Government of the People's Republic of Bangladesh

Ministry of Water Resources

National Water Management Plan

Volume 2

Main Report

December 2001

WARPO
পানি সম্পদ পরিকল্পনা সংস্থা

Water Resources Planning Organization

Government of the People's Republic of Bangladesh

Ministry of Water Resources

National Water Management Plan

Volume 2

Main Report

December 2001

Approved by
National Water Resources Council on March 31, 2004

Water Resources Planning Organization

National Water Management Plan

Volumes

1 Summary

2 Main Report

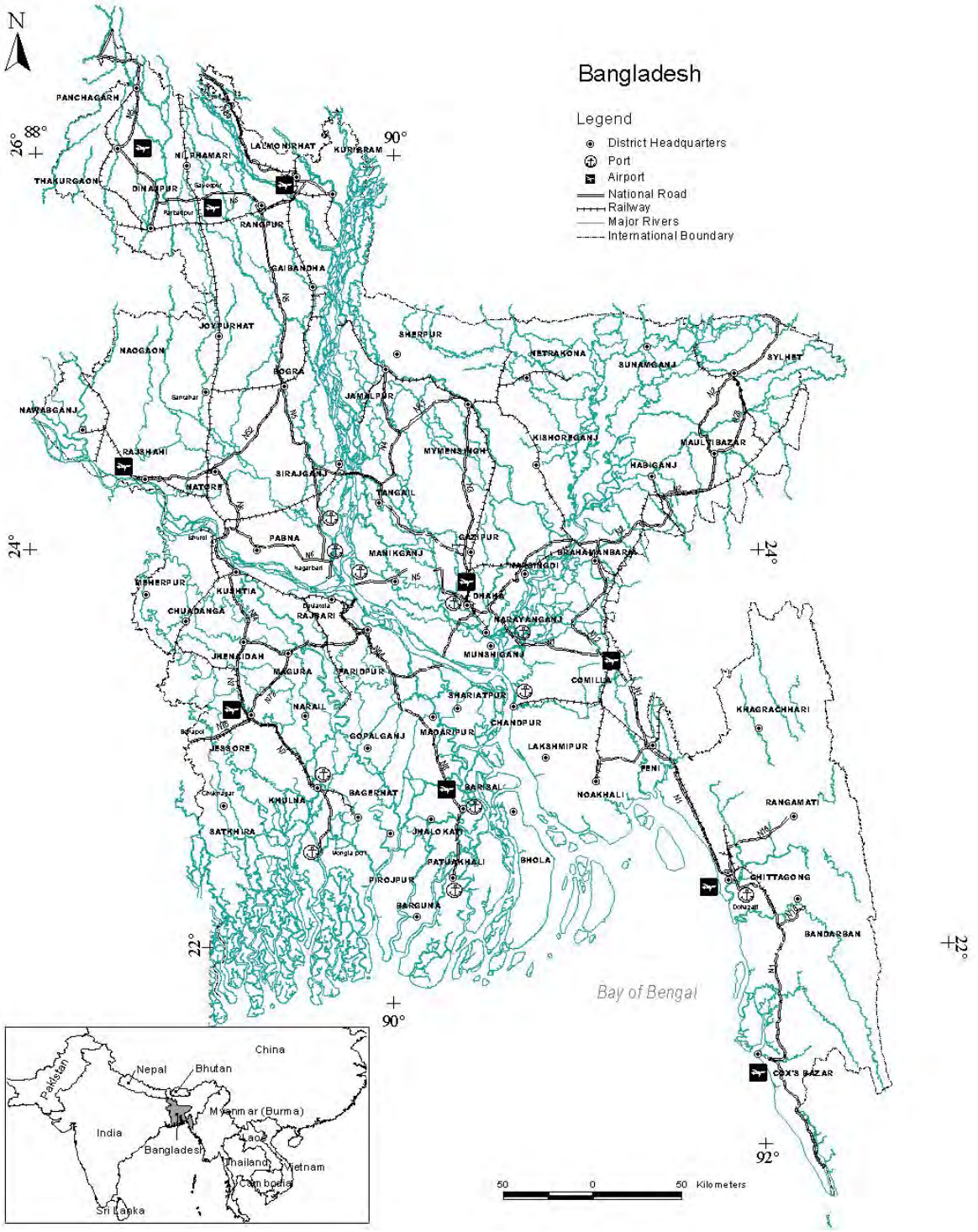
Part A: The Context
Part B: The National Water Management Plan
Part C: Implementation Arrangements

3 Investment Portfolio

4 Regional Plans

5 Supporting Information

Annex A: The National Water Policy
Annex B: Development Strategy for the NWMP
Annex C: Environmental Assessment
Annex D: Supporting Information


N
Bangladesh
Legend
District Headquarters
Port
Airport
National Road
Railway
Major Rivers
International Boundary
PANCHAGARH
THAKURGAON
NILPHAMARI
LALMONIRHAT
KURIGRAM
DINAJPUR
RANGPUR
GAIBANDHA
JOYPURHAT
NAOGAON
BOGRA
SHERPUR
NETRAKONA
SUNAMGANJ
SYLHET
NAWABGANJ
JAMALPUR
RAJSHAHI
MYMENSINGH
KISHOREGANJ
MAULVIBAZAR
HABIGANJ
SIRAJGANJ
PABNA
TANGAIL
GAZIPUR
BRAHAMANBARIA
MANIKGANJ
NARSINGDI
MEHERPUR
KUSHTIA
CHUADANGA
DHAKA
RAJBARI
NARAYANGANJ
JHENAIDAH
MAGURA
FARIDPUR
MUNSHIGANJ
COMILLA
SHARIATPUR
NARAIL
KHAGRACHHARI
CHANDPUR
GOPALGANJ
MADARIPUR
JESSORE
LAKSHMIPUR
FENI
BAGERHAT
BARISAL
NOAKHALI
RANGAMATI
KHULNA
SATKHIRA
JHALOKATI
PATUAKHALI
BHOLA
CHITTAGONG
PIROJPUR
BARGUNA
BANDARBAN
COX'S BAZAR
Bay of Bengal
22°
24°
26°
88°
90°
92°
50 0 50 Kilometers
China
Nepal
Bhutan
Pakistan
Myanmar (Burma)
India
Laos
Bangladesh
Thailand
Vietnam
Cambodia
Sri Lanka

Contents

Figures

Tables

Part A: The Context

1 Introduction

1.1 *Background*

1.1.1 A call for a new plan

National level planning of the water resources of Bangladesh dates back to 1964 when the East Pakistan Water and Power Development Authority's Water Master Plan was published. Later in 1986 the Master Plan Organisation prepared a draft National Water Plan, which was updated in 1991. The severe floods of 1987 and 1988 prompted widespread support from the international community for the Flood Action Plan, resulting in a series of five regional plans and supporting studies. These culminated in the Bangladesh Water and Flood Management Strategy (BWFMS) Report which was prepared by the Flood Plan Coordination Organisation (FPCO) in 1995 and subsequently revised and re-issued in 1998.

Although the studies that lead to these various plans have resulted in a substantial appreciation of the nation's water resources, the plans themselves varied significantly in how best to develop them. This was recognised by the 1995 Strategy Report, by which time it had been realised that earlier plans had:

- an excessive focus on the needs of the agricultural sector (irrigation, drainage and flood protection) to the detriment of other sectors (water supply, sanitation, industry, fisheries plus environmental and other in-stream demands);
- inadequate policy frameworks to respond to or objectives to address;

and,

- no supporting strategies.

Furthermore, earlier plans were also criticised for not addressing the social and environmental impacts of water resource development. Responding to this, BWFMS recommended that the Government should formulate a National Water Policy addressing these issues; that a supporting strategy be developed that relates water sector development to the overall National Goals and that a comprehensive National Water Management Plan (NWMP) should be prepared within this framework. It was also recommended that FPCO should be merged into the permanent Water Resources Planning Organisation (WARPO) with a mandate to prepare NWMP, to monitor activities within the sector and to provide information and advice on best practice.

The Government acted promptly to implement these recommendations. WARPO, which was formed in 1992, took over the functions of FPCO in January 1996. A National Water Policy was prepared after extensive discussion and was approved in November 1998 by the Government. In parallel, arrangements were made to launch the NWMP and Consultants were mobilised on in March 1998 to provide assistance to WARPO in preparing a comprehensive water management plan and strengthening WARPO to continue the process thereafter.

1.1.2 *Approach to preparation of the NWMP*

The approach to preparing this plan has been both structured and highly participatory. Three main phases were identified from the outset. These are illustrated in Figure 1.1 overleaf.

- **Inception Phase**, during which data and information started to be assembled and the overall approach was reviewed and timetables were revised.

Options Phase, during which sectoral issues were identified from widespread consultations, and on a similar basis options were developed to address these issues in the context of the directions by then given by the National Water Policy. Taking full account of the reactions received, an assessment framework was constructed to test the different options against various criteria, including their ability to meet different national goals. This led to the identification of alternative strategies for consideration by Government.

- **Plan Preparation**, which commenced with the Government considering and determining a Development Strategy from the alternatives provided. Preparation of the Plan proceeded in accordance with the directives given both by the Policy and this Strategy, from which a series of programmes of action have been determined, which together form the building blocks to the overall management plan.

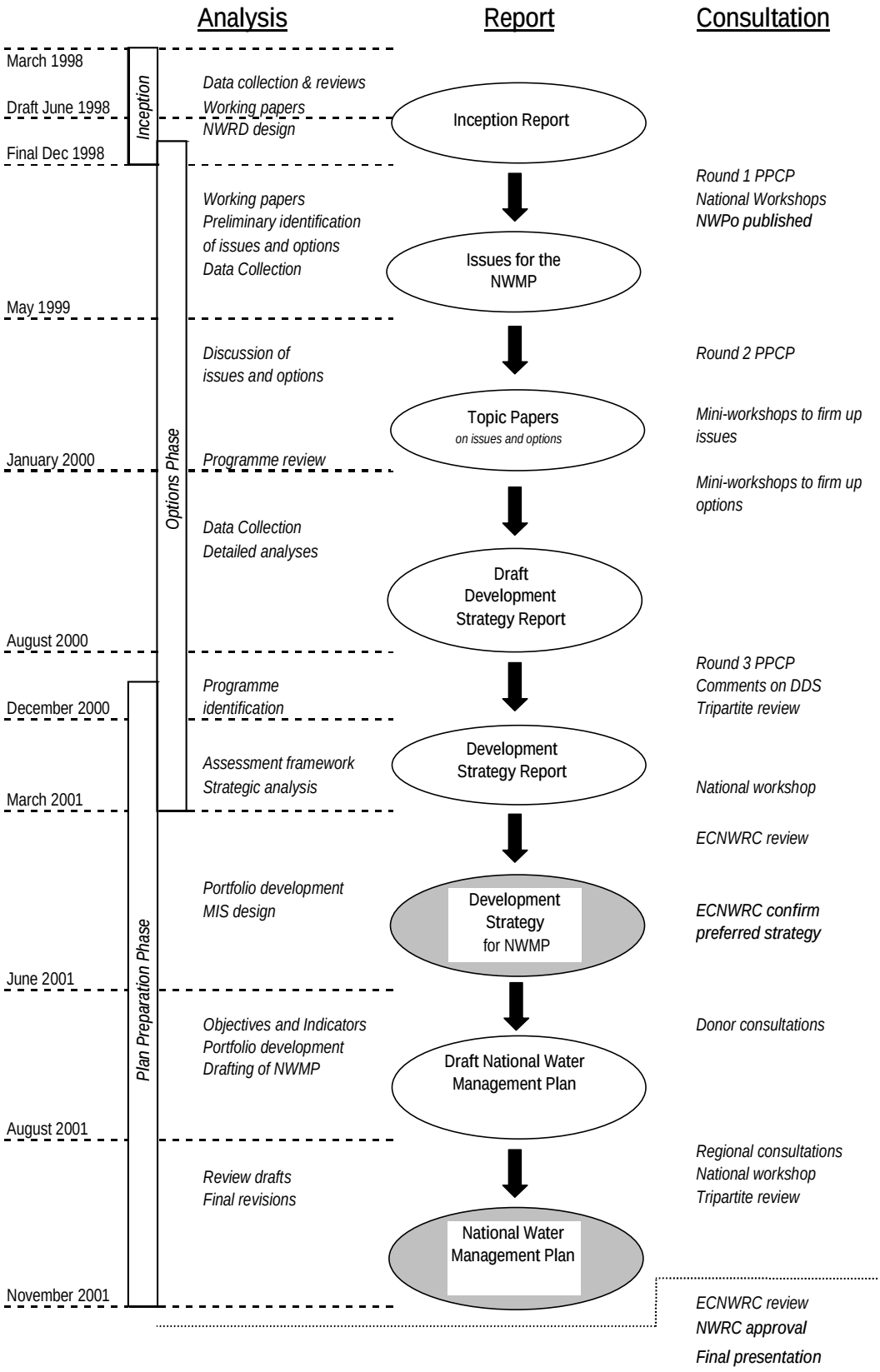
1.1.3 *Importance given to participatory planning*

In line with Policy requirements for participatory planning, widespread consultation has been undertaken throughout the preparation of the plan. Efforts have been made to engage a wide range of stakeholders at each stage of the plan preparation.

People's Participation and Consultation Programme: Three rounds of consultation have been undertaken in 28 Districts spread across the country. Round 1, conducted at Village to District levels focussed on identifying water-related issues that concerned people most and what they considered could be done about it. Round 2, conducted at village to District levels, sought to verify what had been learnt from the first round and explore possible options. The third round, at Thana and District levels, took back the development options for review and suggestions. Independent reports on each round were commissioned from the Bangladesh Institute of Development Studies (BIDS).

Agency Consultations: Early in the programme all Government agencies with a stake in the water sector were identified and invited to nominate representatives to be members of a Contact Group. All the main published reports have been circulated to the Contact Group, and meetings arranged to discuss their views.

Figure 1.1: Main Steps in the Preparation of the NWMP



Workshops: A series of National Workshops have been held, involving a wide range of audience comprising NGOs, donors, academics, Government staff, and media representatives. Topics raised at these workshops included the Inception Report, identification of issues and options and major issues that arise from consideration of those options. Workshops were also held regionally and nationally on the draft Plan also. In addition to these, group discussions have been held during option formulation with subject matter specialists and eminent experts, chaired mostly by Secretaries from different Ministries.

Bi-lateral discussions: Numerous meetings, both formal and informal, were held with different agencies and individuals to seek information on different topics. Latterly this included a series of one-to-one meetings with donors to appreciate their perspectives.

Web site: WARPO established a web site early in the proceedings, on which copies of published reports and other relevant information have been posted. A quarterly WARPO Newsletter was launched, which *inter alia* has kept people informed of the progress of NWMPP and advertised the web site.

1.1.4 Formative steps in the planning process

It is important to recognise that a number of steps in the planning process have played a particularly important part in development of the Plan. These are briefly highlighted below.

The **Terms of Reference** (ToR) provided to the Consultants, as agreed by both the Government and the World Bank, prescribed the general approach to be adopted and laid down a number of important principles at the outset. The ToR required that the NWMP should be a rolling plan to be reviewed and updated every five years, and that it would provide a firm plan for the first five years, an indicative plan for the subsequent five years and a perspective plan for the long term (25 years). Also, the ToR established three main sets of considerations to guide the formulation of the Plan.

- The first consideration is that the Plan should be forward looking to what Bangladesh's society and economy could be in future, notwithstanding the valuable lessons from the past. This requires designing water resources policies, programs and projects to help promote structural change in the national economy, with a perspective well into the 21st century (at least 50 years ahead).
- The second consideration is that the Plan must be realistic about the prospects for institutional and implementation capacity, and everything possible should be done to rationalise and strengthen institutional capacity.
- Thirdly, the Plan should be seen as an interactive consultative process. It should provide a long-term planning framework compatible with national goals and objectives and with sound environmental management principles, and represent a flexible planning system capable of continuous evolution.

The ToR also stipulated that the primary goal of the NWMP should be to contribute to national economic development through rational development of water resources while protecting the natural environment and improving the quality of life of the citizens of Bangladesh.

