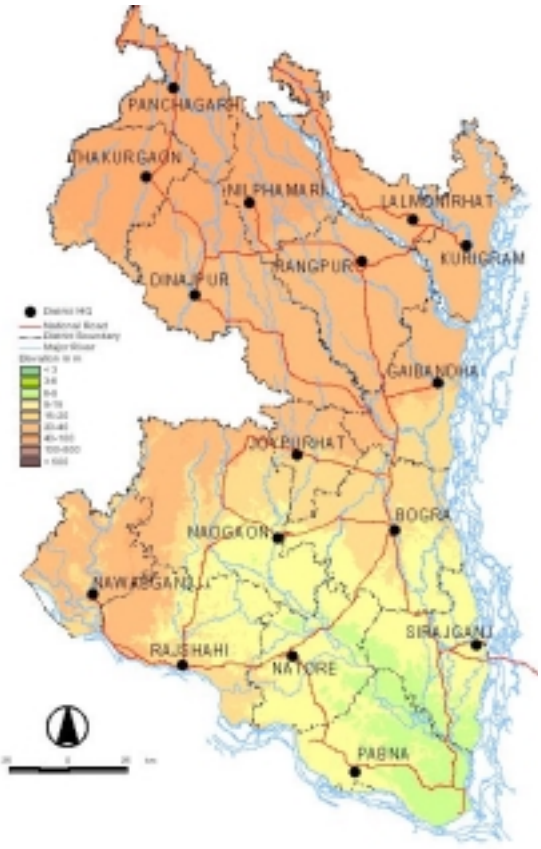

## North Central Region

As home to the nation's capital, development of the NC region is particularly dependent upon plans to manage urban expansion. Major issues specific to the region are:

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

Major programmes will be taken up to address the water supply,

sanitation, storm drainage and flood protection of Dhaka, along with a concerted effort to clean-up industrial pollution. Studies will be taken up to investigate the feasibility of augmenting the regional rivers from main rivers to improve navigability and the availability of clean water. Flood-proofing will be promoted along with drainage improvements under the regional river improvement programmes.




## Northwest Region

The NW region suffers a number of problems associated with flooding in some parts and dry season shortages in the higher land to the west. Major issues specific to the region are:

- 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

Strategies for river bank erosion will be reviewed in the light of experience and studies are on-going for relieving dry season shortages from the Ganges. These will lead to investments as found appropriate. In areas where shallow tubewells are ineffective and surface water cannot be feasibly diverted to, efforts will be made to extend force-mode tubewell irrigation with public support. Flood proofing will be promoted and improvements made to drainage. Special attention will be given to upgrading and expanding water supply, sanitation, storm drainage and flood protection for Rajshahi City to meet future service demands.

## South Central Region

Although the SC region has a marked excess of dry season water supplies, it experiences severe flooding from the Padma-Meghna rivers and a number of other problems in the coastal areas. Major issues specific to the region are:


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

The main programmes for this region will be directed to extending cyclone protection and improving coastal protection for existing and newly accreted land through afforestation and embankment rehabilitation.

Flood proofing will be promoted, particularly of areas adjacent to the major rivers.

## Southeast Region

The SE region suffers similar problems to the SC region and is particularly affected by arsenic contamination. Major issues specific to the region are:

- 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

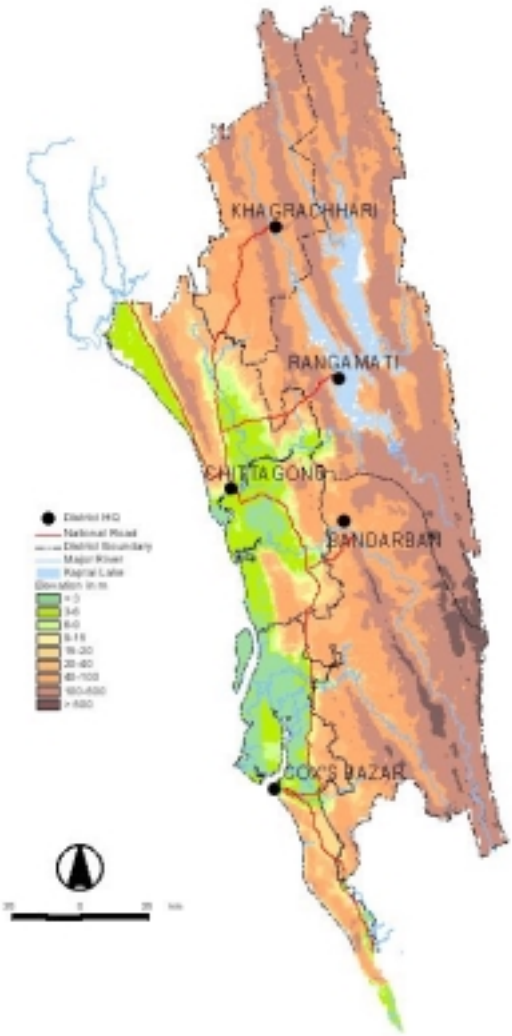
Studies will be made of the potential of developing the Meghna river to the benefit of both the SE and NE regions to improve safe water availability, with follow-on investments as required.

Other programmes similar to the SC region will be taken for cyclone protection, flood proofing and coastal protection and afforestation.

## Eastern Hills Region

This region, the most hilly in Bangladesh, is relatively short of water in the dry season but cannot be augmented feasibly from the main river systems. Its coastal fringe is particularly exposed to cyclones. Major issues specific to the region are:

- 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




Emphasis will be placed on making best use of dry season water resources, particularly the hilly *charhas* and the artesian wells, and programmes will be initiated to develop hill irrigation for high value crops. The limited potential for mini-hydropower for remote areas will be exploited and steps taken to optimise use of Kaptai reservoir to serve multi-purpose needs. Catchment management will remain an important task. Special attention will be given to developing water supply, sanitation, storm drainage and flood protection for Chittagong city. Elsewhere on the coastal plain cyclone protection will be improved and expanded including necessary works for coastal protection and afforestation.

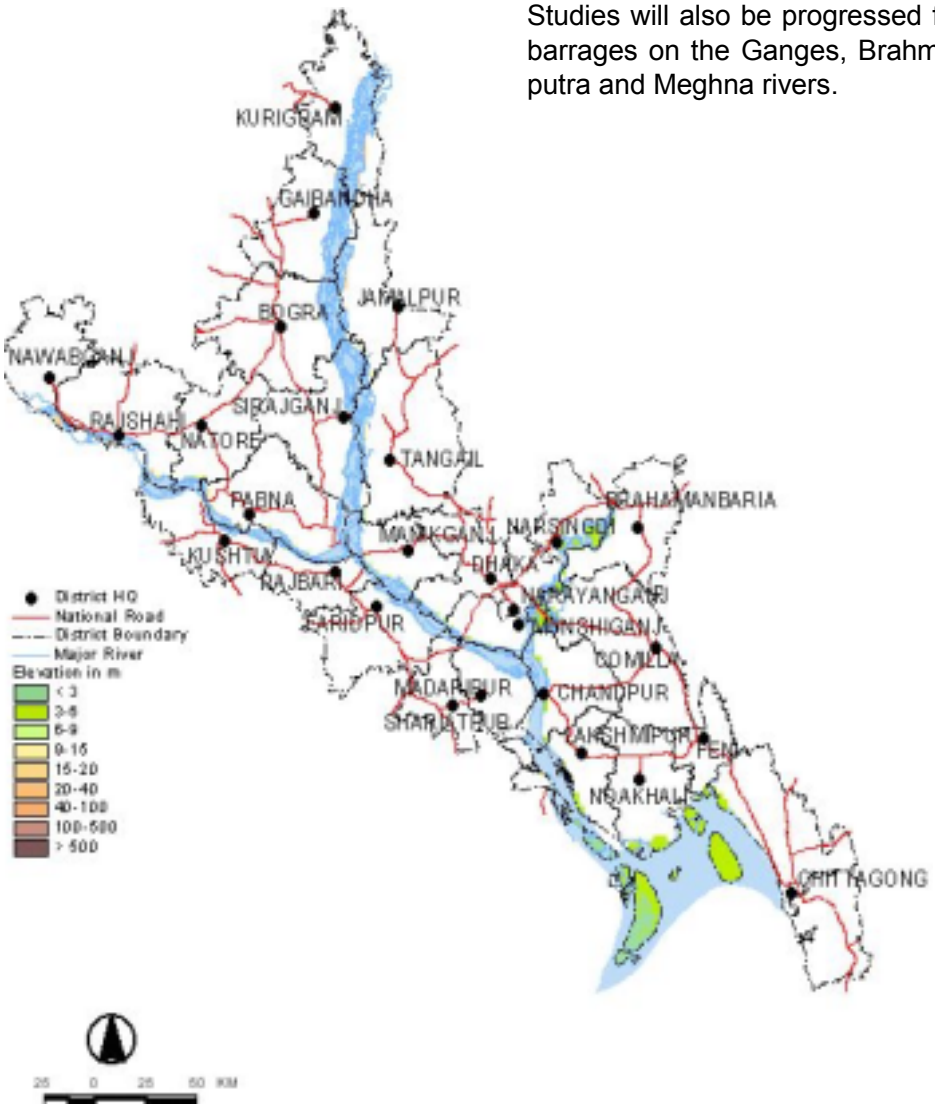
## Rivers and Estuary Region

Management of the main rivers is a particularly challenging task given the magnitude and ferocity of monsoon flows, and the strategic importance of the dry season waters they otherwise convey into the Bay of Bengal. Major issues specific to the region are:

- 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
- Land accretion and land reclamation
- Timely protection on newly accreted lands

Strategies for erosion control and development of the rivers will be studied in detail, and these will set the scene for long-term investment plans for these rivers. Both structural and non-structural approaches to erosion management will be considered.