The **National Water Policy**, approved in November 1998 and published in January 1999), reconfirmed WARPO as being responsible for preparation of the NWMP under the oversight and guidance of the National Water Resources Council. The preface to the Policy requires that the NWMP will provide necessary advice on follow-up actions to be taken up for implementing the policies enunciated in the National Water Policy. The Declaration of Policy also makes clear that the purpose of the Policy is to ensure continued progress towards *fulfilling the national goals of economic development, poverty alleviation, food security, public health and safety, decent standard of living for the people and protection of the natural environment.*

The Policy describes the NWMP as a plan that addresses *the overall resource management issues in each region and the whole of Bangladesh, and providing directions for the short, intermediate, and long runs. The plan will be executed by different agencies as determined by the Government from time to time. The NWMP and all other related plans will be prepared in comprehensive and integrated manner, with regard for the interests of all water-related sectors. The planning methodology will ensure co-operation across sectors and people's participation in the process. Within the macro framework of the NWMP, sector agencies of the Government and local bodies will prepare and implement sub-regional and local water-management plans in conformance with the NWMP and approved Government project appraisal guidelines. The Executive Committee of the National Water Resources Council (ECNWRC) will resolve any interagency conflict in this regard.*

The **Development Strategy** for the NWMP, approved by the Executive Committee of the NWRC in June 2001, was drawn up after following the widespread consultations described above and extensive assessment of alternative measures. The document stipulates that a balanced strategy, giving equal weight to each national goal, is the most appropriate course to follow at this time.

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

1.2 *Scope of the National Water Management Plan*

Drawing upon the formative statements above, the scope of the National Water Management Plan has been determined as follows:

(i) The overall objectives of the NWMP are to contribute in a balanced fashion to the overall 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;

(ii) The purpose of the NWMP is to operationalise directives given in the National Water Policy, and to do so in accordance with the Government approved Development Strategy;

(iii) The NWMP is to be a framework plan to guide (but not prescribe), in an integrated and comprehensive manner, the actions of all concerned with developing and managing water resources and water services;

(iv) It is to be a rolling plan to be reviewed and updated every five years, providing a firm plan for the first five years, an indicative plan for the subsequent five years and a perspective plan for the long term (25 years), all set in the context of what may happen at least 50 years ahead;

(v) The Plan has to be realistic about the prospects for institutional and implementation capacity, and should seek to rationalise and strengthen institutional capacity.

1.3 *Structure of the National Water Management Plan*

The National Water Management Plan is presented in five volumes, as follows. Details of how to make best use of the document are given in Chapter 16:

Vol	Title	Purpose
1	**Summary**	To enable a quick overview of the Plan as a whole
2	**Main Report**	
	Part A: The Context	Summarises the context within which the Plan has been prepared and the driving forces determining the need for future actions
	Part B: The Plan	Describes the Plan components and their expected impacts, how these fit into a management information system, and the risks and the prospects for managing risks
	Part C: Implementation Arrangements	Describes the phasing of Plan components and funding requirements, sets out key linkages, describes how the Plan can be monitored and evaluated, and finally actions now required
3	**Investment Portfolio**	Describes each of the component programmes by sub-sector, setting out Policy context, purpose and outline, financing and institutional arrangements, indicators, existing documentation, linkages and risks
4	**Regional Plans**	Summarises the Plan components by Hydrological Region

5	Supporting Information	
	Annex A: National Water Policy	Restatement of National Water Policy
	Annex B: Development Strategy	Restatement of Development Strategy for the National Water Management Plan
	Annex C: Environmental Assessment	Assesses the environmental implications of the overall Plan
	Annex D: Supporting Information	Documents information assembled under the NWMPP, provides lists of acronyms and defines specific words as used in the NWMP

1.4 *Supporting Documents*

Supporting documents are listed in Annex D. This provides a full listing of the information prepared under the NWMPP, as illustrated in Figure 1.1. These comprise:

- Published Project Reports — Five main reports prepared between June 1998 and to date
- Topic Papers — Fifteen discussion notes prepared during the options phase
- Other Reports — Twenty three reports on various specific subjects, including studies made on the Ganges Dependent Area
- Working Papers — Forty five internal papers prepared by individual specialists of the NWMPP team
- NWRD data holdings — Three hundred sets of data compiled jointly by WARPO, NWMPP and EGIS II in collaboration with data collecting agencies.

All the above are available with WARPO, virtually all in electronic form.

1.5 *Target Audience*

The National Water Management Plan is intended to be of use to all agencies and organisations engaged directly or indirectly in the water sector.

- NWRC and the Government — To set out how their policies are to be implemented, to appreciate the funding and other actions required of Government to implement the plan, and to provide a framework by which to monitor plan implementation

• Line agencies and Local Government	To provide a framework for their own planning and programmes
• Civil Society	To understand how GoB's plans will affect them
• Private Sector	To identify market, service provision and investment opportunities
• Funding Agencies	To identify and plan their funding support programmes

2 Policy for Water Management

2.1 *National Water Policy*

The goal of the National Water Policy (NWPo) is to ensure progress towards fulfilling national goals of economic development, poverty alleviation, food security, public health and safety, a decent standard of living for the people and protection of the natural environment.

WARPO participated with many other institutions in the definition of the NWPo. Work on this started in March 1997 and the final Policy was approved by the Government in November 1998 and published by MoWR in January 1999. The NWPo is presented in full in Annex A. The broad objectives of the NWPo are to:

(i) 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.

(ii) 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.

(iii) 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.

(iv) Bring institutional changes that will help decentralise the management of water resources; enhance the role of women in water management and initiate cost recovery processes.

(v) 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.

(vi) Develop a state of knowledge and capability that will enable the country to design future water resources management plans by itself with economic efficiency, gender equity, social justice and environmental awareness to facilitate achievement of the water management objectives through broad public participation.

The Government's Development Strategy acknowledges that to achieve these objectives will require a comprehensive implementation package involving:

- New legislation and regulations, particularly a Water Resources Act and a regulatory framework for private sector participation;
- Institutional development and strengthening at central and local levels;

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

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

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

2.2 *Related Policies*

2.2.1 National Environment Policy (1992)

The environment policy concerns in the water sector are broadly similar to those of the fisheries policy. The policy also highlights the need to maintain ecological balance and overall development through protection and improvement of the environment and protect the country against natural disasters. It seeks to identify and regulate activities that pollute and degrade the environment to ensure environmentally sound development in all sectors. The policy addresses 15 sectors in all, in addition to providing directives on the legal framework and institutional arrangements. Environmental audit of existing flood control and drainage projects on an emergency basis is advocated along with steps to modify these projects as necessary.

2.2.2 *National Forestry Policy (1994)*

The policy proposes that approximately 20% of the area of Bangladesh will be afforested by the year 2015. Special emphasis is placed on programmes for new charlands, denuded state forest, the Barind Tract, fallow lands in general and on the sides of road, rail and flood embankments. A multiple-use policy is adopted for the Sundarbans, covering forest, water and fish. The policy recognises the international commitments Bangladesh has made on global warming, desertification and control of trade in wild birds and animals.

2.2.3 *National Energy Policy (1996)*

The objectives of the National Energy Policy are to provide energy for sustainable economic growth so that the development of other sectors is not constrained due to lack of energy. The NEP provides directives for the expansion of the energy sector, with increased equity between the rural and urban sectors and between different parts of the country. The principle of non-renewable energy being priced at economic cost is confirmed. Cross-subsidies are permitted to stimulate growth and to ensure social justice. Equalised pricing at the point of delivery throughout the country is to be maintained. Rural electrification programmes are to continue through the *Palli Bidyut Samity* system with a medium-term objective of providing at least 20 watts per household.

2.2.4 *National Policy for Safe Water Supply and Sanitation (1998)*

This policy, issued by the Local Government Division of the Ministry of Local Government, Rural Development and Co-operatives, calls for nationwide access to safe drinking water and sanitation services at an affordable cost (sanitation is defined as sewage disposal, solid waste management and storm water drainage). The objective is to improve public health and produce a safer environment by reducing water-borne disease and contamination of surface water and groundwater. The Government will encourage increased user participation, including the active support and involvement of other partners, such as non-governmental organisations (NGOs), market-oriented business organisations and similar private organisations in water and sanitation development.

Specifically, the policy aims in rural areas to reduce the number of users per tubewell from 105 to 50 in the near future, and install one sanitary latrine per household. In urban areas, the policy aims to ensure each household has safe drinking water and easy access to a sanitary latrine, with options ranging form pit latrines to water-borne sewerage. Measures are proposed for the provision of solid and liquid waste disposal in urban areas and for the production of compost.

2.2.5 *National Fisheries Policy (1998)*

This policy aims to enhance fisheries production and improve socio-economic conditions for households where capture fishing is the main activity; to meet the demand for animal protein; to boost economic growth by export of fish and fisheries products; and to maintain an ecological balance. The policy highlights the need to

conserve fish habitats, especially in the development of water management infrastructure. It clearly points to a determination to prevent further drainage of standing water bodies for agricultural development, and to promote fisheries development in all water bodies.

2.2.6 National Agricultural Policy (1999)

The goal of this policy, issued in 1999, is to maintain self-sufficiency in food. It also aims to ensure that agriculture is profitable to farmers by improved input supply and credit. Emphasis is placed on efficient irrigation. Environmental concerns are addressed through promotion of integrated pest management and more use of composted fertiliser. Social concerns relate to the protection of the interests of small and marginal farmers. The policy also calls for diversification of crops, expansion of biotechnology and expansion in production of crops as inputs for agro-industries and for export. The policy sets out a clear agenda to promote and develop socially and environment-friendly agriculture.

2.2.7 Industrial Policy (1999)

The vision of the 1999 Industrial Policy (IP) is that within a decade the industrial sector will grow from its current 10% of GDP to at least 25%. The industrial workforce is expected to double to 10% of those in employment. Labour-intensive manufacturing is seen as the core business, whilst not precluding high-tech niche markets. GoB's role is to be that of a facilitator, engaged in undertakings only where their involvement is essential to stimulate private sector growth or where there are overriding social concerns. The IP aims to encourage foreign direct investment and to diversify and expand exports, disperse medium and small-scale industries throughout the country through suitable measures and incentives. The IP however does not designate the water sector as a "thrust sector", qualifying for special incentives as, for instance, in the energy sector.

2.3 *Overview of Policy Framework for NWMP*

The policy statements above provide an extensive framework for management of the water sector. Assessment of these policies indicates that there are no major contradictions between them. There are however some gaps in terms of water planning.

The main policy gap is in land use planning. Principles need to be established that will guide management of the massive urban expansion expected over the next 25 years. Will Bangladesh invest pro-actively in the expansion areas? To what extent will private sector resources be mobilised in that investment? Will there be a policy to attract people to centres other than the major cities? How would that policy be brought about? What roles have economic and regulatory instruments in this?

Land use planning needs to take account of the plans and capacities of other sectors. Planners in the energy, water, education, health, communications and other sectors need to be consulted and in turn need to know what principles will guide land use

development. In the same way, existing policies have considerable bearing on future land use, and these need to be integrated into the land use policy[1].

There are also issues of land tenure reform that have a bearing on development prospects. Usufruct rights are intimately linked with willingness and ability to invest, and protection of the rights of landless and other disadvantaged groups is of paramount importance. The land use policy needs to consider these as well as the issues of displacement and resettlement, as a result of natural disaster or land acquisition.

There is also no integrated transport policy nor, it is understood, is one under consideration. Thus decisions on water transport (navigation) are taken in isolation of the potential for expansion of road and rail transport. Whilst in the short term this is not a major problem, it is an area which Government may address for the medium term.

1 A draft National Land Use Policy was made available to the Planning Team just as this document was being finalised.

3 The Baseline for the Plan

3.1 *Introduction*

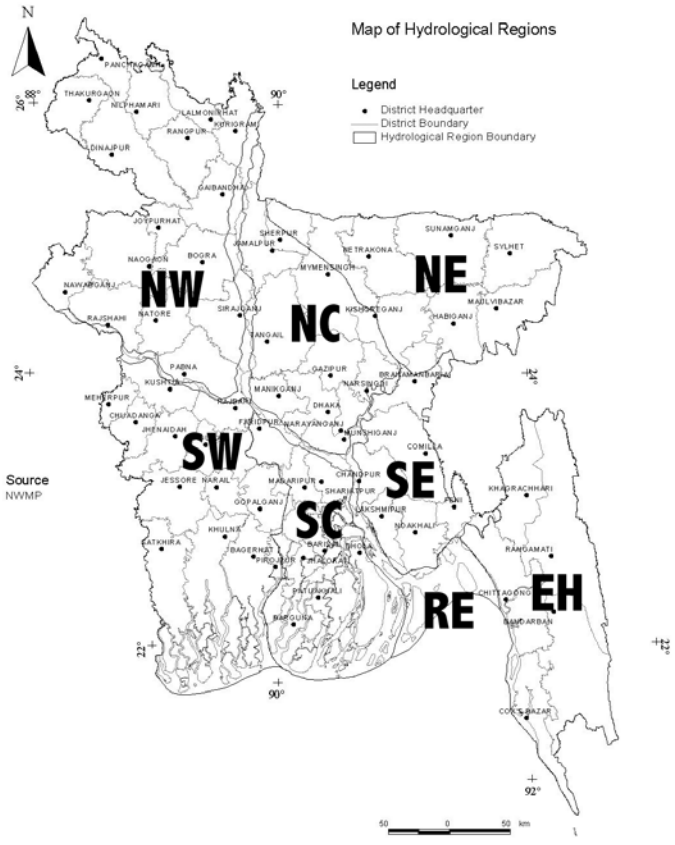
All plans need a starting point. Understanding where that it is and the forces that will drive future developments are essential to effective planning. In this chapter a brief review is given of the analytical framework (the Planning Framework is described in Chapter 6), followed by a summary of the current institutional and legal framework and the challenges that the Plan must face. The chapter concludes with a summary of the main regional issues and the knowledge gaps that need to be filled in the short-term to guide medium term actions.

3.2 *Analytical Framework*

3.2.1 Definition of Hydrological Regions

In accordance with NWPo para 4.2a, WARPO has delineated hydrological regions of the country, based on appropriate natural features, for planning the development of water resources. Previously under Master Plan Organisation, five hydrological regions were defined: Northwest, Northeast, Southeast, South Central and Southwest, plus the Active Floodplain. They covered exactly the area of the entire country.

Figure 3.1: Hydrological Regions



Under the Flood Action Plan, five regions were also defined: Northwest, Northeast, North Central, Southeast, and Southwest, plus Charlands. The boundaries of these do not cover the entire area of the country, and overlap in two areas. Even where MPO and FAP regions have a common name, the boundaries are not the same.

The NWPo points out that the principal river systems create natural boundaries for these regions, while the hilly areas of the east form another hydrological region. In defining hydrological regions the principles adopted below stemmed from the policy and the history of previous regions above. The principles adopted by WARPO were (i) the entire

country should be covered; (ii) the principal rivers and natural features should form boundaries; (iii) the principal rivers themselves form a region; and (iv) effective use should be made of previous studies.

Based on these principles, eight regions were defined: Northwest (NW), North Central (NC), Northeast (NE), Southeast (SE), South Central (SC), Southwest (SW), Eastern Hills (EH), plus the active floodplains and charlands of the Main Rivers and Estuaries (RE), as illustrated in Figure 3.1. All divisions are to a large extent arbitrary and made for the convenience of describing and characterising the area. Within each region there are significant sub-regions, defined by parameters such as agro-climatic zone, landform, river salinity and degree of urbanisation.

3.2.2 Extended Hydrological Regions

The hydrological regions as defined above are inappropriate for presentation and analyses of many types of non-water data because the RE region comprises the major rivers, charlands and land within the active flood plain. A set of seven extended hydrological regions (EHRs) have therefore been defined in which the RE region has been absorbed into the other regions. The boundaries of the EHRs have also been adjusted to follow, where possible, District or Thana boundaries in order to facilitate analysis and presentation of data based on administrative units. The areas of the EHRs are given in Table 3.1.

Table 3.1: Areas of Extended Hydrological Regions

Region	Extended Hydrological Region Area (km²)	Hydrological Region Area (km²)	EHR as % of HR
SW	26,445	26,100	101%
SC	16,432	15,236	108%
NW	33,974	31,607	107%
NC	17,001	15,950	107%
NE	20,038	20,061	100%
SE	12,615	10,275	123%
EH	21,065	19,910	106%
RE	-	8,431	0%
Total	147,570	147,570	100%

Source:: NWRD

3.2.3 Classification of Areas

NWMP has planned water use for all land types covering the entire area of Bangladesh under the eight land type categories described in Table 3.2, which are built up from 32 land sub-types. Issues associated with the definition of land types and the identification of associated areas have been resolved in consultation with BBS, Department of Forestry, Department of Fisheries and various other authorities.

Table 3.2: Classification of Land Use Types for NWMP Planning Purposes

Land Type	Area (km^2) in 2025		Description
Rivers	12,277	8%	The area occupied by the main rivers (Brahmaputra, Ganges, Meghna), within its meander belt, the area of other rivers of widths down to 20m, excluding the above, as defined in the SWMC model database and also those visible in February 1989 SPOT Imagery and the coastal water.
Other	4,302	3%	Charlands (islands within rivers) and land between embankments and the rivers' edges, known as attached chars.
Water	10,891	7%	Beels, baors and ponds still flooded in the month of February, as observed on February 1997 imagery, and including the maximum area of Kaptai lake.
Forest	24,693	17%	Land designated as state reserve forest by the Forestry Department, excluding mangrove, plus other official forest, fruit trees, etc.
Mangrove	5,623	4%	Mangrove areas
Urban	12,956	9%	Towns and growth centres identified as having an urban population in the 1991 census, plus infrastructure such as roads, railways, canals and industrial land outside settlements.
Rural	8,167	6%	The 60,000 villages scattered all over Bangladesh where the rural population lives.
Agriculture	68,661	47%	Land under cultivation at least once a year, plus current fallow and cultivable waste, described by flood phase. This includes agricultural land within forests, urban areas and on charlands.
Total	**147,570**	100%	

3.2.4 Identification of Sub-Sectoral Clusters

The National Water Management Plan has, as a primary aim, the establishment of a framework within which other agencies can prepare their own sub-regional and local water management plans. It follows from this that the Plan must be expressed in terms meaningful to those agencies. Thus from the outset of options assessment, the outcome of the analyses were presented along sub-sectoral lines.

This did not obviate the need to consider regional variations, and due recognition has been given to these during the analyses, particularly with regard to water resource and demand estimation. However, as may be seen in Part B, the majority of issues that have to be addressed are generic in nature, rather than specific to hydrological regions. There are of course exceptions to any generalisation, but even in these cases, mostly the issues are common to more than one region (eg cyclone protection). Furthermore, in matters relating to dealing with dry season shortages, solutions appear to lie in trans-regional developments (eg the Ganges Dependent Area, which spans three hydrological regions).

The sub-sectors selected, and adopted in the Government's Development Strategy, are summarised in Table 3.3, along with the main agencies who are concerned with each (the listing of agencies is by no means exclusive). From the table it may be seen that emphasis is given to the main uses of water as well as to the main rivers, which are themselves strategically significant, given their magnitude and their potential impacts at a national scale.

Table 3.3: Sub-Sectoral Clusters

Cross-Cutting		Disciplinary	
Cluster	Main Agencies	Cluster	Main Agencies
• Institutional Development	*All*	• Main Rivers	*BWDB, BIWTA*
• Enabling Environment	*All*	• Towns and Rural Areas	*Local Government, DPHE, BWDB*
		• Major Cities	*Local Government, WASAs, DPHE, CCs, BWDB*
		• Disaster Management	*DMB, LGED, MoA, R&H*
		• Water Management for Agriculture	*BWDB, LGED, BADC, BMDA, DAE*
		• Environment and Aquatic Resources	*DoE, DoFish, DoForest, Local Government*

3.3 *Institutional and Legal Framework*

3.3.1 Existing Institutional Setting

The current institutional framework is summarised below.

(i) Central Government Agencies

Altogether some 35 central Government organisations, affiliated with 13 different Ministries, have been identified with functions relevant to the water sector. The main agencies are listed below and their main areas of responsibility are shown in Table 3.4.

- The National Economic Council (NEC) is the highest executive body in the Government's planning process and is responsible for policy decisions on the basis of recommendations from its Executive Committee (ECNEC).
- The National Water Resources Council (NWRC) is the highest national body reporting to Cabinet on all water policy issues, including oversight of the NWMP and updates, resolution of inter-agency conflicts, and adoption of common standards for the water sector. The NWRC has an Executive Committee (ECNWRC) that provides directives and guidance to water management institutions.
- The Planning Commission is a technical body responsible for advising and assisting ECNEC and NEC on development planning. The Planning Commission produces the Five Year Plan; the Three Year Rolling Plan and the Annual Development Programme.

- The Ministry of Water Resources (MoWR) is responsible to the Government for most aspects of the water sector including flood control, irrigation, water conservation, surface and groundwater use, and river management
- Water Resources Planning Organization (WARPO) is responsible for water sector planning at national level and acts as the secretariat of the ECNWRC. It also is responsible for establishing and maintaining the National Water Resources Database, a management information system and for coordinating water sector developments.
- The Joint Rivers Commission is responsible for dealings with India and other co-riparian countries through similar organisations in those countries.
- Bangladesh Water Development Board (BWDB) is responsible for the planning and execution of medium and large-scale water resource development projects, river dredging and training, flood forecasting, surveys, data collection and sundry activities.
- Bangladesh Inland Water Transport Authority (BIWTA) in the Ministry of Shipping is responsible for maintaining the main inland waterways.
- Ministry of Agriculture (MoA) is responsible for overall agricultural development, including minor irrigation. In addition it oversees the BADC, SRDI, all Agricultural Research Institutes in the country and the Department of Agricultural Extension (DAE) – the WM&AE wing of which inter-alia provides advice through 13,000 block supervisors regarding on farm water management.
- Bangladesh Agricultural Development Corporation (BADC) under MoA pioneered the introduction of mechanised minor irrigation, laying the foundation for the rapid expansion that has since occurred through the private sector. Despite being responsible for promoting and facilitating minor irrigation development it was withdrawn from minor irrigation in 1993 and is in the process of being restructured.
- The Department of Fisheries (DoF) under the Ministry of Fisheries is responsible for the development of both capture and culture fisheries.
- The Ministry of Local Government, Rural Development and Cooperatives (MoLGRDC) sets policies for rural development and oversees the functions of local government at all levels through its two divisions, the Local Government Division (LGD) and Rural Development and Cooperatives Division (RDCD).
- The Department of Public Health Engineering (DPHE), under LGD is responsible for the installation of water supply and sanitation systems in rural areas and in urban areas outside Dhaka and Chittagong. These schemes are turned over to the communities served.

Table 3.4: Organisations Relevant to the Water Sector

Ministry	Organisation	National/Regional								Regional/Sub-Regional								Local Rural/Semi-Rural								Urban			
		Policy	International river basins	National/regional planning & coordination	Laws, regulations, rules, guidelines etc	Economic instruments	Research/service/education	Flood warning dissemination	Data collection	Programme planning and coordination	Standards monitoring	Major river maintenance & erosion	Barrages and transfers	Management of medium/large FCD	Regl river maintenance & erosion	Coastal Protection	Large scale irrigation projects	Local area development planning	Rural/village water supply and sanitation	Management of small water bodies	Minor irrigation	Maintenance of local drainage	Flood proofing	Management of small FCD	Promotion/education/awareness raising	Urban development planning	Town water supply and sanitation	Flood protection/proofing and drainage	
Inter-Ministerial	National Water Resources Council	■			■																								
	Executive Committee of NWRC	■			■																								
	National Economic Council					■				■																			
	Executive Committee of NEC					■				■																			
MoWR	Water Resources Planning Organisation	■		■	■	■																							
	Joint Rivers Commission		■																										
	River Research Institute						■																						
	Surface Water Modelling Centre [1]						■																						
	Environment and GIS Project [2]						■																						
	B'desh Water Development Board							■	■	■	■	■	■	■	■		■				■	■	■	■				■	
	B'desh Haor & wetland Development Board							■		■	■																		
MoA	B'desh Agricultural Development Corporation								■												■	■							
	Dept of Agricultural Extension								■												■				■				
	Soil Resources Development Institute						■				≈																		
	B'desh Agricultural Research Council	≈					■																						
	B'desh Agricultural Research Institute						■																						
	B'desh Rice Research Institute						■																						
LGRD&C	Local Government Division																	■											
	Local Government Engineering Dept.								■									■				■	■	■					■
	Dept of Public Health Engineering								■									■	■						■		■		
	Dhaka Water Supply and Sanitation Authority																									■	■		
	Chittagong WASA																									■	■		
Works	Rajdhani Unnayan Katripakha																									■			
Science & Tech	Space Research & Remote Sensing Org						■																						
MoEF	Dept of Environment				■				■		■																		
	Department of Forest									≈						■		≈							≈				
Communications	Dept of Roads and Highways													≈										≈					
MoPS&IWT	B'desh Inland Water Transport Authority								■						■														
MoFL	Dept of Fisheries								■	■								■		■		■							
MoPlan	Planning Commission			■	■	■				■																■			
	B'desh Institute of Development Studies [1]	≈				■			■																				
	B'desh Bureau of Statistics								■																				
MoL	Ministry of lands				■															■									
MoI	Ministry of Industry				■													■								■			
MRDM	Disaster Management Bureau							■															■						
Other organisations																													
	LGI: Paurashava																	■								■	■		
	LGI: Parishads																	■	■	■		■	■		■				
	Community Based Organisations													■			■		■	■	■	■	■	■					
	Non-Government Organisations	■	■	■	■	■	■	■											■	■	■		■	■	■				
	Co-operatives																		■		■								
	Private Sector [3]						■												■		■				■				

Notes : [1] *Established as a not-for-profit trust* [2] *At present a project, due to become a trust in 2001*
[3] *Excluding consultants and contractors* ≈ *Indirectly related to water sector activities*

- The Local Government Engineering Department (LGED) under the LGD plans and executes rural works. In the water sector, LGED has mainly focussed on small-scale schemes up to about 1000ha.
- The Ministry of Environment and Forests (MoEF) sets policies for environmental protection and management and is responsible through DoE for enforcement of environmental rules and guidelines for all sectors.
- The Department of Environment (DoE) under MoEF is mandated to regulate and enforce environmental management, including pollution control of water resources. Its responsibilities include ensuring the adequacy of Environmental Impact Assessments.
- The Soil Resources Development Institute (SRDI) is responsible for monitoring water related soil erosion in 20 districts.
- Bangladesh Haor and Wetland Development Board (BHWDB) is responsible for monitoring, coordinating and integrating the haor area schemes of other agencies in the wetland areas.
- The River Research Institute is responsible for research, especially by means of physical modelling into river behaviour at the national and regional levels.
- The Department of Forest (DoFo) is responsible for controlling forested watershed areas in Sylhet, Cox's Bazar, Chittagong, Rangamati, Khagrachari and Bandarban.

(ii) Local Government Institutions

Various levels of Local Government are being established in Bangladesh in accordance with State Policy and the recommendations of the Local Government Commission. All Local Government Institutions (LGI) come under administrative responsibility of the Local Government Division of MLG&RDC.

City Corporations: Four have been established, for Dhaka, Chittagong, Rajshahi and Khulna, under the City Corporation Act of 1990.

Paurashava (Municipalities): In addition to the four cities, there are 206 Paurashavas established under the Paurashava Ordinance 1977 (amended 1998), each with population in excess of 15,000 and a population density in excess of 2000 per sq mile (approximately 730 per sq km).

Zila (District) Parishad: There are 64 Zilas throughout the country. The Zila Parishad Act was passed in 2000 providing for Parishads (councils) in each District, elected from lower-level Parishads and municipalities. Election of the Parishad officers is yet to be held.

Upazila (Thana) Parishad: There are 464 Upazilas. The Upazila Parishad Act was passed in 1998, but elections are yet to be held.

Union Parishad: There are 4451 Unions with Parishads established under a 1983 Ordinance. The Chairman and 12 members (including three nominated women members) are elected from wards comprising one or two villages each.

Gram Parishads: There are approximately 86,500 Grams (villages) in the country. The Gram Parishad Act was passed in 1997 replacing the 1989 Palli (village) Parishad Act. Elections are yet to be held.

Each City Corporation, Paurashava and Parishad is a corporate body with perpetual succession, entitled to acquire, hold and dispose of movable and immovable property, and to raise taxes and other income. Parishads are allowed to raise taxes to meet local expenditure, exercise full control over their affairs and prepare, approve and implement development plans within their jurisdiction. Only Union Parishads have thus far been elected.

The City Corporations of Dhaka and Chittagong are supported by Water Supply and Sewerage Authorities (WASA) formed in accordance with the 1996 WASA Act. Each WASA is also a corporate body responsible for provision and up-keep of potable water supply, sewerage and storm drainage. The WASAs are allowed to levy tariffs and fees at rates that Government approves.

In the other towns and cities, each Paurashava is responsible for its own water supply, sewerage and storm drainage and for charging and recovering fees. They are assisted by the DPHE who are responsible for planning, design and construction of schemes, that are handed over to the Paurashava on completion. LGED assists the Paurashavas in development of other infrastructure, and the Public Works Department (PWD), under the Ministry of Housing and Works, is responsible for the establishment and upkeep of all public buildings.

(iii) Other organisations and the private sector

Local and international NGOs provide goods and services normally associated with the public and private sectors. In some areas (eg. micro-credit, non-formal education and primary health care), the NGOs of Bangladesh are internationally recognised for their successes. NGOs are increasingly significant in influencing public policy on issues such as land reform, primary education, environment and water management planning. They have also become involved in advocacy on behalf of disadvantaged groups and other sections of civil society. Academia is also active in the water sector via valuable teaching and research activities, with the Department of Water Resources Engineering at the Bangladesh University of Engineering and Technology playing a leading role.

The Co-operative movement started nearly a century ago and expanded rapidly in the 1960s. The Bangladesh Rural Development Board (BRDB) provides support to the national co-operative movement of 63,000 farmer societies (KSS) which are grouped into Upazila Central Co-operative Associations (UCCA). Despite determined efforts on the part of Government, the movement has achieved mixed results. Repeated forgiveness of debts in the past has contributed to a culture of non-payment, which continues to pervade the movement.

The private sector is closely involved in all aspects of water resources development and management. Examples include consultants, contractors, equipment importers and suppliers, distribution and sales organisations, and service providers, including maintenance of equipment and training and credit agencies. Private sector activities have expanded significantly over the last 20 years with progressive liberalisation of the water sector, and it is particularly active in minor irrigation, and rural water supply and sanitation. Outside the water sector, traditional public sector approaches are changing with private concessions being awarded in the energy sector and design/construct packages for major bridges. Construction and O&M of the Bangabandhu Bridge illustrate how public-private partnership can successfully achieve results in a limited time-span. However, privatisation of public assets is in its infancy in Bangladesh. Despite GoB's efforts to create an attractive investment climate, many problems exist that discourage investor confidence, including issues of good governance, viability of state enterprises, inadequate charging systems, poor revenue collection and strong union resistance to change.

(iv) Donor Agencies

The World Bank, the Asian Development Bank and numerous bilateral development agencies, notably the Dutch, Danish, Japanese, British and Canadian, have been active for many years in financing water development projects with technical assistance and capacity building. UNDP and other United Nations Agencies, especially UNICEF, are active in support of water sector programmes and rural development.

3.3.2 *Water Rights and Laws in the Water Sector*

As in many countries, ownership of water rests with the State and users are accorded usufructuary rights. The NWPo reconfirms this and makes clear an intention to be able to regulate water use in areas of scarcity, to protect downstream users and to be able to confer secure, defensible and enforceable water rights on private and community bodies to attract private investment.