Studies will also be progressed for barrages on the Ganges, Brahmaputra and Meghna rivers.




Flood proofing of charlands will continue meantime and measures will be taken up to provide adequate protection to those in the estuary areas and on newly accreted land.

# 8 Investment Portfolio

The Investment Portfolio provides a complete set of programmes that are spatially and technically integrated and chronologically phased to fulfil the overall goals of the National Water Management Plan over the next 25 years. Each programme has been designed to contribute to attainment of specific objectives. Full details of each programme are given in Volume 3. These include:

- Location
- Relevance to the National Water Policy
- Purpose of Programme
- Programme Outline
- Financing Arrangements
- Objectives and Indicators
- Institutional Arrangements
- Existing Documentation
- Linkages
- Risks and Assumptions

These programmes are not in themselves projects. Projects are the responsibility of the line agencies, Local Government and others, and are to be developed and implemented by them within the framework of the Investment Portfolio and in accordance with Government's procedures. There is no reason that individual projects should not contribute to several Investment Portfolio programmes, and in many instances this may lead to better projects.

Aspects of phasing, linkages, implementation and financing are discussed later. Given overleaf is a full list of the 84 programmes and their objectives, listed by cluster.

| MIS Ref | Title | Key Programme Objective |
|---|---|---|
| **INSTITUTIONAL DEVELOPMENT** | | **Rational management and wise use of Bangladesh's water resources** |
| ***Immediate Objective ID 01*** | | ***Bangladesh's institutional framework for the water sector regulated, decentralised and devolved according to subsidiarity principles*** |
| ID 001 | Local Government Needs Assessment for Water Management | *Outline management structure, procedures and human resource requirements for local water sector development and management by LGIs agreed by all stakeholders* |
| ID 002 | Independent Regulatory Bodies for Water Supply & Sanitation Service Sector | *Independent regulatory bodies for water supply and sanitation services established and fully functional* |
| ID 003 | FCD and FCD/I Management Rationalisation | *75% of decentralised FCD/I schemes considered sustainable within 10 years of transfer* |
| ID 004 | BWDB Regional and Sub-regional Management Strengthening | *BWDB internal organisation structured to plan, develop and manage river improvement programmes effectively, with established capacity* |
| ***Immediate Objective ID 02*** | | ***Capacities of Bangladesh's restructured water sector institutions strengthened in line with future demands on them*** |
| ID 005 | Local Government Capacity Building for Water Management | *LGI water management operational capacity consistent with the needs of decentralized water management in Bangladesh* |
| ID 006 | WARPO Capacity Building | *WARPO established as a centre of excellence* |
| ID 007 | Department of Environment Capacity Building | *Department of Environment capacity building programme completed* |
| ID 008 | Disaster Management Bureau Capacity Building | *Disaster Management Bureau capacity building programme completed* |
| ID 009 | Capacity Building for Other Organisations | *Reliable predictions of extreme climatic events (both short and long term), and morphological changes; and effective wetland management procedures* |
| ID 010 | BWDB Capacity Building | *BWDB capacity building programme completed* |

| | | |
|---|---|---|
| **CREATION OF ENABLING ENVIRONMENT** | | **Rational management and wise use of Bangladesh's water resources** |
| ***Immediate Objective EE 01*** | | ***Rights, obligations and rules of business as they relate to all stakeholders promulgated via a consistent and comprehensive set of documents*** |
| EE 001 | Support to the Preparation of New Legislation | *Final Draft National Water Code establishing GoB's obligation to manage water as a public good while facilitating the participation of equitable, well regulated, community based organisations presented to Parliament* |
| EE 002 | Field Testing of Participatory Management Models | *A range of appropriate and replicable institutional models for decentralized water management in Bangladesh* |
| EE 003 | Water Resources Legislation - Preparation of Supporting Ordinances | *An easily understood legal framework for water sector development and management* |
| EE 004 | Project Preparation Procedures – Guidelines and Manual | *Water sector programme and project preparation regulated by an approved set of guidelines and manuals* |
| EE 005 | Regulatory and Economic Instruments | *Regulatory and Economic instruments in force* |
| EE 006 | Field Testing & Finalisation of Guidelines for Participatory Water Management | *Guidelines for Participatory Water Management applied to all relevant programmes and projects* |
| ***Immediate Objective EE 02*** | | ***Development and management of water sector resources, institutions and infrastructure characterised by the use of reliable, well organised data and targeted adaptive research*** |
| EE 007 | NWRD Improved Data Collection and Processing Facilities | *All water sector reports archived in digital format and available to all water users in hard and soft copies* |
| EE 008 | Water Resources Management Research and Development Studies | *Research playing a Key role in quinquennial NWMP updates* |
| EE 009 | Water Resources Management Long Term Research and Development | *Bangladesh's water sector considered to represent a regional center of research excellence* |

| MIS Ref | Title | Key Programme Objective |
|---|---|---|
| ***Immediate Objective EE 03*** | | ***User commitment to the sustainable and wise use of Bangladesh's water resources*** |
| EE 010 | Raising Public Awareness in the Wise Use and Management of Water | *Effective public demand for sustainable water resources management* |
| ***Immediate Objective EE 04*** | | ***Bangladesh's water sector costs shared between public, private and user entities according to comparative advantage*** |
| EE 011 | Private Sector Participation in Water Management | *Full but regulated access to water sector investment and service delivery opportunities to the private sector* |
| EE 012 | Water and Environment Funds | *Increased pollution clean up and arsenic mitigation catalysed by grants and subsidies* |
| EE 013 | Alternative Financing Methods for Water Management | *Increasing use of non-traditional financing for water sector development and management* |
| **MAIN RIVERS** | | **People's quality of life improved by the equitable, safe and reliable access to water for production, health and hygiene** |
| ***Immediate Objective MR 01*** | | ***Bangladesh's main and regional rivers comprehensively developed for multi-purpose use*** |
| MR 001 | Main River Studies and Research Programmes | *A sound basis for strategic decision-making and the planning of future Main River development accepted by the due authorities* |
| MR 002 | Main River Abstraction Projects | *Increased irrigated areas, environmental health, navigability and other conditions* |
| MR 003 | Ganges Barrage and Ancillary Works | *Increased dry season water availability in the GDA* |
| MR 004 | Meghna Barrage and Ancillary Works | *Increased dry season water availability in the NE and SE regions* |
| MR 005 | Brahmaputra Barrage and Ancillary Works | *Increased dry season water availability in the NW, NC and NE regions* |
| MR 006 | Regional River Management and Improvement | *Sustainable river development and management works* |
| MR 007 | Ganges Dependent Area Regional Surface Water Distribution Networks | *Increased dry season water availability in the GDA* |
| MR 008 | North East and South East Regional Surface Water Distribution Networks | *Increased dry season water availability in the Northeast and Southeast Regions* |
| MR 009 | North Central and North West Regional Surface Water Distribution Networks | *Increased dry season water availability in the Regions* |
| MR 010 | Main Rivers Erosion Control at Selected Locations | *Socio-economic impacts of erosion minimised* |
| MR 011 | River Dredging for Navigation | *Navigation traffic enabled* |
| MR 012 | Hydropower Development and Upgrading | *Profitable hydropower generation* |
| **TOWNS AND RURAL AREAS** | | **People's quality of life improved by the equitable, safe and reliable access to water for production, health and hygiene** |
| ***Immediate Objective TR 01*** | | ***Demand for safe and reliable drinking water supplies satisfied in towns and rural areas*** |
| TR 001 | Urban Arsenic Mitigation | Arsenic free potable water available to 100% of large and small town populations |
| TR 002 | Rural Arsenic Mitigation | Arsenic free potable water available to 100% of rural population |
| TR 003 | Large and Small Town Water Supply and Distribution Systems | 100% of large and small town population have access to formal water supplies |
| TR 004 | Rural Water Supply and Distribution Systems | 100% of rural population has access to formal water supplies |
| ***Immediate Objective TR 02*** | | ***Demand for sanitation services created and satisfied in towns and rural areas*** |
| TR 005 | Large and Small Town Sanitation and Sewerage System | 100% of large and small town populations have access to sanitation facilities |
| TR 006 | Rural Sanitation | 100% of rural populations have access to sanitation facilities |

| MIS Ref | Title | Key Programme Objective |
|---|---|---|
| ***Immediate Objective TR 03*** | | ***Large and small towns protected from flooding and stormwater run-off*** |
| TR 007 | Large and Small Town Flood Protection | All large and small towns protected from 1: 100 year floods |
| TR 008 | Large and Small Town Stormwater Drainage | Stormwater drainage installed in all large and small towns |
| **MAJOR CITIES** | | **People's quality of life improved by the equitable, safe and reliable access to water for production, health and hygiene** |
| ***Immediate Objective MC 01*** | | ***Demand for safe and reliable drinking water supplies satisfied in the Statistical Metropolitan Areas*** |
| MC 001 | Inventory and Asset Management Plan of Water Supply & Sanitation Sector | Detailed development plan for water supply and sanitation facilities in the SMA's |
| MC 002 | Dhaka Bulk Water Supply and Distribution Systems | 100% of Dhaka's population have access to formal water supplies |
| MC 003 | Chittagong Bulk Water Supply and Distribution Systems | 100% of Chittagong's population have access to formal water supplies |
| MC 004 | Khulna Bulk Water Supply and Distribution Systems | 100% of Khulna's population have access to formal water supplies |
| MC005 | Rajshahi Bulk Water Supply and Distribution Systems | 100% of Rajshahi's population have access to formal water supplies |
| ***Immediate Objective MC 02*** | | ***Demand for sanitation services created and satisfied in the Statistical Metropolitan Areas*** |
| MC 006 | Dhaka Sanitation and Sewerage System | 100% of Dhaka's population have access to sanitation facilities |
| MC 007 | Chittagong Sanitation and Sewerage System | 100% of Chittagong's population have access to sanitation facilities |
| MC 008 | Khulna Sanitation and Sewerage System | 100% of Khulna's population have access to sanitation facilities |
| MC 009 | Rajshahi Sanitation and Sewerage System | 100% of Rajshahi's population have access to sanitation facilities |
| ***Immediate Objective MC 03*** | | ***Statistical Metropolitan Areas protected from flooding and stormwater run-off*** |
| MC 010 | Dhaka Flood Protection | Dhaka protected from 1:100 year flood |
| MC 011 | Dhaka Stormwater Drainage | Dhaka served by stormwater drainage |
| MC 012 | Chittagong Flood Protection | Chittagong protected from 1:100 year flood |
| MC 013 | Chittagong Stormwater Drainage | Chittagong served by stormwater drainage |
| MC 014 | Khulna Flood Protection | Khulna protected from 1:100 year flood |
| MC 015 | Khulna Stormwater Drainage | Khulna served by stormwater drainage |
| MC016 | Rajshahi Flood Protection | Rasjshahi protected from 1:100 year flood |
| MC017 | Rajshahi Stormwater Drainage | Rajshahi served by stormwater drainage |
| **DISASTER MANAGEMENT** | | **People's quality of life improved by the equitable, safe and reliable access to water for production, health and hygiene** |
| ***Immediate Objective DM 01*** | | ***Lives, livelihoods and national infrastructure protected or mitigated against inundation damage by structural and non-structural measures*** |
| DM 001 | Cyclone Shelters and Killas | 775 multi-purpose shelters and 1,369 killas constructed in cyclone-prone areas |
| DM 002 | Bari-level Cyclone Shelters | 43,776 bari-level cyclone shelters |
| DM 003 | Flood Proofing in the Charlands and Haor Basin | 3,500,000 charland and haor basin inhabitants in flood proofed dwellings |
| DM 004 | National, Regional and Key Feeder Roads – Flood Proofing | 100% of all national and feeder roads raised by 1m in high and .5m in low risk areas; 20% of feeder and rural roads raised by 1m in high risk areas |
| DM 005 | Railway Flood Proofing | 100% of all high risk railways raised by 1m and 100% of low risk railway raised by .5m |
| DM 006 | Supplementary Irrigation and Drought Proofing of Rural Water Supplies | Increased quality of life in target areas |

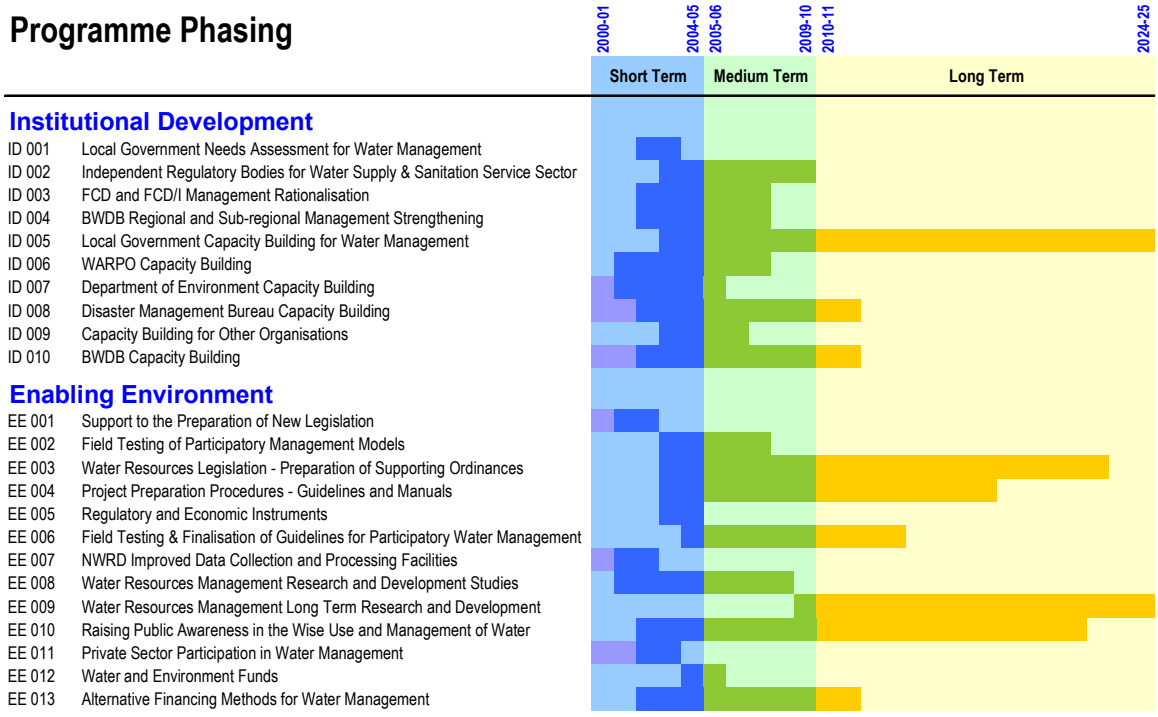
| MIS Ref | Title | Key Programme Objective |
|---|---|---|
| **AGRICULTURE and WATER MANAGEMENT** | | **People's quality of life improved by the equitable, safe and reliable access to water for production, health and hygiene** |
| ***Immediate Objective AW 01*** | | ***Water-related constraints on agricultural production minimised*** |
| AW 001 | Promotion of Expanded Minor Irrigation and Improved On-farm Water Management | Average return per unit of water increased in minor irrigation areas |
| AW 002 | Improved Performance of Existing Public Surface Water Irrigation Schemes | Increased returns per unit of water and labour on public irrigation schemes |
| AW 003 | New Public Surface Water Irrigation Schemes | Increased area under public surface water irrigation schemes |
| AW 004 | New Public Deep Tubewell Irrigation Schemes | Increased area under public groundwater irrigation schemes |
| AW 005 | Improved Water Management at Local Government Level | Local rivers, feeder canals and main drains restored, rehabilitated, upgraded, as appropriate |
| AW 006 | Improved Water Management at Community Level | Sustainable sub-secondary water use efficiencies of 60% for paddy and 75% for dryfoot crops |
| AW 007 | Rationalisation of Existing FCD Infrastructure | Increased returns per unit of water and labour on public schemes |
| AW 008 | Land Reclamation, Coastal Protection and Afforestation | Study for land reclamation from sea and estuary undertaken; and 1550 $km^2$ of new coastal land protected |
| **ENVIRONMENT AND AQUATIC RESOURCES** | | **Clean water in sufficient and timely quantities for multi-purpose use and preservation of the aquatic and water dependent eco-systems** |
| ***Immediate Objective EA 01*** | | ***Sufficient clean water for multi-purpose use*** |
| EA 001 | National Pollution Control Plan | National Pollution Control Plan agreed |
| EA 002 | National Clean-up of Existing Industrial Pollution | Multi-purpose water use not constrained by quality considerations |
| EA 003 | National Water Quality Monitoring | Reduction of gross/persistent pollution |
| ***Immediate Objective EA 02*** | | ***Quality, size and connectivity of water bodies adequate for the restoration and preservation of the aquatic biomes*** |
| EA 004 | National Fisheries Master Plan | Wild fish stocks conserved or increased |
| EA 005 | National Fish Pass Programme | Sustainable increase in floodplain fish catches, in terms of both numbers and diversity |
| EA 006 | Unspecified Regional Programmes | Improvement in region-specific environmental characteristics |
| EA 007 | Improved Water Management in The Haor Basins of the North East Region | Water-related regulations established |
| EA 008 | Environmentally Critical Areas and Integrated Wetland Management | Improved levels of protection extended to existing and new environmentally critical areas |
| EA 009 | Improved Water Management and Salinity Control in the Sundarbans | Pending |
| ***Immediate Objective EA 03*** | | ***Public sensitised and empowered to demand restoration and stewardship*** |
| EA 010 | Public Awareness Raising and Empowerment in respect of Environmental Issues | Effective public demand for sustainable environmental stewardship |