Usufructuary water rights in Bangladesh are tied into land ownership. With the recent rapid growth in demands, conflicts over water have inevitably arisen, particularly between different types of user such as farmers, fishermen, boat owners and domestic users. The State has intervened in recent years with various legislative and structural measures, but these have been

Previous legislation that may require review and reconsideration

Revenue Sale Act	1859
Land Registration Act	1876
The Bengal Irrigation Act	1876
Ferries Act	1878
Courts of Wards Act	1879
Cess Act	1880
Transfer of Property Act	1882
Local Self-Government Act	1885
The Embankment Act	1888
Estates Partition Act	1897
Ancient Monuments Preservation Act	1904
Registration Act	1908
The Excise Act	1909
Public Demands Recovery Act	1913
Agriculture & Sanitary Improvement Act	1920
Waste Land Manual	1936
Bengal Land Improvement Act	1939
State Acquisition and Tenancy Act	1950
Embankment and Drainage Act	1952
Inland Water Transport Authority Ordinance	1958
Local Government Ordinance	1976
Acquisition and Requisition of Immovable Property Ordinance	1982
Local Government (Union Parishads) Ordinance	1983
Irrigation Rates Ordinance	1983
Groundwater Management Ordinance	1985
Land Management Manual	1990
Water Resources Planning Act	1992
Water Supply and Sewerage Authority Act	1996
Environment Conservation Act	1995
Environment Conservation Rules	1997
BWDB Act	2000

predominantly orientated towards development of agriculture, often to the disbenefit of other users. The new Policy indicates that the State now wishes to redress this situation by both securing individual and community rights and encouraging a revised system of water allocation giving greater priority to non-agricultural uses, whilst still ensuring that self-sufficiency in food is maintained.

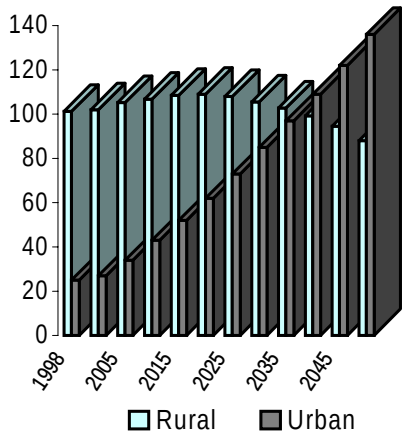
There is no shortage of water sector legislation, some dating back over a century. Concurrent with consideration of the draft Water Resources Act, it will be necessary to overhaul all water sector and some land legislation (see box). Particularly important laws to consider are highlighted below.

The Bengal Irrigation Act 1876 needs amendment or replacement to accommodate the transfer of ownership and the management of schemes from Government to community based organisations (CBOs), or alternatively to allow for assets to be held in Trust and usufruct rights made available to CBOs. *The Irrigation Water Rate Ordinance 1983* needs to separate the payment of irrigation rates from the payment of water management rates in FCDI areas, whilst *the Groundwater Management Ordinance 1985* is currently in suspension and should be repealed.

The State Acquisition and Tenancy Act 1950 needs revision to enable land acquired under this Act for FCDI schemes to be transferred to community-based organisations as an alternative to Local Government. Similarly, *the Embankment and Drainage Act 1952* will require replacement with a new Act that reflects adequately new approaches to change of ownership and management responsibility. *The Acquisition and Requisition of Immovable Property Ordinance 1982* relating to the acquisition and requisition of immovable property also has similar impediments to the 1950 Act above in terms of transfer of ownership.

3.4 *Socio-Economic Challenges*

The National Water Management Plan must respond to the socio-economics needs of the country as they affect management of water resources and delivery of water services. The main social and economic imperatives that have been taken into account in plan formulation are as follows.



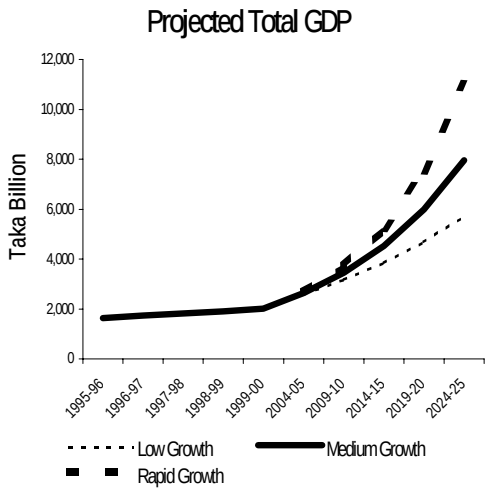
Population growth - the rate of population growth has slowed to less than 2% per year, but in absolute terms this still means that the population is projected to increase by 40% from about 129 million in 2000 to 181 million by 2025, and 224 million by 2050.

Urbanisation - most of the predicted population increase is expected to be in urban areas, where, partly due to rural urban migration, the population will increase by 46 million in the next 25 years, from 27 million (21% of total) in 2000

to 73 million (40%) by 2025, and 136 million (60%) by 2050. Therefore, substantial investment and improved provision of social and economic infrastructure will be required in the urban areas.

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

Economic growth and development - sustained high-level economic growth is a key target if the country is going to address its most pressing problems. The projections presented in this report are based on forecasts, which suggest that the current economic growth rate of 5.5% will increase to 6% per year over the next 25 years. In a global market place, this will depend on increasing economic liberalisation and greater private sector participation (domestic and foreign).

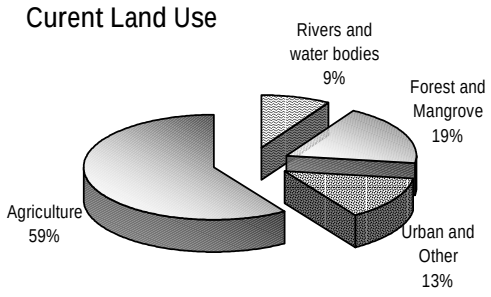


Employment generation - job-creation, particularly in the urban areas, will become a key policy issue. The projected growth in urban population means that some 14 million new employment opportunities will be needed in the next 25 years - and a further 21 million by the year 2050.

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

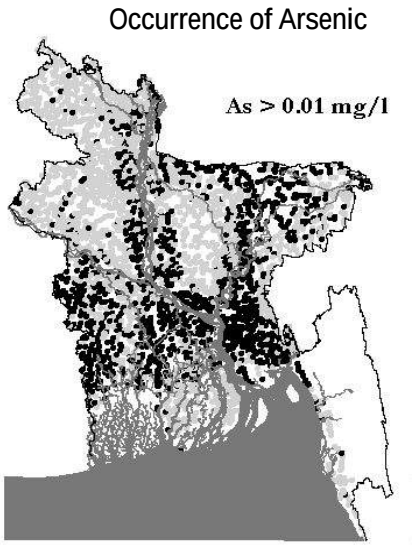
Education and public health - major investments will be required in education and public health to eliminate illiteracy, develop new skills and ensure the well-being of all the people. Additional investment will be needed to manage the adverse impact of arsenic contamination.

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



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

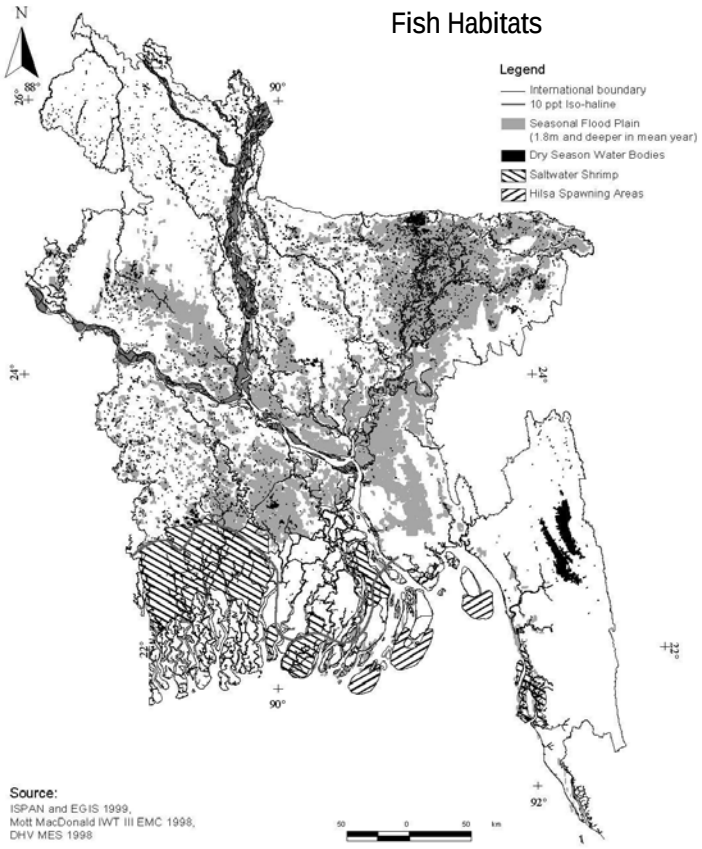
3.5 *Environmental Challenges*



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

Surface water quality – Severe problems are arising in industrial areas, particularly around Dhaka, and faecal contamination, mainly in urban areas, village ponds and small streams, is also a major problem. There are indications that aquifer pollution is also occurring in some of these areas. Major efforts are needed to arrest and reverse these trends.

Groundwater quality – Whilst naturally occurring iron and boron each represent varying degrees of hazard to water users, the presence of arsenic in the shallow aquifer is an undeniably major threat to human health, as it is both toxic and carcinogenic. Current understanding is that about 25% of the population are exposed to contamination exceeding Bangladesh standards, with a further 21% with supplies that do not meet the more stringent WHO standards. This dire situation requires priority attention, along with lesser issues of other contaminants. In addition the potential remains for agricultural chemicals also to contaminate the aquifers; but monitoring to date has not identified this as a major problem as yet,



Fisheries – Capture fishing on the flood plains has been a traditional activity of immense value to the poor. Stocks have declined rapidly in recent years due to water pollution, impeded migration routes and over-exploitation. Unless urgent steps are taken, capture fishing will become a think of the past, at great commercial loss and raising major issues of protein security for the poor.

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

Environmental conservation and protection - The principal ecologically-sensitive areas of the country are under great pressure, both from encroachment and as sources for subsistence and production. Both the Sundarbans and the Tanguar Haor Basin of the Northeast, being Ramsar sites, merit special attention. There is a real danger that their degradation will become habitual. The key issue is to reverse this trend before there are no sites left worth conserving. Effective measures to control and reduce wastewater pollution from municipal and industrial sources are also needed to improve and sustain water quality standards for surface water and groundwater. In view of the projected expansion in urban population, these interventions will become increasingly important.

3.6 *Demand Scenarios*

3.6.1 Monsoon Season Demands

In general, water shortages do not occur during the monsoon season from June to October. In the early part of this season, rainfall can be variable, which is significant to those many farmers who plant *aman* at this time of the year. Supplementary irrigation is practised by few farmers, although there is potential to expand this. Many of the public sector's surface water irrigation schemes were originally designed to promote both early and late monsoon crops, rather than the now popular dry season *boro* crop.

The main issue for the monsoon however is excess of water. Most of Bangladesh is located within the floodplains of the three great rivers, the Brahmaputra, Ganges and Meghna, but only 8% of the total catchment area lies within Bangladesh. River flows have huge seasonal variations, with the combined flow of the Ganges and Brahmaputra typically increasing from less than 10,000m^3/s early in the year to a peak of 80,000 to 140,000m^3/s in late August or early September. These high flows, along with (i) high internal rainfall, (ii) the general low-level of the country and iii) inadequate drainage result in widespread inundation each year.

Drainage problems themselves arise from drainage impediments and drainage congestion. Drainage impediments are caused by insufficient drainage capacity through road embankments, blocked drainage channels due to siltation, cross-dams or fishing activities and inadequately sized drainage sluices. Drainage congestion, on the other hand, occurs due to high outfall water levels that prevent drainage flows, irrespective of any other impediments. Both circumstances are inter-linked, as one

can affect the other, and both are common problems in Bangladesh. However, the pattern of flooding is not the same everywhere and the issues are different in different hydrological regions, as shown below.

Annual inundation has both negative and positive impacts. Positive impacts of floods are increases in soil fertility, the enhancement of capture fisheries and navigation, increased groundwater recharge and the flushing of pollutants. Negative impacts include damage and loss to property, infrastructure and crops, and sometimes loss of life. Furthermore, inundation of handpumps and latrines increases incidence of disease while disruption to transport, communications and economic activities leads to loss of employment opportunities. Coastal flooding also has mainly negative impacts on modern agricultural systems because of the salinity of the floodwater.

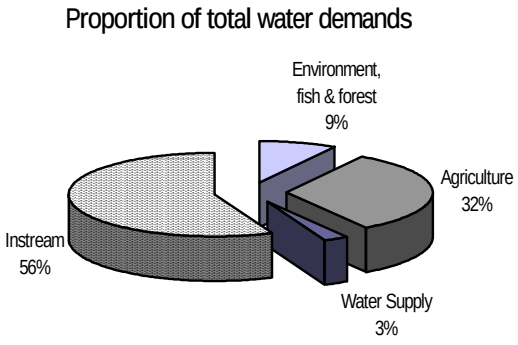
Table 3.5: Major Sources of Flooding

Region	Major Sources of flooding
Southwest	Tides and cyclonic rainfall
South Central	Tides, cyclonic rainfall and surges, and overspill of Lower Meghna
Northwest	Local intense rainfall, impeded drainage, breaches in the Teesta and Brahmaputra Right Embankments and breaches in internal polder embankments and drainage congestion preceded by high flows in the major rivers
North Central	Local intense rainfall, impeded drainage, spillage from the Brahmaputra and congested drainage on the Meghna
Northeast	Flash floods on transboundary rivers, local intense rainfall, impeded drainage and drainage congestion on the Meghna
Southeast	Flash floods on transboundary rivers, local intense rainfall, impeded drainage and drainage congestion on the major river
Eastern Hills	Flash floods and cyclonic rainfall
Rivers & Estuaries	High inflows through the Ganges and the Brahmaputra and surges

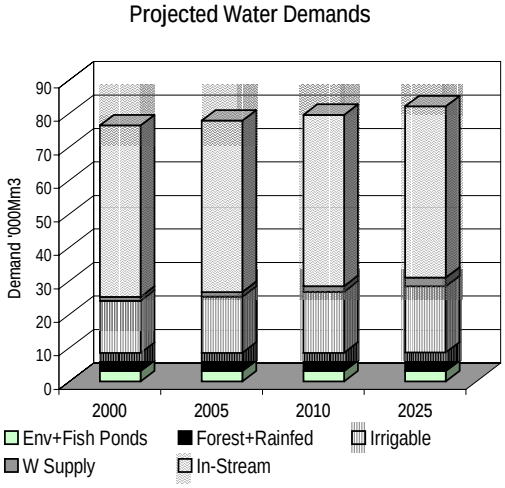
From time to time, 1988 and 1998 for instance, peak flows of the major rivers, spring tides in the Bay of Bengal, and cyclonic surges can occur simultaneously thereby transforming the annual inundations into devastating floods that result in major damage to life, livelihoods and property, particularly in the coastal regions. Equally however, the North East and Northern transboundary rivers are susceptible to flash flooding from the adjacent hills in India.

3.6.2 Dry Season Water Demands

Consumptive demands for water include evaporation from forests, water bodies, charland, urban and rural environments, rainfed and irrigated agriculture, as well as the needs of water supply and sanitation. In-stream demands include the overlapping requirements for salinity and pollution control, navigation and fisheries.



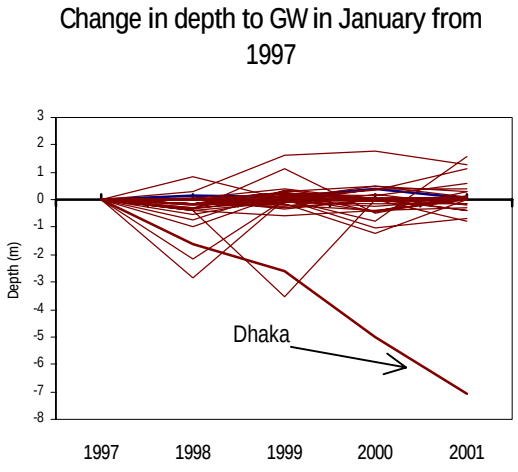
Consumptive demands represent 44% of the total water demand and in-stream demands the balance of 56%. Agricultural demands, the focus of previous studies, amount to only 32% of total demand. At present, only about half the area is irrigated but, as much of the remaining agricultural land is classified as unsuitable for irrigation, existing demands are already 85-90% of the future potential.