# 9 Development Schedules

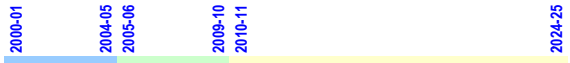
Each programme in the Investment Portfolio has an internal scheduling based on practical considerations and demand forecasts. Overall, programmes have been scheduled according to priority and sequential linkages and with a view to smoothing overall investment requirements across the sector, particularly in relation to Government's development budget. Account has been taken also of ongoing programmes and their impact on the timing of new programmes.

In general the Plan places a high priority on programmes for institutional development, creating an enabling environment, rationalisation of FCD&I schemes, and key actions required to protect the natural environment and aquatic resources. The former two are essential prerequisites to developing sound institutions and an operational environment conducive to efficient and timely implementation of the investment programmes. Rationalisation of FCD&I scheme management is a central Policy aim, and an early start is needed to develop an appropriate methodology. Urgent actions are needed also in averting further degradation of the natural environment. To delay in this regard will escalate the costs of remedial actions and may prompt irreversible changes.

Programmes relating to provision of water supplies and sanitation (including arsenic mitigation), whether in major cities, urban or rural areas are also accorded priority, given the backlog in investment and the expected sharp rise in demands particularly in the urban areas. The Plan as presented assumes that this back-log will be removed by the end of the medium term. Alternative scenarios are considered in Chapter 10.



## Programme Phasing (continued)




### Main Rivers

MR 001 Main River Studies and Research Programmes
MR 002 Main River Abstraction Projects
MR 003 Ganges Barrage and Ancillary Works
MR 004 Meghna Barrage and Ancillary Works
MR 005 Brahmaputra Barrage and Ancillary Works
MR 006 Regional River Management and Improvement
MR 007 Ganges Dependent Area Regional Surface Water Distribution Networks
MR 008 North East and South East Regional Surface Water Distribution Networks
MR 009 North Central and North West Regional Surface Water Distribution Networks
MR 010 Main Rivers Erosion Control at Selected Locations
MR 011 River Dredging for Navigation
MR 012 Hydropower Development and Upgrading

### Towns and Rural Areas

TR 001 Urban Arsenic Mitigation
TR 002 Rural Arsenic Mitigation
TR 003 Large and Small Town Water Supply and Distribution Systems
TR 004 Rural Water Supply and Distribution Systems
TR 005 Large and Small Town Sanitation and Sewerage Systems
TR 006 Rural Sanitation
TR 007 Large and Small Town Flood Protection
TR 008 Large and Small Town Stormwater Drainage

### Major Cities

MC 001 Inventory and Asset Management Plan of Water Supply & Sanitation Sector
MC 002 Dhaka Bulk Water Supply and Distribution Systems
MC 003 Chittagong Bulk Water Supply and Distribution Systems
MC 004 Khulna Bulk Water Supply and Distribution Systems
MC 005 Rajshahi Bulk Water Supply and Distribution Systems
MC 006 Dhaka Sanitation and Sewerage Systems
MC 007 Chittagong Sanitation and Sewerage Systems
MC 008 Khulna Sanitation and Sewerage Systems
MC 009 Rajshahi Sanitation and Sewerage Systems
MC 010 Dhaka Flood Protection
MC 011 Dhaka Stormwater Drainage
MC 012 Chittagong Flood Protection
MC 013 Chittagong Stormwater Drainage
MC 014 Khulna Flood Protection
MC 015 Khulna Stormwater Drainage
MC 016 Rajshahi Flood Protection
MC 017 Rajshahi Stormwater Drainage

### Disaster Management

DM 001 Cyclone Shelters and Killas
DM 002 Bari-level Cyclone Shelters
DM 003 Flood Proofing in the Charlands and Haor Basin
DM 004 National, Regional and Key Feeder Roads - Flood Proofing
DM 005 Railway Flood Proofing
DM 006 Supplementary Irrigation and Drought Proofing of Rural Water Supplies

### Agriculture and Water Management

AW 001 Promotion of Expanded Minor Irrigation and Improved OFMW
AW 002 Improved Performance of Existing Public Surface Water Irrigation Schemes
AW 003 New Public Surface Water Irrigation Schemes
AW 004 New Public Deep Tubewell Irrigation Schemes
AW 005 Improved Water Management at Local Government Level
AW 006 Improved Water Management at Community Level
AW 007 Rationalisation of Existing FCD Infrastructure
AW 008 Land Reclamation, Coastal Protection and Afforestation

### Environment and Aquatic Resources

EA 001 National Pollution Control Plan
EA 002 National Clean-up of Existing Industrial Pollution
EA 003 National Water Quality Monitoring
EA 004 National Fisheries Master Plan
EA 005 National Fish Pass Programme
EA 006 Unspecified Regional Programmes
EA 007 Improved Water Management in the Haor Basins of the North East Region
EA 008 Environmentally Critical Areas and Integrated Wetland Management
EA 009 Improved Water Management and Salinity Control in the Sundarbans
EA 010 Public Awareness Raising and Empowerment in respect of Environmental Issues

# 10 Investment Requirements and Funding

There are two main capital investment categories within the NWMP. The first, termed as “Water Resources”, covers the traditional areas of Government sectoral funding, such as FCD, river works, public irrigation, research, studies and the like. The second, “Water Supply and Sanitation” covers urban and rural water supply and sanitation service provision.

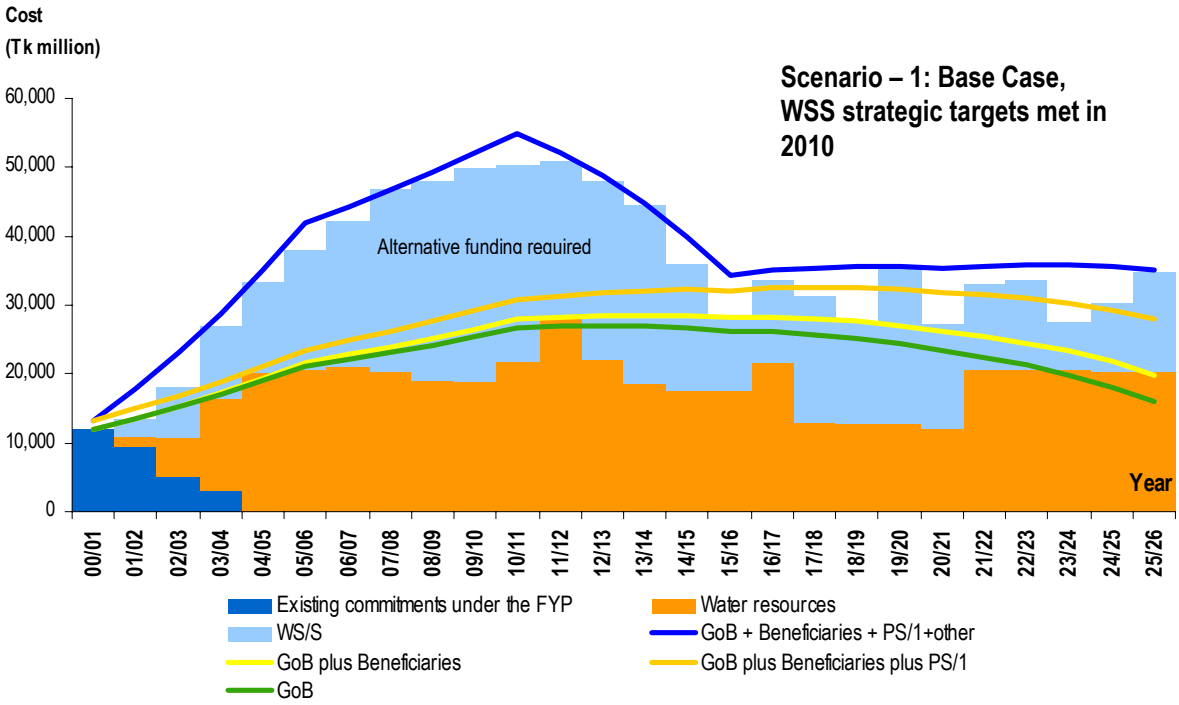
The distinction between the two categories is that whilst “water resources” has been and will continue to be funded generally directly by Government, “water supply and sanitation” has been funded in the past by a mix of public and private investment. This mix could be varied in the future, with the potential for reducing direct GoB funding if alternative funding modalities are introduced.

The table below illustrates the Base Case funding requirements for the NWMP by sub-sectoral cluster for each phase of the Plan. It may be noted that overall investment requirements are dominated by three of the clusters (Main Rivers at 24%, Towns and Rural Areas at 29% and Major Cities at 34%, the latter two making up nearly two-thirds of the total investment requirements).

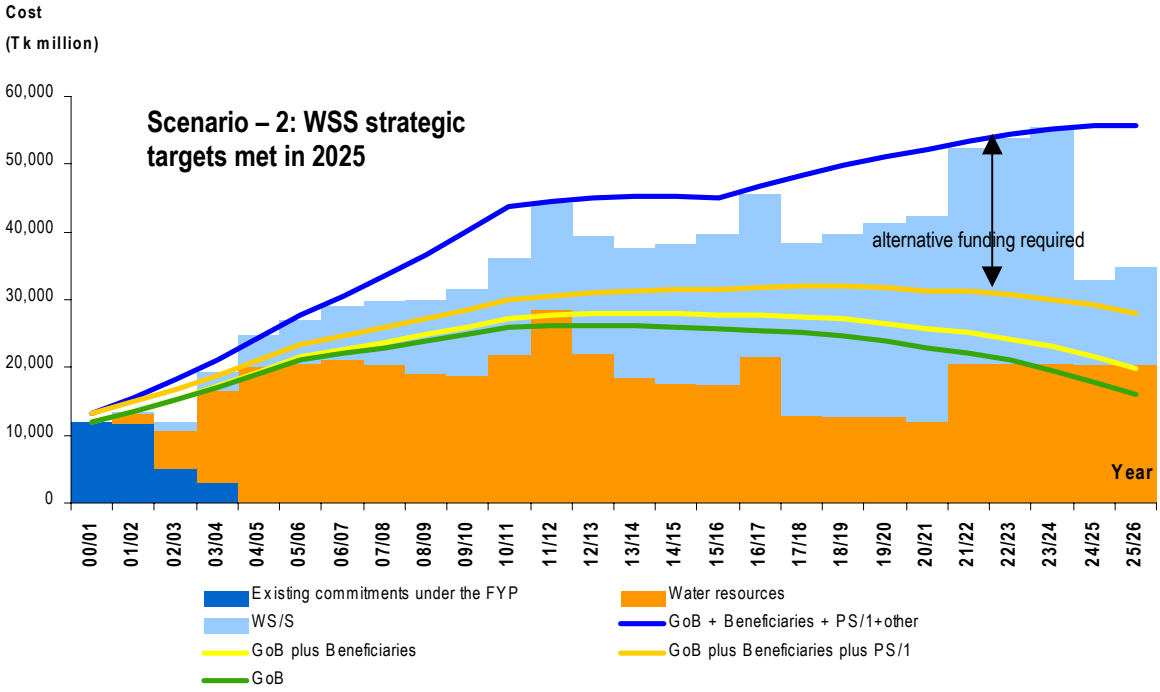
| **NWMP Cost Estimates**<br>**Taka million** (mid 2000 prices) | **Short Term**<br>2000-05 | **Medium Term**<br>2006-10 | **Long Term**<br>2011-25 | **Residual *** | **Total** | **Percentage of Overall NWMP Budget** |
|---|---|---|---|---|---|---|
| Institutional Development | 3,780 | 6,723 | 7,981 | 1,452 | **19,936** | 2.2% |
| Enabling Environment | 849 | 940 | 1,793 | - | **3,574** | 0.4% |
| Main Rivers | 8,437 | 14,301 | 155,196 | 45,286 | **223,220** | 24.4% |
| Towns and Rural Areas | 29,512 | 88,274 | 133,699 | 13,404 | **264,889** | 29.0% |
| Major Cities | 22,078 | 93,946 | 185,563 | 10,344 | **311,931** | 34.1% |
| Disaster Management | 4,980 | 7,809 | 13,707 | 668 | **27,165** | 3.0% |
| Agriculture & Water Management | 1,658 | 7,240 | 29,525 | 7,186 | **45,609** | 5.0% |
| Environment & Aquatic Resources | 3,092 | 5,473 | 9,677 | - | **18,241** | 2.0% |
| **Estimated Totals** | **74,378** | **224,706** | **537,141** | **78,340** | **914,565** | |

** Residual costs relate to development programmes started prior to 2025 and continuing thereafter. They exclude routine costs, eg continued river dredging etc.*

The Base Case (Scenario 1) assumes that investment in water supply and sanitation will be sufficient to allow the back-log of investment to be caught up by the end of the medium term in 2010, as required by the Development Strategy. This leads to a rapid build-up of annual investment requirements, peaking during the medium term at a little under Taka 50 billion per year, as illustrated overleaf.




An alternative Scenario 2 has been considered where the catch-up for provision of water supply and sanitation will have been accomplished by 2025. This moderates significantly the rate of capital investment in the short and medium terms, but inevitably stacks up the costs in the long term.



In both scenarios, minimum levels of Government investment are set at that which is sufficient to cover all water resources investments net of beneficiary contributions. The latter are expected to progressively increase over the Plan period as the impacts of the institutional and fiscal reforms take effect, rising by 2025 to approximately 6-7% of total investment costs.

The current activities within the private sector are also expected to increase. These are driven by demand for equipment and services from mainly small businesses throughout the country, and it is fully expected that, even with only modest encouragement, this segment of the private sector will make further in-roads into the water supply and sanitation sub-sector.

Nevertheless, in both scenarios there is a funding gap to fill in order to match total investment requirements. The opportunities for filling this gap are (i) to increase GoB investments, (ii) to mobilise alternative funding, or (iii) to adopt a mix of the two. Alternative funding modalities are to be looked into in the short term programmes EE 011, EE 012 and EE 013. Possible modalities include mobilising both domestic and foreign resources, including establishment of investment funds, public and municipal bonds and privately financed infrastructure development (e.g. BOT schemes for bulk water supply). Success in realising non-Government funds will also be linked to establishment of a disciplined and viable fiscal and regulatory environment.

The ability of Government to provide funding will be conditioned by growth in Gross Domestic Product and the consequent increase in Government income. The Plan assumes a medium growth rate for GDP of 5-6% over the Plan period. At present GoB invests 0.59% of GDP in the sector as a whole, down from 0.9% in 1995-96. The table below illustrates the relative proportions of GDP expected from different sources.