The main determinant in overall demand for water resources in the future is the growth of irrigation demand. Water supply for urban and rural domestic and commercial use will more than double, but this represents a very small portion of overall demand. Irrigation demands are expected to increase potentially by at least a quarter over the next 25 years, depending upon the extent to which future agricultural production requirements are met through yield improvements as opposed to intensification.

3.6.3 Groundwater Resources

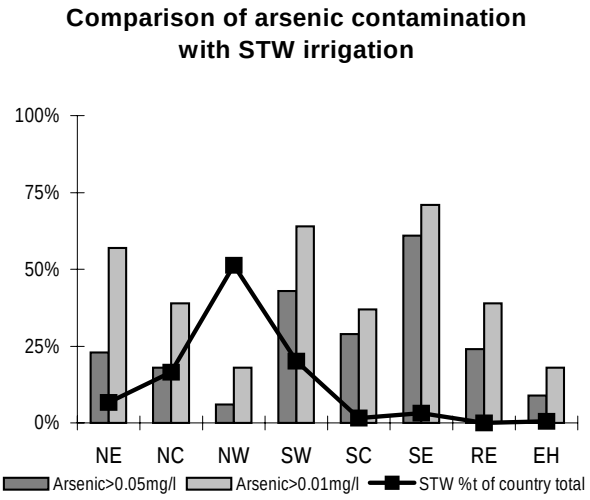
Attempts to estimate accurately the quantity of groundwater available in Bangladesh were started in 1986. Past approaches have led to estimates that have clearly been exceeded in some places. However, despite the rapid growth in groundwater-based irrigation in the last 15 years, in some areas groundwater levels continue to return each year to the same level (although levels are falling under Dhaka due to the heavy abstractions there). The chart of water levels in 36 BWDB monitoring wells ably illustrates this.



However, groundwater in appreciable quantities underlies only in some area of the country (the Groundwater Irrigation Thanas or GIT). In other areas, small quantities of available groundwater exist, sufficient only to support a limited amount of domestic and municipal uses, but these are easily over-exploited. Other parts of the country, mainly the NE, SE, EH and the southern parts of the SW and SC, rely principally upon surface water to meet all their needs. A comparison of potential demands on groundwater availability indicates that deficits may arise in both the Southwest and Northwest regions, principally along the western border where recharge tends to be less. The spatial distribution of exploitable groundwater is reflected in the Regional plans.

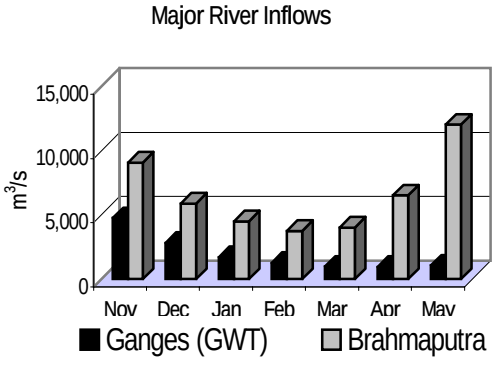
Further expansion of ground-water irrigation nevertheless causes seasonal water levels to decline further, although in those areas where irrigation is already highly developed, this mean a small change from current levels. Increased seasonal drawdown is of significance both to rural water supply planning, as well as to the types of technologies required for irrigation abstraction.

Research is continuing into the impacts that irrigation with arsenic-contaminated water might have on food safety. No firm conclusion can be drawn as yet. The implications if it is shown to be unsafe will depend on whether the health hazards are applicable to some or all crops, and whether treatment is a viable option. However, if there was a need to ban irrigation from groundwater in these areas, the impacts would be moderated by the fact that most STW irrigation is not in areas of high arsenic contamination.



3.6.4 Surface Water Resources

Surface water is an important strategic resource for Bangladesh in the dry season. It is the only resource for some 44% of the country (barring some small pockets of groundwater used for domestic and municipal supplies), and can be used to augment all areas where deficits arise. Under the directions of the National Water Policy, however, much more attention is now being given to in-stream demands and the environmental benefits that will come from healthy river systems.



In-country run-off during the dry season is minimal, and by far the most dominant sources of surface water are the Brahmaputra and Ganges Rivers (notwithstanding the locally important inflows on other transboundary rivers). Of the two, the dry season flows in the Brahmaputra are substantially greater than those on the Ganges, even after the signature of the 1996 Ganges Water Treaty. The Ganges catchment is much more developed than the Brahmaputra, and it is more likely in the future that increasing demands will be more strongly apparent in the former. Studies are already in place to make use of the flows secured under the Ganges Treaty to restore the environment and develop areas commanded by the Ganges. The Brahmaputra, on the other hand, represents more of a long-term

strategic reserve of dry season water resources, notwithstanding the high costs associated with controlling and distributing these to deficit areas.

Assessments have been made of overall regional water balances, the results of which are summarised in Table 3.6.

Table 3.6: Overview of Regional Water Balances

Region	Assessment
Southwest Region	This region is clearly the region with greatest need of augmentation, due to multiple demands and the low flows entering the region when the Gorai is cut off in the dry season. The deficit could be made up by diversion from the Ganges, and options to do this are being reviewed in the GRRP and OGDA studies. The region has a significant extent of arsenic contamination.
North East Region	There is relatively little exploitable groundwater in the area, there are large quantities of static surface water resources that could meet the demands outside the groundwater areas. However, the haor basins that contain this static water are of considerable environmental importance, and therefore water resource development of this region needs to be handled with particular sensitivity. The area is relatively highly contaminated with arsenic in the groundwater areas.
North Central Region	This region is in overall deficit and available groundwater is not enough to meet evaporative demands, and net irrigation requirements. The shortage arises because regional inflows from the Old Brahmaputra and Dhaleswari are small compared with the flows needed for navigation in the busy waterways around Dhaka. Parts of the region are contaminated with arsenic adjacent to the main river courses.
North West Region	Groundwater is generally in good supply, there are nonetheless significant parts, mainly along the border with India (notably the western part of the High Barind) that are in deficit due to low recharge. In the four northernmost thanas, although groundwater is plentiful, there is a high incidence of boulders, making drilling of tubewells difficult. The region is relatively free of high arsenic contamination, although low levels appear to occur throughout the Region.
South Central Region	There are inflows through the Arial Khan and the three Tetulia channels. These natural inflows can be used to meet the potential consumptive and in-stream demands in the region
South East Region	The region experiences a deficit in the peak month of January. In the northern part, within the groundwater area, groundwater is available but is difficult to extract with suction mode pumps, as it often has a high content of gas. The area has the highest concentration of arsenic in the country, and is therefore the one where additional surface water would first be required if arsenic became a problem for agriculture.
Eastern Hills Region	This region may be viewed in two parts: the hills, where surface run-off and irrigation returns feed the plains, and the coastal plain, where they contribute to salinity control. The region as a whole is in deficit, and therefore will require a different approach to the rest of the country. In the hills for instance, there are opportunities for drip irrigation of high value tree crops, which use less water. A concern is that over-irrigation on the coastal plain with groundwater will cause saline water to be drawn in.

These assessments, qualified as they may be in the absence of further research on groundwater, reinforce the conclusion that the Ganges flows secured under the 1996 Treaty are critical to the sustenance of the Southwest Region.

A key feature of the NWMP must therefore be the improvement of long range water resource and agricultural demand assessment, coupled with preparation of a strategy for maintaining water balances beyond the plan period and beyond the 2026 end-date for the Ganges Water Treaty. At the same time, treaties securing Bangladesh's share of the flows of the other 53 transboundary rivers should ideally be brought into place. Though many of these contribute only a small proportion of the overall balance, locally they are important.

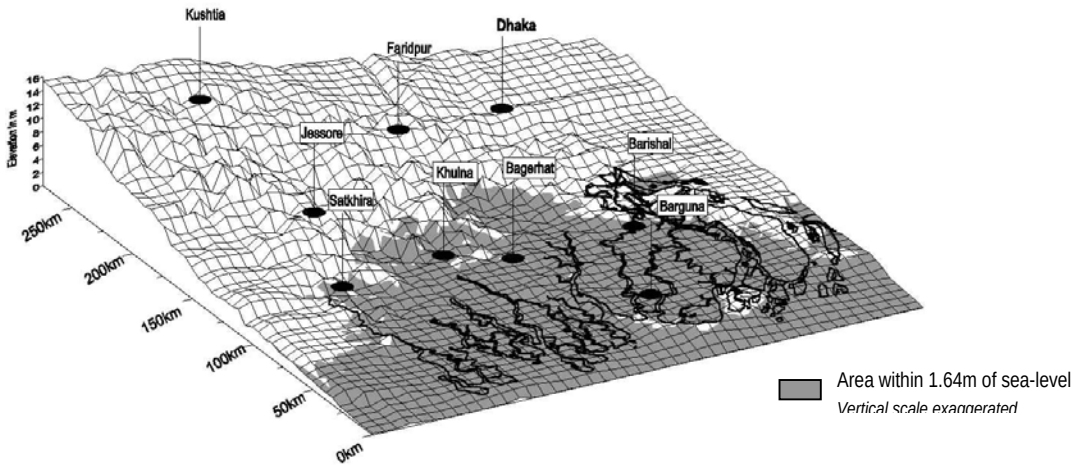
3.6.5 Climate Change

Assessments using climate change models indicate changes in rainfall and evapotranspiration (ETo) occurring progressively over the next 50 years. Indications are that the dry season will become significantly drier with a noticeable increase in crop water requirements. By year 2050 this increase may be as much as 25% above current requirements. This will raise water demands from farmers, but in increasing the cost of water, may over this period encourage further diversification into non-rice cropping, thus partially off-setting an overall rise in demand for water. Such changes will also be reflected throughout the Ganges river basin, with increasing overall pressure on Ganges dry season flows.

Rainfall in the peak monsoon period may be even higher than for the season as a whole, and is predicted to be about 28.6% above current levels by 2050. This will increase drainage requirements and flood duration more significantly than peak flood levels. From a socio-economic perspective, this will impact negatively on people's livelihoods, but in environmental terms may have positive effects on coastal sedimentation and overall salinity ingression. Such impacts are hard to predict at present however.

Sea-level rise due to global warming, continued sedimentation of the rivers and flood plains and subsidence of the Ganges Basin are all factors that will effect sea-levels with respect to land levels. Each is difficult to predict with certainty, as reflected in the breadth of estimates of net sea-level rise of 4.5-23cm in 2025 and 6.5-44cm by 2050.

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



The situation is further complicated by an observed trend of increased tidal amplitude associated with reduction of tidal flows due to empolderment in the Southwest Region. By 1995, the tidal range had increased to about 3.0m from about 1.8m in 1960. It is improbable that a new equilibrium has been reached, and the tidal range is expected to continue to increase. The combined effect of both sea-level rise and increased tidal range will have a substantial impact over much of the coastal area.

Furthermore, it has been estimated that the rise in sea level will result in backwater effects detectable as far inland as Faridpur and the Haor Basins of the NE.

3.6.6 Demand Uncertainties

Planning for the future requires that good appreciation of what the future holds in store. It is important to recognise where uncertainties lie. In some cases they relate to a lack of knowledge (which generally can be addressed by further studies and research) or to either future political decisions or to margins of error in predictions of future trends. The first is discussed later in Section 3.8, the latter two below.

Most areas of political decision are clear, in so far as the policy framework established by Government (see Section 2.3) is quite comprehensive as it affects the water sector. Policies do not usually commit to timelines, and therefore there is an implicit degree of uncertainty over how quickly policy directives will be addressed. Adoption of NWMP is all about committing to a plan of action with a time schedule, and therefore this particular uncertainty is in effect removed by the Plan.

The main policy gap is therefore the absence of a land use, or physical planning, policy. As well as having implications for agriculture, not least as regards brackish water aquaculture, the lack of such a policy it has a very tangible effect on urban issues in the water sector, particularly for those who are entrusted with preparing detailed water services plans. A key element of this will be provision of bulk water supply and mains sewerage. These are discrete and major investments, which can be far more efficiently planned with a clear understanding of where the urban population will be situated, and in what densities. In the absence of this information, the National Water Management Plan has therefore to take a broad-brush approach to this issue. It is certainly to be hoped that this policy gap will be filled by the time of the first NWMP update.

There are three areas of prediction that are important to highlight, as they have considerable bearing on different aspects of the Plan. Firstly is the issue of demographic trends. These predicate estimates of future demand for water, directly in the case of water supply and sanitation services, and indirectly in terms of food production requirements and the demand for irrigation. In general, these do not affect short-term decisions and therefore their precision, in the context of a rolling plan, is not a matter of substantial importance now. However, again this does affect bulk water supply provisions. The Plan, as now cast, foresees investment in this area in 10-year tranches, and providing adequate long-term provision is made for way-leaves, this should render this problem manageable.

The second important prediction is economic growth. This is important primarily as it will affect the ability of the Government to fund the wide range of programmes envisaged over the next twenty-five years and beyond. There are two considerations to this. Firstly the Plan, in line with Policy, envisages the opening up of new financing sources. Providing Government is successful in doing this, these new sources will reduce the dependence of development investment upon direct Government funding. The second consideration is that, given the imperative of providing adequate water supply and sanitation services (which are the area most

appropriate for the new sources of capital funding), the other major investments envisaged are essentially those related to development and management of the main river systems. By inference therefore, the impact of lower economic growth is mostly likely to be reflected in a slowing of investment in the Main River sub-sector.

The third important area of prediction is what happens to agriculture over the next 25 years. It is evident that total rice production (the biggest water consumer) essentially follows domestic demand, and that an increasing population will drive this up. Given also a trend towards diminishing land available to agriculture, and a marked downwards trend in agricultural land per capita, the pressure to increase agricultural production will be considerable. At issue is the extent to which this increased production will come from intensification through irrigation, as continues to happen today, or through internal yield increases through improved crops, husbandry and crop inputs. The conversion to HYV, which also has been a major success over the last twenty years, is coming towards the end however, and there is genuine debate over the potential for a second "green revolution" on the back of new varieties now being tested in Bangladesh. The Plan assumes that all can be irrigated will eventually become irrigated, which may be an overestimate, but at least on this basis removes dry season water as a constraint to agriculture. Clearly the situation needs to be monitored for future Plan updates, as it may have bearing on the efficacy of long-term public sector investments in irrigation.

3.6.7 Balanced use of Surface and Groundwater Resources

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.

3.7 *Technical Challenges*

There are many different technical issues to address in improving water resources management in Bangladesh. Some of these are common to all regions, some are specific to a few only, as the box overleaf illustrates. Amongst these issues are some significant technical challenges. Some of these are relatively well understood, and solutions are already available either within the country or can be found from elsewhere. However, in a number of strategically important areas, major challenges exist that will require careful attention by the agencies concerned.

3.7.1 River maintenance

The Government is intent on maintaining the rivers to serve these purposes through comprehensive development and management of both the main and local river systems. The strategy to effect this combines the progressive development of barrages and local diversion structures where feasible, combined with dredging programmes to sustain adequate depths of flow to meet multipurpose use. At a local level, community participation in drain re-excavation will be encouraged also.

All this needs to be achieved in a cost-effective manner, and the main technical challenge lies in being able to properly plan dredging and other works in a manner that effectively minimises re-siltation. This will require an ability to understand the morphology of the rivers in question and how different interventions may help sustain dredging efforts. A start in this regard is being made with the studies so far undertaken on restoring the Gorai offtake by a mixture of dredging and training works.

3.7.2 *Erosion control*

River bank erosion causes immense hardship to those affected and the Government is committed to mitigating this problem. To this end the SWMC has applied its erosion/accretion forecasting model to over 1000 km of river channels since 1996.