**Investment and Funding Requirements**

*Percent of Projected GDP (medium trend)*

| | | NWMP TERM | | |
|---|---|---|---|---|
| **Investment Requirements** | **Current** | **Short** | **Medium** | **Long** |
| Water resources | | 0.34% | 0.64% | 0.34% |
| Water supply and Sanitation - 1 | | 0.28% | 0.80% | 0.31% |
| Water supply and Sanitation - 2 | | 0.08% | 0.30% | 0.43% |
| Total investment - 1 | | 0.63% | 1.45% | 0.64% |
| Total investment - 2 | | 0.42% | 0.95% | 0.76% |
| **Funding Options** | | | | |
| Current private sector | 0.06% | 0.07% | 0.08% | 0.09% |
| Beneficiary contributions | 0.00% | 0.01% | 0.03% | 0.05% |
| GoB minimum requirements | **0.59%** | **0.26%** | **0.54%** | **0.20%** |
| Funding gap - 1 | | 0.28% | 0.80% | 0.31% |
| Funding gap - 2 | | 0.08% | 0.30% | 0.43% |
| GoB maximum funding - 1 | | **0.55%** | **1.34%** | **0.51%** |
| GoB maximum funding - 2 | | **0.34%** | **0.84%** | **0.63%** |

***Scenario - 1*** *Water Supply and Sanitation Strategy targets met from 2010 onwards*

***Scenario - 2*** *Water Supply and Sanitation Strategy targets met from 2025 onwards*

It may be seen therefore that, in the **short term**, maintaining Government funding at current proportions of GDP on average (nevertheless requiring a modest increase in real terms), should be sufficient for the sector as a whole, irrespective of scenario, without recourse to new types of funding.

However, in the **medium term**, to maintain the Base Case targets (water supply and sanitation investments catch up with demand by 2010), Government would have to more than double its contribution in GDP terms unless new funding can be mobilised to off-set this. Even under Scenario 2 (water supply and sanitation investments catch up demand by 2025), Government may have to increase funding up to as much as 0.84% of GDP (40% above current levels, but similar to 1995-96 levels) to achieve the long term strategic targets if no new funding is developed.

Thus in summary, the attainment of strategic targets is conditional upon adequate and timely funding. Mobilisation of new sources of funding is of paramount importance if Government wishes to maintain funding at or around current proportions of GDP through the critical medium term. Mobilisation of new funding potentially could reduce Government spending in the long term to significantly below current levels.

# 11 Benefits and Impacts

## Benefits

The benefits to Bangladesh of implementing the National Water Management Plan are the attainment of the different levels of objective as previously set out. These may be summarised at Plan and Sub-Sectoral level as follows.

**Rational management and wise-use of Bangladesh's water resources**: The institutional framework will have evolved, separating policy, planning and regulatory functions from operational ones, and reflecting the commitment to decentralised and devolved water management. Local Government institutions and community groups will have an established and substantial role in water management. Existing institutions will have been strengthened to fulfil their roles within this new framework, and new regulatory bodies will have been formed for the water supply and sanitation service sector.

An appropriate legal framework will have been introduced, complete with a consistent set of under-laws, rules and guidelines that comprehensively defines each institution's mandate and responsibilities and the rules of business, in a manner that establishes and protects all stakeholder rights on an equitable basis.

The role of the private sector and grass-roots entities will have been expanded to an appropriate degree based on considerations of comparative advantage. New funding modalities will have been introduced to lessen the burden on Government's development and revenue budgets, and operation and maintenance will have been placed on a financially sustainable basis.

Major improvements will have been made in the collection, processing and management of information, filling knowledge gaps and leading to efficient and widespread dissemination of information to all stakeholders.

**People's quality of life improved by the equitable, safe and reliable access to water for production, health and hygiene**: A comprehensive long-term strategy for securing safe and reliable water supplies for Bangladesh will have been drawn up and agreed, and a programme for management of the transboundary rivers consistent with this will have been initiated.

Rational and comprehensive plans for management of each regional and sub-regional river system will have been drawn up and agreed, reflecting the needs of all users and in a manner that protects the natural environment and aquatic resources. A programme of works to achieve the above will have been substantially completed.

A permanent solution to the arsenic problem will have been determined and all necessary actions taken to implement this. All people will have access to basic, safe and hygienic water supply, with a substantial proportion in the towns, and a lesser proportion in the rural areas, having piped water and water borne sanitation facilities. All towns and cities will have an appropriate level of flood protection and about 70% of towns and each city will be equipped with storm drainage.

Protection against cyclones will have been extended to all in high risk areas, and a programme for those in medium to low risk areas will have been extensively progressed. Flood proofing of vulnerable rural communities will have been taken up, with an emphasis on poor and disadvantaged groups.

The management of existing flood control and drainage infrastructure and public irrigation projects will have been substantially rationalised and improved and measures taken up to improve their environmental performance. Community managed schemes will be playing a substantially more significant role in local water management and measures will have been taken to expand and improve the performance of farmer owned irrigation and drainage systems. Where appropriate, some new public irrigation schemes will have been taken up.

**Clean water in sufficient and timely quantities for multi-purpose use and preservation of the aquatic and water dependent eco-systems**: A major programme to clean up existing industrial pollution will have been substantially completed, and action taken to encourage new industries to be established on a non-polluting basis. Water quality monitoring will be being rigorously conducted to monitor the situation.

Action will have been taken to improve the connectivity of the flood plains with the river systems, and appropriate measures will have been adopted to preserve and restore environmentally critical areas. Improvements to water management of the Sundarbans and the haor basins of the northeast will have been given priority attention.

Programmes to increase people's environmental awareness and empowerment will have been taken up, along with those associated with making wise use of water.

## Impacts on National Goals

The National Water Management Plan is intended to operationalise the NWPo. Since the Development Objectives of the NWPo are the National Goals, the impacts of the NWMP have also been assessed in relation to these goals as they apply to the physical environment; the human environment and the institutional environment.

The results of the assessments made of how these objectives stand up against the selected dimensions of each of these National Goals are presented in detail in the Main Report in matrix form.

**Impact on the Physical Environment**: The National Goals have an unequivocal environmental dimension. The NWPo and the NWMP respond to this challenge by placing immediate emphasis on the health and sustainable exploitation of Bangladesh's extensive and highly complex river and groundwater systems.

Nevertheless, any plan involving the consumption, diversion or quality of a natural resource will have unavoidable environmental implications, some of which will inevitably be either negative or potentially so. From the assessments undertaken, and reported on in detail in Volume 5, it is evident that with few exceptions, the NWMP is proactively beneficial for the natural environment.

**Impact on the Human Environment**: The National Goals have an equally unequivocal social dimension, with four out of the six national goals specifically applicable in this regard. Different clusters vary in their strength of response, but all are seen as positive towards the human environment to greater or lesser degree. Programmes bringing major benefits are those in the Towns and Rural Areas and Major Cities clusters, together with those connected with pollution control and disaster management.

**Environmental Dimensions of the National Goals**

Water pollution reduction
Fish habitat improvement
Cross-cutting approaches
Mainstreaming the environment
Safeguarding the natural environment
Social equity and people's participation
Human health and welfare
Sustainable economic growth
Addressing long term issues
Institutional capacity building
Establishment of reliable and available data
Mobilisation of comparative advantage

**Social Dimensions of the National Goals**

Water pollution reduction
Fish habitat improvement
Social equity and people's participation
Human health and safety
Sustainable economic growth
Institutional capacity building
Poverty alleviation
Food security
Choice, empowerment and self determinacy
Decent standard of living
Mobilisation of comparative advantage

**Institutional Dimensions of the National Goals**

Cross-cutting approaches
Social equity and people's participation
Institutional capacity building
Establishment of reliable and available data
Food security
Regulation versus supply
Rights and obligations
Actors, powers and accountability
Choice, empowerment and self-determinacy
Legal and policy framework
Cost recovery, user pays principles and alternative financing mechanisms
Private sector participation
Mobilisation of comparative advantage

**Impacts on the Institutional Environment**: An efficient and effective institutional environment is implicit, rather than explicit, in the National Goals. The NWPo is itself a powerful acknowledgement of the crucial role that institutional dynamics must play as regards the sustainable long-term management of water as a fungible public good. This is fully reflected in the NWMP.

# 12 Risks and Risk Management

Risks associated with each NWMP Programme have been identified and discussed, along with mitigating assumptions, in each Programme Description Profile in the Investment Portfolio.

## Political and Institutional Risks

Political and institutional risks are related and likely to be both conceptual and operational. Conceptual risks relate mainly to the vested interests of the line agencies in maintaining the status quo. This manifests in a culture of secrecy and rivalry, leading in turn to a lack of coordination, cooperation and accountability. The technical consequences may be seen in an apparent preference for prescriptive, supply driven, project-based approaches over more responsive, demand driven or systems ones.

Clearly, these risks can be mitigated by time, political will and win-win-win solutions to institutional reformulation. If political will is maintained and the institutional reformulation required by Policy takes place, then GoB wins by definition. If the institutional reformulation is properly driven by the future demands on those institutions, then the grass roots interests will win by having responsive institutions that serve their operational needs. Finally, a combination of cost recovery and demand driven institutions should eventually be reflected in sustainable remuneration packages for their employees, making them also winners.

Operational risks include both the continuing delays in the establishment of the Local Government Institutions that will have a crucial role to play in decentralised water management, and delays in engaging the consensus-building processes between stakeholder institutions of Bangladesh's water sector.

These and associated risks, resulting from inadequate capacity and ad-hoc approaches to planning, can be expected to reduce as a result of the NWMP's strong emphasis on institutional capacity building and the enabling environment.

## Social Risks

Two of the main social risks relate closely to the political and institutional risks. Unwillingness to acknowledge the valuable role that the grass roots can play in the management of a modern water sector will result in inadequate needs assessments and sensitisation campaigns. Similarly, such attitudes may limit grass roots empowerment, which together with new accountability relationships, is a useful building block for sustainable demand driven institutions. The NWMP recognises these risks and mitigates them through

emphasis placed on participation and consultation as well as the capacity building necessary to establish the necessary skills, equipment and facilities within the agencies likely to be involved.

Even with expertly delivered sensitisation campaigns, some initiatives may be genuinely of no interest to the target group. Where such lack of interest is at conflict with policy, or represents a refusal to acknowledge any community responsibility for perpetuating negative macro-forces, political will must be tempered with perseverance and fresh efforts mounted until legal enforcement remains the only option. The NWMP provides for this with an emphasis on demand-driven programmes, together with preparation of appropriate regulatory mechanisms where wider community or social interests are at placed at risk.

Nevertheless, in broad terms, social risks are difficult to mitigate fully simply by means of a water management plan because they have causes beyond the confines of the water sector. These mostly concern poverty, the roots of which lie only partially within the purview of the water sector. This does not abrogate the NWMP's responsibility to contribute to poverty alleviation, and indeed many of the programmes are specifically designed to ensure better access to water and water services than hitherto. These include flood proofing; increasing the productivity of water; reducing the effects of water borne disease on socio-economic activity and improving accessibility to water for hygiene and production purposes.

## Environmental Risks

Without adequate sensitisation, environmental strategies are often viewed as counterproductive limitations on human survival and economic activity. Given the delicate state of Bangladesh's aquatic resources, there is a risk that continuing development of the water sector will inflict further harm before any sensitisation campaign has time to inculcate changes on the demand side.

At particular risk are the inland capture fisheries, for which ongoing development, if unregulated, will continue to disrupt piscine breeding cycles and compromise gene pools as a result of water body fragmentation. Equally, urgently needed arsenic mitigation measures for the short term will introduce sludge disposal problems, while inadequate operation and maintenance of water supply and sanitation treatment plants and unregulated industrial discharges may result in rapid deterioration of the river systems.

Risks of this nature are mitigated however by the NWMP's holistic view which includes the environment itself as an important water sector stakeholder with an entire cluster of programmes devoted to it. Furthermore, programmes within the environment cluster are strategically timed in order that public awareness raising, the establishment and enforcement of regulatory mechanisms and long term planning are addressed as a priority.

## Financial Risks

Financial risks concern both capital and recurring costs. Whilst much of the NWMP can be funded through its traditional sources, it is evident that a substantial increase in capital funding will be needed in the short to medium term in order to meet Strategic targets, notably in the water supply and sanitation sector. Much of the traditional funding is reliant on donor support, for which conditionalities apply. The NWMP should pave the way towards gaining strong multi-national support for the sector, which will ameliorate the onus on direct Government funding. Nevertheless, alternative sources of capital funding do need to be explored, and the Plan makes provision for this. However, developing new sources will require fiscal and regulatory discipline, and the necessary political commitment to support this.

Recurring costs represent an altogether different and more serious risk. Much of the decline in existing facilities has resulted from a combination of under-funded recurrent budgets and grossly inadequate cost recovery. This represents a major challenge to overcome. The Plan addresses this wherever possible and meaningful by placing responsibility firmly on users, while reformulating the institutional landscape in terms of demand, accountability, transparency and service standards. Undoubtedly however, effective implementation of cost recovery, *inter alia*, will require a broad consensus at national-level.

## Technical Risks

A wide range of technical risks have been identified relating to implementation and operation of water sector schemes:

| Implementation | Operations |
|---|---|
| • Inadequate needs assessment<br>• Inadequate data<br>• Difficult aquifer conditions<br>• Unproven technology<br>• Inadequate feasibility studies<br>• Technical complexity<br>• Unanticipated site difficulties | • Unexpected levels of siltation<br>• Unexpected erosion<br>• Low durability, especially of short term solutions<br>• Underestimates of operation and maintenance costs<br>• Underestimated operation & maintenance difficulties |

The NWMP mitigates against these risks by stressing the need to fill knowledge gaps wherever they are encountered, with several programmes included specifically to this end. Furthermore, no physical works or interventions will be compatible with this Plan if they are technically unproven or infeasible, except in the case of pilot schemes, which may be justifiable as such.

# 13 Implementation Arrangements

The National Water Management Plan is a rolling framework plan. It is neither static nor prescriptive. Together with its supporting information systems, the NWMP lays the foundation to comprehensive and integrated development of the sector as a whole. The success of the Plan will be measured ultimately against the extent to which all stakeholders work together to realise its objectives. Thus, the process of making use of the Plan should be viewed as important as the Plan itself.

## Responsibilities

Within the Investment Portfolio, primary responsibility is assigned for each programme to a specific agency. Each agency is expected to develop projects within the framework established by the Portfolio to fulfil the objectives of the programmes designated to them. The projects are to be consistent with the policies, rules and guidelines set out by Government from time to time. Line agencies will prepare their own plans accordingly and will progress their projects through the normal administrative channels.

The Investment Portfolio also sets out which agencies are expected to play a secondary or supportive role in each Programme. Line agencies will need to take these further responsibilities into account whilst preparing their work plans. The Programmes Database, part of WARPO's Management Information System, will facilitate rapid scanning of the Portfolio to identify primary and secondary responsibilities of each agency. A summary is given overleaf.

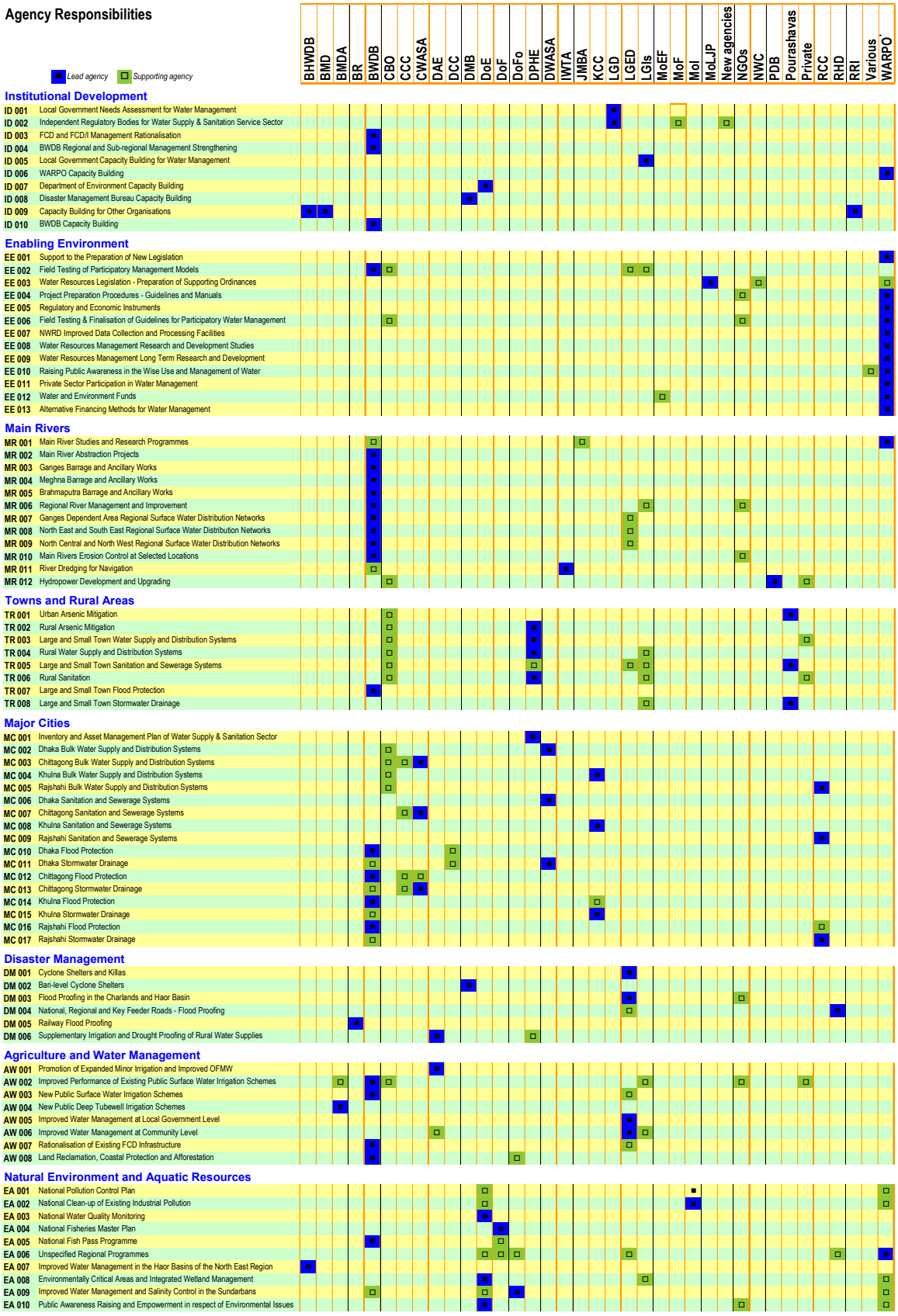
Projects may be designed to implement only part of a programme or aspects of one or more programmes. This is a matter for the agency in question to determine on the basis of practical experience, current knowledge and capacity.