Engineering works, particularly on the main rivers are expensive to build and maintain, and can be subject to high risk. Lessons need to be learned from those already constructed, and strategies need to be re-evaluated in the light of the experience so far gained in this most technically challenging of engineering tasks.

Investigations into lower cost solutions including non-structural measures have been taken up and need to be further developed. Much new knowledge needs to be assimilated from the recently completed FAP21/22 pilot projects and from the innovative designs developed under the Meghna Estuary Study.

Different solutions will be applicable to different situations. Work undertaken by EGISII will help in being able to predict where erosion can be expected, but much remains to be done to be able to fully understand the processes involved.

Given the often high costs and high risks with erosion control works, thinking needs to advance beyond one-off structural interventions (often driven on an *ad hoc* reactive basis), and the concept of whole-life evaluation of strategies needs to be given greater consideration.

Such an approach, which would require much greater participatory planning, may prompt a much wider range of solutions than hitherto, particularly if focus is kept on sustaining people's livelihoods rather than merely halting erosion.

Principal water-related issues in the regions

Common issues

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

South West Region

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

North East Region

- Environmental management of the Haor Basin
- Flood 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

North Central Region

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

North West Region

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

South Central Region

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

South East Region

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

Eastern Hills Region

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

Rivers and Estuary Region

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

3.7.3 Land accretion

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

3.7.4 Coastal zone management

Policy recognises that management of water resources in the coastal zone requires further study. These areas suffer from salinity intrusion, cyclone storms, lack of fresh water and impeded drainage. Sites of environmental importance, such as the Sundarbans, are threatened by the diminution of upland flows. The polder systems have created much benefit, but have had side effects, particularly in terms of poor drainage. Development of the shrimp industry has prompted significant social tensions.

The Government is committed to help resolve these problems, and has already taken up a number of initiatives in this regard, such as afforestation of the foreshore to protect against tidal surges. Equally the Surface Water Modelling Centre has undertaken modelling of hydraulic responses to cyclonic surges, salinity intrusion and tidal fluxes and an Integrated Coastal Zone Management Programme is also under preparation, which will bring a holistic view to the many pressing problems unique to the tidal areas. However, from a water perspective, the challenge is to develop comprehensive and sustainable solutions that take account of the inter-action on the water regime between tidal flows from the Bay of Bengal and the upland flows from outside the coastal regions.

3.8 *Knowledge Gaps*

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

3.8.1 Climate change

The potential impacts of climate change resulting from global warming are of great importance to Bangladesh. In broad terms, evaporation to precipitation ratios are expected to rise progressively, prompting an increase in irrigation water requirements unless offset by diversification towards dry-foot crops. Whilst groundwater resources may be little affected, dry season transboundary flows may reduce. Main river flooding may increase in duration and flash flooding will tend to be more frequent, as also will cyclones. Surge depths will increase and a sea level rise of 0.44m by 2050 would greatly exacerbate drainage congestion. Accretion of new coastal lands may be slower as a result.

Understanding the full implications of climate change for Bangladesh and developing an appropriate response requires further consideration. A recent publication by the World Bank on this subject will help to bring focus to many of the issues.

3.8.2 Arsenic

The implications of arsenic contamination of the shallow aquifer are substantial and at the centre of many strategic choices. Although much research has already been conducted into its occurrence and possible solutions, there are still considerable gaps in the understanding of both. It is imperative that high priority is given to filling these knowledge gaps by means of expert and focussed research.

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

3.8.3 Groundwater utility

The utility of groundwater depends on its quality, the level from which it must be pumped and its sustainable yield. Notwithstanding the remarkable growth in groundwater use over the last two decades, both for domestic and irrigation use, there are important planning considerations that need to be explored further.

Although the presence and attendant risks of arsenic in the shallow aquifer are relatively well recorded, there is much less information about the safety of the deeper aquifer in this regard. Current evidence points to it probably being generally safe, a view supported by the Government's Technical Committee, but contradictory views are also expressed. Utility of the lower aquifer is a major strategic issue in terms of overcoming current arsenic problems, particularly for domestic water supplies and is worthy of urgent attention.

Arsenic is however not the only contaminant of groundwater. For instance, iron is commonly found, and is frequently cited by people as a nuisance. Other hazards include contamination from agricultural inputs, improperly constructed sanitation facilities and industrial effluent. Few are especially prevalent at present, but all are in a category where the risks are likely to grow.

As surface water is further developed, the inter-action between surface and groundwater will increase in significance. At the same time, with further expansion of tubewell irrigation, seasonal water levels will decline further. The ability to predict future water levels can be refined with the improved modelling techniques that are now available.

3.8.4 Natural environmental water requirements

The relationship between water and the natural environment is not well understood, and in few cases readily quantifiable. Particular issues relate to appropriate water management of wetlands, the impacts of changing salinity and morphological

regimes on the coastal environment, requirements to sustain fish migration, and pollution control requirements.

Some work has started on these important issues, but much remains to be done. It will likely take many years to obtain a clear understanding of all the processes involved, let alone to be able to quantify them. Nevertheless, establishing key indicators and thresholds for environmental health and sustainability is an early requirement in order to fulfil Policy commitments. It would be prudent to prioritise those issues where early tangible improvements in knowledge can be gained, bearing in mind the wider impacts of actions otherwise deferred.

3.8.5 Long-term implications for water management

As the lower riparian state of three major river systems, Bangladesh has made clear its intentions to work with its neighbours towards overall basin management, with an early focus on the different hydrological regions and promoting information exchange. Signature of the Ganges Water Treaty in 1996 is an important milestone, and continued efforts will be needed to secure Bangladesh's share of the flows of the other 53 transboundary rivers. Though many of these rivers contribute only a small proportion of the overall balance, locally they are important.

In the longer-term there will be increased competition for water amongst the co-riparians, spurred on by the effects of climate change. There will also be greater environmental risks as urbanisation and industrialisation expand throughout the international river basins.

It is firmly in the mutual interests of all States to have a shared long-term view of how these changes will be managed. It is Bangladesh's particular interest as the lower riparian to understand how this wider perspective may effect its internal management of water resources. A continuing dialogue amongst the co-riparian countries and extensive further studies will be needed to develop appropriate long-term strategies in response to the increasing demands on the overall system, and how best for Bangladesh to manage the attendant risks.

3.8.6 Devolved and decentralised water management

A major challenge set by Policy is to devolve and decentralise management of water resources and services. A variety of approaches have been adopted in different countries, often on the basis of historical precedence and cultural preference.

It is not possible as yet to be certain what will be the best approach for Bangladesh, and a period of experimentation is required, most notably for management of flood control and drainage schemes, and more generally for water supplies. In view of the emphasis given by Policy to this, a substantial effort is called for to investigate, test and assess the options.

3.8.7 Promotion of private sector participation

Similarly, increased private sector participation is a major Policy platform where there are considerable uncertainties as to what would work best in this country. Whilst there is room for optimism over the development of small businesses, increased participation in major infrastructure development and management is less certain.

Again, there is a considerable body of knowledge in other countries, which have seen both success and failure in this regard, as well as early experience in Bangladesh's energy sector. Understanding Private Sector Participation in the Bangladesh context, and the benefits it could bring in terms of improved efficiency and alternative funding sources, needs to be addressed at an early stage of the Plan.

4 Strategy for the Water Sector

4.1 *Introduction*

Strategy defines the broad direction of a plan. Strategy is set within the framework laid down by Policy, which defines the overall goals that are sought. In this case, the National Water Policy also defines in many instances what approach should be adopted in achieving its stated goals. Thus the Development Strategy adopted by Government for the water sector may be seen as an elaboration of Policy, providing increasing definition of the course of action Government has chosen to take. However, the Strategy refrains from being specific on programmes, time lines and resources, these being, *inter alia*, the job of the NWMP to set out.

The steps taken in deciding upon a strategy have been briefly described in Chapter 1. They include a detailed review of all aspects of the sector, including the way it is managed. Past interventions have been assessed and lessons drawn. Future trends in the forces that drive the sector have been examined, and demands upon the resource system around the year in each region have been estimated for now and up to 50 years hence. People have been consulted about what concerns them, and what they would wish to see happen. Technical options have been identified, discussed and compared in different ways. Institutional, legal and financial reviews also have been conducted from which clear recommendations emerged.

During this process, sometimes widely divergent views were expressed and hotly debated. Through discourse has emerged common ground on most matters, but some issues require further study and consideration in order to resolve fully. Taking all of this into consideration, and mindful of the overall resource implications, the Government has chosen to adopt a balanced strategy that gives broadly equal emphasis to the national goals. The Strategy recognises that there are still some knowledge gaps, and makes provision to resolve these at an early stage in the Plan.

The following summarises the main elements of the chosen Strategy. The full document is included in Volume 5. The Strategy starts by giving emphasis to the cross-cutting issues of Institutional Development and Enabling Environment, both of which have bearing on each of the sub-sectors that follow: Main Rivers, Towns and Rural Areas, Major Cities, Disaster Management, Agriculture and Water Management, and Environment and Aquatic Resources.

4.2 *Institutional Development*

Main Aims: The Government intends to follow sound institutional principles and thereby to separate policy, planning, and regulatory functions from implementation and operational functions at each level of government, whilst at the same time holding each institution accountable for financial and operational performance. The main aims for developing water sector institutions are determined by the NWPo and the changes envisaged to the institutional framework are intended to bring about:

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

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

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

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

(ii) The sector will be managed through national and regional framework plans that reflect both the Government's policies and the demands of the people. In time, national planning will be increasingly driven by consolidation of local plans. WARPO will retain responsibility for national planning and Local Government, with advice and overview from WARPO, will be the focus for local planning.

(iii) Activities will be coordinated at a national level by Planning Commission according to advice given by WARPO. At a local level, the present DLIPEC system will be phased out and replaced by District Committees under Local Government with support from BWDB.

(iv) The sector will be regulated under law. DoE will continue its mandate to protect and enhance the environment. New independent regulatory bodies will be formed to ensure water service delivery meets appropriate standards cost-effectively. It is anticipated that NGOs will continue their advocacy role at least until regulation becomes fully established.

(v) The river systems and coastal embankments will be managed and developed by BWDB, which will be encouraged to operate on a regional basis.

(vi) Groundwater will be monitored and managed by BWDB but will continue to be largely developed by the private sector.

(vii) Local Government will be strengthened and will increasingly take on management of local water resources, water supply and sanitation developments, urban and peri-urban services and cyclone protection shelters. DPHE and LGED will support this effort and become progressively more accountable to LG at zila level and below.

(viii) The recently constituted Haor Development Board will ensure integrated development and management of haors and wetlands in accordance with their mandate

(ix) Existing FCD infrastructure (up to 5,000ha), currently operated by BWDB and LGED, will be handed over to local Government and/or community groups as soon as sustainable mechanisms to effect the transfer are established. Ownership of schemes up to 1,000ha will be transferred to Local Government.

(x) Management of existing and new public irrigation projects and FCD over 5,000ha will be progressively restructured in line with Policy in a manner to be determined through trial and testing.

(xi) MoA, through its agencies such as DAE, BADC and BMDA, will continue to promote efficient and productive use of water amongst farmers through various appropriate measures.

(xii) Disaster preparedness and relief operations will continue to be a key element of sector management, and under the continued direction of DMB. Disaster forecasting responsibilities will remain with BWDB and the Meteorological Department. Local Government, in concert with NGOs, will support flood proofing and bari-level cyclone protection measures.

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

In addition, Government will continue to support the capacity development and training of staff in all its organisations through in-service training programmes. From its position of neutrality, WARPO will be the instigator of sector-wide integrated water resources management programmes covering multi-disciplinary and inter-sectoral skill development. Most actions are seen as short-term requirements to initiate as quickly as possible the development of the water sector institutions, whereas training and capacity building of Local Government Institutions are seen as continuing into the long-term. Significant progress on FCD and FCDI scheme

transfers cannot be expected in the short term until appropriate mechanisms have been tried and tested.

4.3 *Creation of an Enabling Environment*

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

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

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

■ *Fully deals with subject*

❑ *Umbrella reference to subject, for other instrument(s) to elaborate*

Main Focus of Activities: The measures summarised below are of fundamental importance to implement-ation of the NWMP.

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

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

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

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

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

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

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

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

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

(g) Promoting private sector participation - Active private sector participation (PSP) in the water sector, particularly water supply and sanitation, will be promoted through the introduction of a regulatory framework and appropriate incentives and pricing policies, and improved provision for credit and access to investment resources. Important current initiatives to stimulate domestic and foreign investment in industry and power generation will be extended to cover the water sector and promote more local investment in the rural and peri-urban water sectors, including community-based initiatives and a fund to support low-cost appropriate technology solutions.

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

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

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

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

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

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

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

4.4 *Main River Development*

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

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

- To investigate the options and the feasibility of a range of identified **inter-regional potential developments** that would make multipurpose use of the main river dry-season flows. An ongoing study of the Options for the Ganges Dependant Area is expected to establish the most appropriate method of utilising the Ganges waters secured under the Ganges Treaty which the Government intends to implement on an urgent basis. An inter-regional study of the potential of the Meghna river to serve the needs of the Northeast and Southeast regions by means of a barrage and/or by river pumping is required to establish the best choices for these regions.
- To investigate the potential for developing the waters of the Brahmaputra river.

- To review and update the **master plan for erosion control** in the Brahmaputra and studies for other major rivers to ensure cost-effective development of erosion control measures in the light of experience gained over the last decade and the investments now made in bridge works.

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

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

(b) River management for navigation and erosion control - Maintenance and/or expansion of navigation routes will be on the basis of well designed and managed dredging programmes. The development of barrages as determined above would alter the conditions of many of the river systems, which may serve to reduce the amount of dredged volumes in the future. In the short-term, the proposals for development of improved navigation around Dhaka, principally through dredging, may be taken further, but efforts should be made to integrate this activity with the overall development of Dhaka city flood protection and drainage. In view of the high investment and maintenance costs involved, and acknowledging the strong social need to manage river erosion, an urgent review of experience gained over the last decade is warranted. The affordability of engineering works will be a significant consideration, and must be compared against the merits and demerits of a soft approach involving resettlement and improved local services.

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

With the possible exception of mini-hydropower, all investments are expected to be funded by central Government. Mini-hydropower development is generally suitable for a measure of private sector participation in development and financing. Other than hydropower and possibly some elements of main river pumping, little or no

cost recovery can be expected. As a consequence, GoB will take into careful account the revenue funding of O&M that would be needed in determining appropriate solutions.

4.5 *Towns and Rural Areas*

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

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

Towns and Rural Areas
Indicative Targets for Water Supply, Sanitation & Stormwater Drainage

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

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

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

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

(a) Water supply - Considerable progress has been made in the provision of potable water supplies in towns and rural areas in the 1990s. However, arsenic contamination of groundwater has become a serious health hazard that must be addressed with the highest priority. Present estimates indicate that at least 30 million people are at risk and about half the total population face a potential risk. The areas most seriously affected are the South East, South West, South Central and North East Regions. Short-term interventions are being tested (arsenic filters and household removal facilities), and medium- to longer-term solutions are being studied to access long-term safe sources of water. In arsenic-affected areas alternative sources, such as surface water, are to be considered.

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

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

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

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

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

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

4.6 *Major Cities*

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

Major Cities
Indicative Targets for Water Supply, Sanitation and Stormwater Drainage

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

The overall objectives are similar to those in the towns and rural areas, namely provision of effective facilities to safeguard public health and the environment, attainment of significantly improved standards of operational efficiency and service provision with active community participation and consultation, promotion of private sector participation in water supply and sanitation, and provision of affordable and sustainable services to all city dwellers with particular emphasis on the poor and disadvantaged. Indicative targets for levels of service are given here for provision of water supply, sanitation, flood protection and stormwater drainage in the major cities.

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

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

Major efforts will be needed to develop bulk water supplies and efficient delivery systems. Groundwater is already over-exploited in Dhaka and surface water systems

will be needed from the Padma and possibly from the Brahmaputra rivers. Future configurations will depend on urban expansion plans, but development of the Dhaka–Tangail axis may be a likely outcome, favouring bulk supply system from near the Bangabandhu Bridge. The other cities will continue with a mix of groundwater and some surface water.

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

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

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

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

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

A sustained programme to implement changes in the institutional and financial framework is required, based on the principles of effective demand management and improved incentives through appropriate governance, ownership and organisational structures, and through appropriate financing systems. The improved incentives will encourage operational efficiency and improved service delivery; and, coupled with

realistic tariffs set at full cost recovery levels, develop sound commercial and financial viability of the urban water sector agencies, enable private sector participation, and attract funding for capital investment in the sector.

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

4.7 *Disaster Management*

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

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

Main Focus of Activities: Water-related natural disasters are a relatively common occurrence in Bangladesh. In this context, they are taken to include floods, droughts, cyclones and riverbank erosion.

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

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

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

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

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

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

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

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

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

4.8 *Agriculture and Water Management*

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

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

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

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

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

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

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

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

the boulder-strewn sub-soils. Support may be provided through provision of direct subsidies to private investors, or by development along the lines of the Barind Integrated Area Development Project (BIADP).

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

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

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

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

Rationalisation of schemes will be considered case by case and may include rehabilitation, remodelling or pro-active disengagement from certain sick schemes.

Emphasis throughout will be on participatory planning and management of the schemes with the long-term aim of achieving improved overall scheme performance, eliminated or properly mitigated adverse environmental impacts, and financial sustainability.

The principles above will apply equally to coastal embankments as to that inland. However, the expectation is that all coastal schemes will be retained in principle due to their particular importance. Nevertheless studies are needed to assess ways by which drainage congestion in the coastal areas can be alleviated, which will have bearing on the way in which individual schemes are rehabilitated. Some new coastal embankments are envisaged on newly accreted land (although premature empoldering should be avoided), and the process of afforestation of sea-facing embankments will be continued.

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

4.9 *Natural Environment and Aquatic Resources*

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

Forestry is also an important element of the natural environment, and is an effective means of preventing degradation of upland watersheds. The Government is committed to massive afforestation, including development of the Coastal Green Belt.

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

The fulfilment of these objectives will need dedicated application by all the institutions and individuals active in all sectors. They will involve significant changes

in the way environmental concerns are treated and, not least, substantial investment in water pollution clean-up.

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

(a) Water pollution and control - Urgent action is needed both to clean-up pollution hot spots and to prevent (re-)pollution of cleaned-up locations and ecologically sensitive areas, with the relative emphasis depending on local priorities. The latter will be determined on the basis of the benefits to people (eg potable, bathing/household water supplies) and to important ecological - mainly aquatic - sites, especially those providing the habitat for major fisheries as well as fish migration routes.

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

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

Main elements of Regulatory Measures for Environmental Protection and Improvement

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

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

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

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

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

The prime concern with capture fisheries is the provision of suitable habitats for maintaining biodiversity as well as fish production, for which good quality water is

essential. In addition, two key sets of water requirements are vital: provision of sufficient areas of water in the dry season water bodies and provision of appropriate river and floodplain flows, plus adequate and fish-friendly hydraulic connections between the floodplains and the main river system. A major water management issue is the great damage done to capture fisheries by past interventions (notably by FCD/I works).

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

Widespread increases in demand for protein are likely to precipitate a substantial increase in culture fisheries, principally at a small-scale level. Integrated development of local water resources for multi-purpose use, combined with necessary institutional support mechanisms, are seen as vital ingredients to satisfying these demands and developing local economies.

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

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

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

(ii) in response to the demands of the people, the development of genuine commitment to take action by all agencies of Government.

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

(f) Institutional reform and strengthening - institutional reform and strengthening are needed to address fundamental environmental weaknesses in the present institutional set-up, including: the lack of an holistic approach to environmental issues; the lack of mechanisms to incorporate genuine 'bottom-up' environmental initiatives into planning and implementation of developments, and the lack of environmental appreciation within institutions, leading to poor inter-agency co-ordination and co-operation. The component will include improved inter-agency communications particularly with regard to strategic planning and project preparation and implementation. Improved communications and sharing of expertise and information will be a major feature.

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

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

5 Current Water Sector Development Activities

5.1 *Introduction*

Adoption of the National Water Management Plan does not mean that current activities should cease. In most instances, in broad terms what is happening at present is generally consistent with Policy, although in many cases there is need to review current projects to ensure compliance with Policy.

Nevertheless, the Plan presented in Part B recognises that there has to be a transition between current commitments and future programme requirements. Particular attention is therefore given to phasing of the new programmes in relation to what is now happening and short term prerequisites of filling knowledge gaps and addressing the cross-cutting issues associated with institutional development and creating an enabling environment that will set medium term investments within an appropriate framework.

Given below is a brief overview of significant current activities, with brief commentary on their relevance to future plans.

5.2 *Institutions and the Enabling Environment*

Preparation and publication of the National Water Policy has signalled a major shift in Government thinking on water resources development and management. A substantial portion of the Policy is devoted to directives on how the sector is to be managed more efficiently and effectively. *Inter alia*, Policy points towards decentralised and devolved management with a greater role for Local Government, community groups and the private sector.

Various levels of Local Government are being established in accordance with State Policy and the recommendations of the Local Government Commission. So far four City Corporations have been established under the City Corporation Act of 1990, and consideration is being to adding two more. There are already 206 Paurashavas established under the Paurashava Ordinance 1977 (amended 1998). Of the four levels of Parishad, so far only those at Union level are fully functional. Although Acts have been passed for Zila Parishads (2000), Upazila (Thana) Parishad(1998) and Gram Parishads (1997), elections of officers at each of these three levels is yet to take place. Establishment of these bodies, which have substantial responsibilities for local water management, is crucial to the decentralisation effort.

Efforts to engage community groups have been stepped up in recent years, but with mixed results. Whilst a measure of success has been achieved in flood proofing programmes both GOs and NGOs, the sustainability of groups established under BWDB and LGED programmes remains in question. Guidelines for Participatory Water Management have been drafted to address this problem in the light of the Policy, and these are now ready for field-testing.

Past decisions to liberalise the minor irrigation and rural water supply and sanitation markets have paid remarkable dividends in terms of investment generated. These continue to expand, but technological, economic and environmental constraints are becoming evident, such that the rapid growth rates over the last decade may not be sustained much longer. Nevertheless, small businesses across the country, supported by the large trading house importers, can be expected to continue to respond to market demands. Progress towards medium to large-scale private investments in the water sector remains minimal, notwithstanding the recent efforts of the Private Sector Infrastructure Development Project. Serious structural impediments have to be removed for this end of the private sector to become active.

A major institutional step forward since publication of the National Water Policy has been the revision of BWDB's mandate, as embodied in its new Act (Bangladesh Water Development Board Act, passed by Parliament in August 2000).

Table 5.1: Institutional Challenges for BWDB

Status	Responsibilities and Functions	Action needed
Currently mandated and to be preserved as core activities	*Structural functions* • River training and river bank protection • Control of surface water flows and underground aquifers • Construction and maintenance of coastal embankments • Rainwater harvesting • Soil preservation, land accretion, land reclamation and estuary control • Forestry and fishery development and embankment roads in BWDB projects *Non-structural functions* • Development of water user associations • Flood forecasting and warning • Hydrological survey and investigation • Basic and applied research	General staff development and training programmes Preparation of integrated and comprehensive river development plans Investment and upgrading of facilities and skills
Functions to be handled in a different way in the future	• Urban flood protection works (working with Paurashava) • Dredging and desiltation (increased private sector participation) • Public irrigation programmes (run as autonomous organisations)	Review and preparation of management plans to handle transitions
Currently mandated and to be divested in due course	• Ownership of FCD(I) <1000ha (to Local Government) • Management of FCD <5000ha (to LG and/or communities) • Management of FCD >5000ha (to private management or joint management) • Management of FCDI (to autonomous bodies) • Drought forecasting (to Meteorological Department)	Management plan for transfer; including motivation and required capacity building; development of appropriate institutional models; rehabilitation and remodelling of schemes as required; start the transfer process
New functions beyond current mandate	• Monitoring (with DoE) and management of water quality • Abstraction licensing (as required) • Enforcement of surface and groundwater regulations	Review and establishment of procedures, facilities, staff recruitment or re-training

The 2000 Act restructures the Board to the extent that it is now has a Board of Directors, to whom the Director General now reports, entrusted with setting BWDB's operational policies and ensuring these are implemented satisfactorily. There are nevertheless important issues for the Board to address, notably how it will establish its management structure to respond the new challenges set by its new mandate. These are illustrated in Table 5.1.

Similar efforts are on-going to put WARPO on a sound and sustainable footing, as well as to strengthen operations of flood forecasting, disaster management and Department of Environment. WARPO has made a start on updating Government Guidelines for the water sector, and in cooperation with DoE, has prepared a new set for Environmental Assessment of new and rehabilitated FCD and FCD(I) schemes. Work has also started on a new Water Act under a task force established by the Ministry of Water Resources.

5.3 *Current Sub-Sectoral Activities*

5.3.1 The GoB Annual Development Programme

The Annual Development Programme (ADP), published by the Planning Commission, presents GoB's capital spending programme (the Development Budget) for each year. It thus provides a good indication of the level of development activity in the different water-related sub-sectors.

Table 5.2 shows the ADP budget provisions for the four main water-related sectors (Water Resources, Water Supply and Sanitation, Fisheries and Inland Water Transport) for the 2000-01 fiscal year and for the six preceding years.

Table 5.2: 1994-95 to 2000-01 ADP Investment Projects Budget by Main NWMP Sector

(Tk million at 1998-99 prices) [1]

Main NWMP Sectors	1994-95	1995-96	1996-97	1997-98	1998-99	1999-2000	2000-01
Fisheries	1,212	1,121	760	290	475	855	779
Water Resources (FCD, irrigation etc)	10,811	10,480	11,107	10,410	7,358	7,099	9,916
Water Supply & Sanitation	3,989	2,915	2,797	5,230	3,859	3,771	4,348
Inland Water Transport	139	234	158	86	130	313	60
Total	16,152	14,750	14,822	16,017	11,821	12,038	15,103
Total original ADP budget (1998-99 prices) (Tk billion)	133.1	137.9	141.3	138.2	136.0	149.0	164.6
Total as % of total ADP	*12.1%*	*10.7%*	*10.5%*	*11.6%*	*8.7%*	*8.1%*	*9.4%*

Source: NWMPP analyses of data from the original (rather than revised) ADPs published by GoB.

Notes: [1] These figures are for water-related projects costing over Tk100 million and exclude cyclone shelter and environment projects. The budget figures are from the original rather than revised ADPs.

Allowing also for the Tk500M small projects costing below Tk100M, which are not included in Table 5.2 the total 2000-01 ADP investment allocation to the four main NWMP sectors is around Tk15.6 billion. This is similar in real terms (at constant prices) to the levels of the 1994-95 to 1997-98 period and well above the low levels of the last two years. Nevertheless, their share of the total ADP budget has fallen in the past three years, and is currently around 9.4% of the total.

Apart from the virtual withdrawal of GoB from minor irrigation and the expansion of private irrigation, the fall in water-related project funding has not been balanced by any major expansion in private sector investment. Thus total water–related investment outside the minor irrigation sector has stagnated during the six-year period, despite the urgent need for increased investment in infrastructure and services such as water supply and sanitation. This stagnation has occurred against a background of substantial economic growth (around 5% per annum) and rapid urbanisation. A major improvement and expansion in water-related infrastructure and services is needed in order to sustain this growth in the economy.

Of the four main NWMP sectors, current GoB Development Budget spending is concentrated on Water Resources (largely FCD and irrigation), which is taking almost two thirds of the total, and Water Supply and Sanitation, which is taking most of the rest. Inland water transport (IWT) is receiving little investment, an important factor being the postponement/cancellation of the proposed IWT IV Project. The Development Budget for fisheries is also comparatively small. However, this reflects the sector's limited scope for heavy expenditure on works and equipment, rather than necessarily a lack of development activity, as there are numerous on-going fisheries projects. A particular feature of the pattern of budgeted expenditure over the period shown in Table 5.2 is the lack of growth in the water supply and sanitation budget, in spite of the growth in demand.

5.3.2 Current and Pipeline Activities in the Water Resources Sector

The principal features of current development in the Water Resources Sector are the continued expansion in STW irrigation (up from 2.18Mha in 1997-98 to 2.64Mha in 1999-2000, an increase of 21%), the strong emphasis on institutional reform, and the reduction in inland FCD develop-ment activity which has occurred in recent years. Donor insistence on institutional reform is delaying the start-up of certain projects.

STW irrigation expansion is independent of direct GoB

Examples of major "pipeline" projects under consideration for donor support

- **Water Management Improvement Project** (World Bank as the lead donor agency), a national-level FCD project bringing together the previously proposed Water Sector Improvement Project and Coastal Zone Water Management Programme.
- **Gorai River Restoration Projects** (World Bank), with permanent river works to sustain surface water flows to SW Region.
- **Small-scale Water Resources Development Sector Project II** (ADB), involving mainly small-scale FCD, is scheduled to start soon, with the planning of a third phase envisaged for 2003.
- **Dhaka Eastern Flood Embankment**, to improve flood protection for the city of Dhaka.
- **Kalni – Kushiyara River Management Project** (ADB), in NE Region, currently held up by donor concerns regarding institutional arrangements and cost recovery.
- Two large main river erosion control projects, the **River Bank Protection Project II** (World Bank), on the Brahmaputra, and the **River Bank Protection – Chandpur and Pabna Project** (ADB).
- Two projects involving BWDB irrigation scheme rehabilitation and improvement, namely a possible second phase of the on-**going Command Area Development Project** (CADP) and the proposed replacement of the **Ganges–Kobadak Irrigation Project** pumpsets.

involvement. However, the successful GoB rural electrifi-cation programme, which has been running since the 1970s, facilitates the spread of electric STWs. GoB's on-going development activities in the sector are concentrated on coastal and inland FCD, with some limited activity in river management and public irrigation scheme rehabilitation and improvement. As explained in Chapter 13, in the NWMP formulation and costing work on-going projects have been treated as committed projects, with their costs being included in the Plan, using the ADP figures as the basis. For NWMP planning purposes the main concern is with potential new programmes and projects, which, unlike the on-going projects, may or may not go ahead (see Box). There are also a number of other potential major donor-supported projects in rural and urban FCD, water resource and flood management, and coastal zone management.

5.3.3 Current and Pipeline Activities in the Water Supply and Sanitation Sector

Numerous water supply and sanitation (WSS) projects are being implemented by the Dhaka and Chittagong WASAs and by DPHE (Department of Public Health Engineering) in both rural and urban areas. As noted in Section 5.3.1 however, the level of investment is insufficient to meet the growing urban demand and raise standards of service. Strong efforts are being made to promote private sector investment in WSS, through the Private Sector Infrastructure Development Project (World Bank) and the DANIDA-funded Institutional Development Component within the Local Government Division of MLGRDC.

Urgent attention is being given to the arsenic problem, although so far the emphasis has been on research and testing rather than the widespread implementation of actual mitigation measures. BAMWSP (the World Bank – supported Bangladesh Arsenic Mitigation Water Supply Project) and the DANIDA-funded Arsenic Mitigation Project in 11 coastal Districts are the two main such projects. There are, however, proposed ADB and Japanese-funded projects in the pipeline.

Institutional constraints, and the effect these have on O&M, cost recovery and sustainability, are holding back donor funding of urban WSS. Several WSS and other urban development are currently on hold, pending the payment of arrears of municipal taxes and service charges by GoB agencies to the Paurashavas. As a result, there are few prospective donor-funded WSS projects in the pipeline (many on-going projects are, however, being funded wholly by GoB). Unless this situation is resolved or there is a large increase in GoB funding, WSS development activity will continue to be well below requirements.

5.3.4 Current Activities in the Fisheries, Inland Water Transport and Disaster Management Sectors

There is considerable GoB development activity in the inland fisheries sector, with large projects such as the Fourth Fisheries Project in progress. Since the emphasis is mainly on aquaculture rather than capture fisheries, the implications of this activity for future water management are limited, except in the case of *bagda* (Tiger Shrimp) brackish water culture in the coastal zone. Emphasis is now being given by GoB to improving existing bagda culture, including its water management, and reducing its adverse and social impacts.