## Information Systems

Information on the planning regions, the cluster programmes and all relevant natural resource, socio-economic and physical data are combined in the multi-dimensional National Water Resources Database and WARPO's Management Information System in a manner that enables comprehensive and flexible planning and monitoring of future activities.

An important activity within the NWMP is to ensure that all stakeholders are in a position to share and contribute to this information to mutual advantage.

## Agency Responsibilities



## Coordination

Responsibility for overall coordination of implementation of the National Water Management Plan lies with the National Water Resources Council, who may issue directives as required through its Executive Committee. As secretariat to the NWRC, it is the responsibility of WARPO to overview implementation of the Plan and draw to Council's attention issues that require their particular consideration.

To this end, WARPO will maintain a Projects Database of all projects relating to Plan implementation. WARPO will seek cooperation from all concerned agencies in this regard, and will work closely with Planning Commission to ensure that the information is kept up to date to mutual advantage. The Projects Database is compatible with the Programmes Database, making possible the tracking of individual Programme implementation.

At a working level, coordination of project activities will conform with directives as issued from time to time by Government. The present arrangements for District Level Inter-sector Project Evaluation Committees (DLIPEC) established by a Planning Ministry instruction in January 1999, will be kept under review and are expected to be evolved as the capacity of Local Government institutions is strengthened.

## NWMP and the National Planning Process

The NWMP complements, and does not replace, the normal planning and budget allocation processes of Government. It is essential that NWRC, with the assistance of WARPO, works closely with the Ministry of Planning to harmonise Five Year Plans and Annual Development Programmes with the NWMP and its updates.

## Programme Linkages

Some programmes are logically linked to other programmes, requiring that they are taken up before, in parallel or following the other. Linkages are discussed in each Programme Description Sheet and are set out diagramatically in the Main Report.

## Parallel Actions

The Plan addresses actions required within the water sector. Many of the agencies concerned have responsibilities that extend beyond the remit of the NWMP. Examples are the broader efforts of the Ministry of Agriculture and its agencies to promote improvements in crop husbandry, seeds and other inputs, and the Department of Environment's wider regulatory mandate than just issues concerned with water. Many of these parallel actions will ultimately have bearing on the demands placed on the water sector, and therefore need to be

kept in view. However, four areas of action outside the bounds of the water sector have special significance.

- **Civil Service Reforms**: The speed and nature of these reforms will have direct bearing on the water sector institutions and will no doubt contribute greatly to improved sectoral performance

- **Local Government Institutions**: Most tiers of Local Government have yet to be elected. Efforts to strengthen LGIs and reinforce decentralisation and devolution of management of the water sector will be held back if there is a delay in establishing these bodies.

- **Land-Use and Physical Planning**: Effective detailed planning of urban and rural water services is contingent upon well-laid physical plans that address the burning issues of rapid urbanisation and increased industrialisation.

- **Integrated Transport Planning**: There is no integrated transport policy. Planning of investments for navigation would be greatly enhanced by consideration of alternative transport modes and development plans for these.

## Monitoring and Evaluation and Plan Updates

Executive responsibility for monitoring, evaluating and updating the Plan will rest with the National Water Resources Council, with day-to-day operations the responsibility of WARPO.

Objective monitoring will involve the regular comparison of activities and impacts against pre-determined objectives, using criteria represented by indicators which themselves may require verification. The Management Information System has been set up to monitor progress down to project level. Each of the 84 programmes has been ascribed immediate objectives, a key objective of relevance to the Plan as a whole and a development objective. These objectives and indicators are included in each programme's records within the Management Information System.

WARPO will elaborate and implement regular monitoring of implementation of the Plan and the impacts achieved in relation to the indicators set. Annual reports will be prepared for NWRC consideration. At five-yearly intervals in advance of Plan updates, a comprehensive assessment will be made. To this end it is anticipated that each programme is subjected to an ex-post and at least one mid-term evaluation, to be carried out by independent third parties.

Five yearly reviews will be major, substantive events and are likely to include redefinition of objectives, refinancing of the Plan or rescheduling of disbursements. Even so, optimal performance of the Plan may also require more modest adjustments on a more regular basis, at least annually.

# Abbreviations and Acronyms

| | |
|---|---|
| ADAB | Association of Development Agencies in Bangladesh |
| AW | Agriculture and Water Management |
| BADC | Bangladesh Agriculture Development Corporation |
| BARI | Bangladesh Agricultural Research Institute |
| BHWDP | Bangladesh Haor and Wetland Development Board |
| BMD | Bangladesh Meteorological Department |
| BMDA | Barind Multi-purpose Development Authority |
| BOT | Build/Operate/Transfer |
| BR | Bangladesh Railway |
| BWDB | Bangladesh Water Development Board |
| CBO | Community-based Organisation |
| CCC | Chittagong City Corporation |
| CDA | Chittagong Development Authority |
| CHT | Chittagong Hill Tracts |
| CWASA | Chittagong Water and Sewerage Authority |
| DAE | Department of Agricultural Extension |
| DCC | Dhaka City Corporation |
| DM | Disaster Management |
| DMB | Disaster Management Bureau |
| DoE | Department of Environment |
| DoF | Department of Fisheries |
| DoFo | Department of Forest |
| DPHE | Department of Public Health Engineering |
| DWASA | Dhaka Water and Sewerage Authority |
| EA | Environmental and Aquatic Resources |
| EE | Enabling Environment |
| EIA | Environmental Impact Assessment |
| FCDI | Flood Control, Drainage and Irrigation |
| GDA | Ganges Dependent Area |
| GDP | Gross Domestic Product |
| GoB | Government of Bangladesh |
| ID | Institutional Development |
| IWTA | Inland Water Transport Authority |
| JMBA | Jamuna Multi-purpose Bridge Authority |
| JRC | Joint Rivers Commission |
| KCC | Khulna City Corporation |
| LG | Local Government |
| LGD | Local Government Division |
| LGED | Local Government Engineering Department |
| LGIs | Local Government Institutions |
| MC | Major Cities |
| MoEF | Ministry of Environment and Forest |
| MoFi | Ministry of Finance |
| MoI | Ministry of Industry |
| MOLJP | Ministry of Law, Justice and Parliamentary Affairs |

| | |
|---|---|
| MR | Major Rivers |
| NC | North Central (hydrological) Region |
| NE | North East (hydrological) Region |
| NGOs | Non-Government Organisations |
| NWMP | National Water Management Plan |
| NWPo | National Water Policy |
| NWRC | National Water Resources Council |
| NWRD | National Water Resources Database |
| O&M | Operation and Maintenance |
| PDB | Power Development Board |
| RAJUK | Capital Development Authority (Rajdhani Unnayan Katripakha) |
| RCC | Rajshahi City Corporation |
| RHD | Roads and Highways Department |
| RRI | River Research Institute |
| SC | South Central (hydrological) Region |
| SE | South East (hydrological) Region |
| SMA | Statistical Metropolitan Area |
| SPARRSO | Space Research and Remote Sensing Organisation |
| SRDI | Soil Resources Development Institute |
| SW | South West (hydrological) Region |
| TR | Towns and Rural Areas |
| WARPO | Water Resources Planning Organization |
| WHO | World Health Organisation |
| WSS | Water Supply and Sanitation |

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