For the NWMP the main IWT concern is with navigability. With the high sedimentation rates typical of Bangladesh, regular dredging is essential to maintain navigability. Due to inadequate maintenance dredging in the past and changing river conditions, a considerable amount of capital dredging is now required. As noted in Section 5.3.1 however, little capital dredging is being undertaken at present. Moreover, the postponement/cancellation of the proposed IWT IV Project, which had a large dredging component, means that there is now no major capital dredging programme in the pipeline. The integrity of much of the nation's commercial IWT network is therefore at risk.

Preparation of the Comprehensive Disaster Management Programme, funded by UNDP, is now successfully nearing completion. It is, however, concerned primarily with institutional aspects rather physical infrastructure like cyclone shelters. Although the Cyclone Shelter Preparation Study, completed in 1998, provides a sound basis for the provision of adequate safe haven capacity throughout the coastal zone, with the building of between 1,500 and 2,000 new multi-purpose cyclone shelters being proposed, the CSPS plans have not been implemented. Equally, very little in terms of operational procedures and other software was delivered during earlier phases of shelter construction. Present shelter and *killa* (raised earth mounds) building activity is far below the level required if the coastal population is to be adequately protected against cyclone surges. There are no large cyclone shelter programmes/projects in the pipeline at present.

The situation with inland structural flood proofing (raising houses and homesteads above flood level) is more satisfactory. Under the on-going Flood Proofing Project, some 1,025 villages are being flood-proofed in the Brahmaputra charlands and the Haor Basin, the principal areas of need.

Part B: The National Water Management Plan

6 An Overview of the Plan

6.1 *The Development Objective of the NWMP*

Bangladesh is a country with six, clearly defined National Goals:

- Economic Development
- Poverty Alleviation
- Food Security
- Public Health and Safety
- Decent standard of living for the people
- Protection of the Natural Environment

It is also a country the natural environment of which is dominated by water. In an average monsoon season (June to October) for instance, twenty percent of the country is covered by standing floods. Three of the world's largest rivers: the Ganges, the Brahmaputra and the Meghna flow through the country on the final stages of their journey to the sea. In fact their common delta comprises much of the country as a whole, and is accordingly prone to the usual deltaic problems of geomorphologic change, seasonal erosion and accretion. Lateral flow from these, and other rivers, is the primary cause of Bangladesh's widespread floods; even so, flash flooding also occurs as a result of intense rainfall driven by Nor'westers which usually strike in the North East during the weeks prior to the monsoon. Although often the cause of damage to life, livelihood and infrastructure, such floods also ensure hydraulic connectivity between standing water bodies and as such are essential for the sustainability of the capture fisheries which represent the principle protein source for most of the country's poor. The same floods also deposit fertile sediments, which contribute to Bangladesh's impressive food security achievements. Not so "benign" however, is the third kind of flood, which regularly effect the country. These are caused by tidal surges and cyclones, which characterise the Bay of Bengal into which the country drains. Historically, floods of this type have wrought major catastrophes on the coastal population and continue to do so.

Another notable feature of the national hydrology is its substantial rainfall, 70% to 85% of which falls between June and September inclusive. It is distributed unevenly however, with some 1200mm typically falling in the West, increasing to almost 6000mm in the East. Potential annual evapotranspiration of around 1300mm is fairly uniform across the country.

Yet despite all this water, several parts of the country, especially the NW and SW, experience regular localised shortages or even droughts. A significant amount of groundwater below some parts of the country has been extensively developed for agricultural and potable use. However, the latter is constrained by arsenic contamination, thought to have originated in the Himalayas and carried from there in river sediments. Other quality problems are significant, increasing, man-made and arise largely as a result of uncontrolled industrial or faecal discharge into the surface streams.

But poor water quality affects not only the country's human population; but also its entire aquatic environment. This is an important consideration because not only is Bangladesh home to several important and rare species that depend on reliable clean water or wetlands such as the Gangetic dolphin and crocodile or the Royal Bengal

Tiger; but also as a transit point for migratory birds. In fact two locations are considered so important in this respect that they are protected under the terms of the Ramsar Treaty. One is the Haor basin of the North East an important stopping point on the Asia flyway; the other is the Sundarbans, the largest remaining refuge of the Royal Bengal Tiger. The Sundarbans are also considered an area of outstanding natural interest to the extent that it has been awarded World Heritage Status.

As things currently stand however, the security of the natural aquatic resources is being slowly but inexorably compromised by human development both within the country and across its borders with India. Riparian flows in the Ganges are particularly affected, and not yet convincingly protected by the Ganges River Treaty established in December 1996.

Add to all these trends and features, the expected knock-on effects of global warming (such as sea level rises, impeded surface drainage and increased evapotranspiration/precipitation ratios) and the profound nexus between its National Goals and Bangladesh's hydrological regime will be obvious. This is clearly reflected in the National Water Policy (NWPo) of 1999 which, in Section 2 states that its provisions are "…designed to ensure continued progress towards full-filling the National Goals…".

Equally:

- the Government's Development Strategy for the National Water Management Plan (DSNWMP, June 2001) states that the Plan itself is "…intended to provide the necessary advice on follow-up actions to be taken for implementing the NWPo…";
- the Draft World Bank Water Sector Assistance Strategy (November 2000) describes the NWMP as a "…holistic, multi-sectoral approach to the development and management of Bangladesh's water resources and hence the implementation of the New Water Policy…":

and,

- the NWMPP Terms of Reference describe it as a "a comprehensive long-term water management plan which responds to national goals and objectives, and scheduled according to appropriate time periods" (Para 3.8, Phase 3 clause iv) while "..covering year round water management beyond the issue of flooding, balancing the conflicting demand of users (Para 2.10).

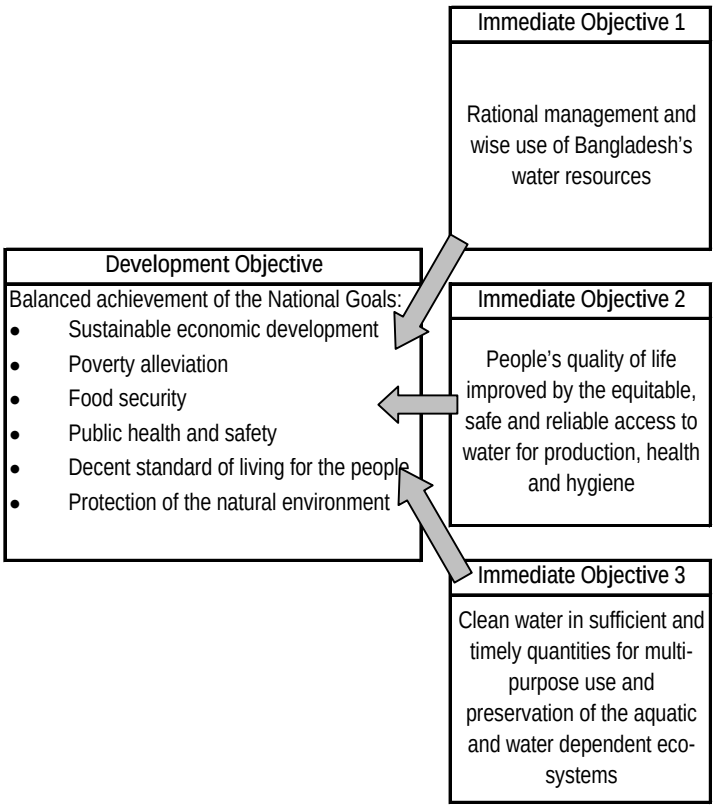
The Overall Objective of the NWMP is therefore clearly the same as that of the NWPo itself, ie achievement of the National Goals; but of course it will take rather more than mono-sectoral interventions and initiatives, however soundly implemented, to achieve goals which are essentially pan-sectoral in nature. Therefore, in conventional monitoring terminology an Overall Objective of this type would be described as a Development Objective whereas objectives that should be achievable solely by means of a focussed and bound initiative such as the Plan are known as Immediate Objectives.

The NWMP has three Immediate Objectives. They are inspired by a clause which appears in both the DSNWMP (part 1 para 4) and NWMPP ToR (article 3.4) which

says that the Plan is intended to contribute to "…national economic growth through rational management of water resources, in a way that protects the natural environment and improves the quality of life for the people of Bangladesh..".

Accordingly the overall Development and Immediate Objectives of the Plan are as shown in Figure 6.1.

Figure 6.1: NWMP Overall Objectives



These Objectives form the apex of a nested system of Objectives and Indicators that links each component and level of the Plan, while providing the basis for implementation monitoring as described later in sections 9 (The Management Information System) and 15 (Monitoring, Evaluating and Plan Upgrading).

6.2 *Political, Strategic and Planning Framework*

A fundamental requirement of a Plan of this nature is that it reconciles the country's structural needs as they relate to policy and development with those of the human and physical environment. In the terminology of the Terms of Reference the Plan is required to "..link analysis of the physical system with those of development and management options so as to meet the needs of sustainable development and protection of the natural environment.." (Para 3.8, Phase 3, Clause iii).

Accordingly, the development strategy or analytical phase of the planning process began with an assessment of the needs arising within the human and physical environments and arising from the National Goals and Policy Directives. Formative,

generic investment approaches for meeting these needs and issues were then identified. It was found that they could be grouped logically and conveniently into:

- Two clusters which address the structural constraints on the sustainable development and management of the water sector. As such these are cross cutting issues, and concern:
  - Institutional Development
  - Facilitation of an Enabling Environment.
- Six clusters of capital needs and opportunities covering:
  - Major Rivers
  - Towns and Rural Areas
  - Major Cities
  - Disaster Management
  - Agriculture and Water Management
  - Environment and Aquatic Resource

As will be seen in the following sub-section, each of these clusters comprises a range of programme options recommended for implementation under the NWMP. These options were themselves selected from larger, initial shortlists by means of a multi-criteria analyses which assessed their potential both in respect of the National Goals (section 6.1 referred) and Regional priorities. Any elements which did not survive the process were discarded. Three different implementation rates for each remaining option were then considered in order to reflect various strategic prioritisation of the National Goals, defined as follows:

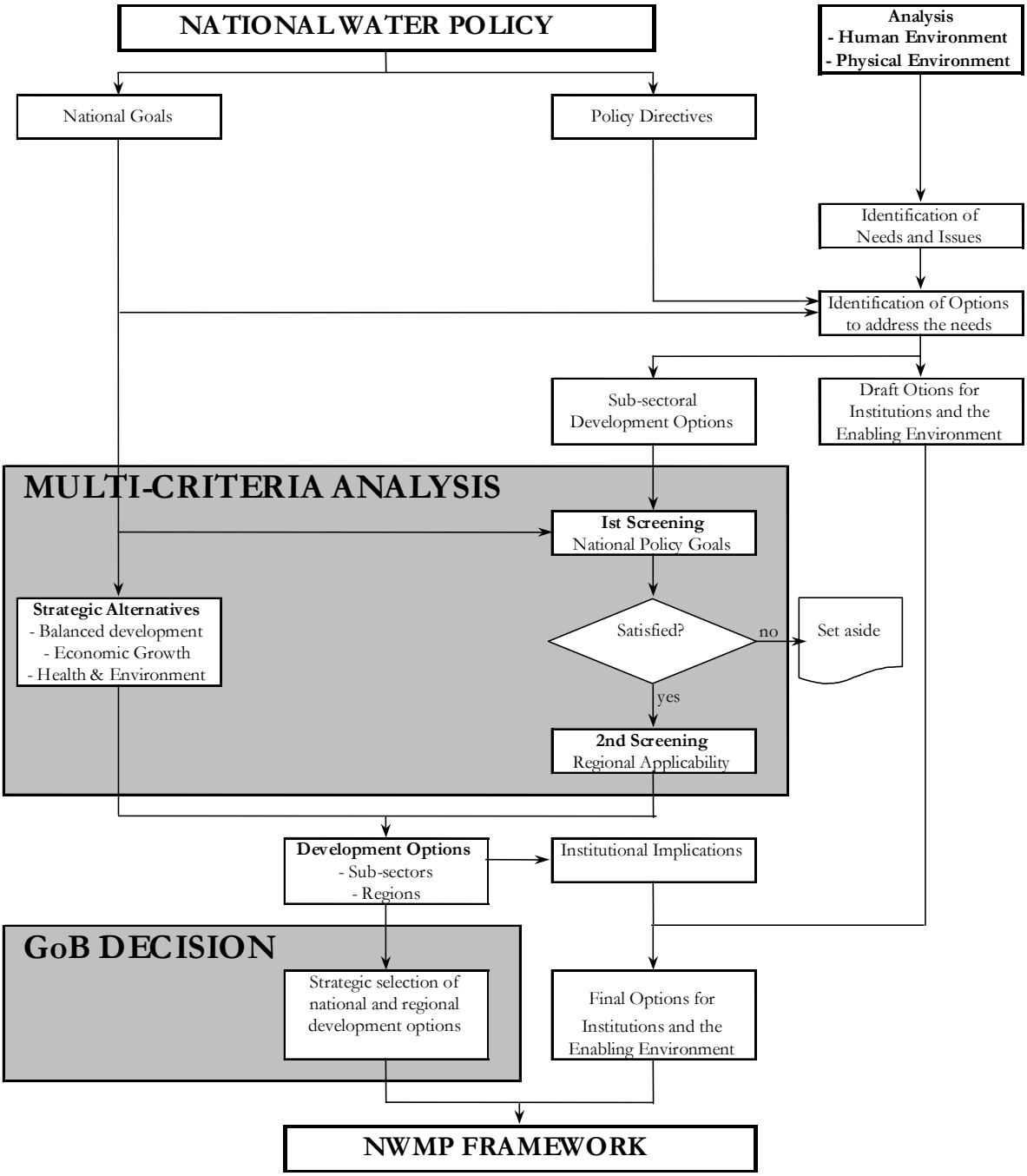
- **Balanced Development Strategy** - where, in selecting Institutional Measures and Development Measures, equal importance is given to all six National Goals.
- **Economic Growth Strategy** - where priority is given to the National Goals of:
  - Economic Development
  - Poverty Alleviation
  - Food Security
  - Standard of Living

and

- **Health and Environment Strategy** - where priority is given to the National Goals of:
  - Public Health and Safety
  - Protection of the natural environment

This analysis resulted in a range of development options or programmes relevant to a particular sub-sector and region which are appropriate, either in nature or timing, for each strategy. En-passant, the analysis also suggested or defined additional cross cutting needs or opportunities. These were added to those identified earlier during the needs assessment exercises. Finally, the Government was invited to consider which of the three strategies would be addressed by the Plan proper: the Balanced Strategy was selected.

Figure 6.2: The Political, Strategic and Planning Framework



6.3 *Structure of the NWMP*

The NWMPP Terms of Reference specify a Plan that is:

- An analytical **framework** "*to allow the systematic evaluation and assessment of water resources management options within the broader multi-sectoral resources allocation context"*. Such a framework should be "*compatible with National Goals and objectives and with sound environmental management principles"* while linking the physical system with rational and sustainable development and management options

  Relevant TOR Paragraphs: 3.8 Phase 3 clause iii

  3.3 (c)

- A timelined, rolling **investment portfolio** of water sector "*projects and programmes, capable of continuous evolution"* relevant not only at the national level; but also consistent – "*so long as compliant with national policy and direction"* - with regional development objectives and recognizable at that level.

  Relevant TOR Paragraphs: 3.3 (c)

  2.11

and

- A coherent and consistent **management information system** to facilitate:
  - *the planning and management of the country's water and associated land resources; improved access to reliable information*;
  - *the sustained monitoring and evaluation of project/program performance and changes in the national resources;*

  and,
  - *the feed back of performance results into the planning and decision making system.*

  Relevant TOR Paragraphs: 3.8 Phase 3 clause ii

  3.8 Phase 3 clause xi

This clearly suggests a Plan which is recognisable in three forms; each of which are described in turn in three sub-sections which follow.

6.3.1 The NWMP Framework

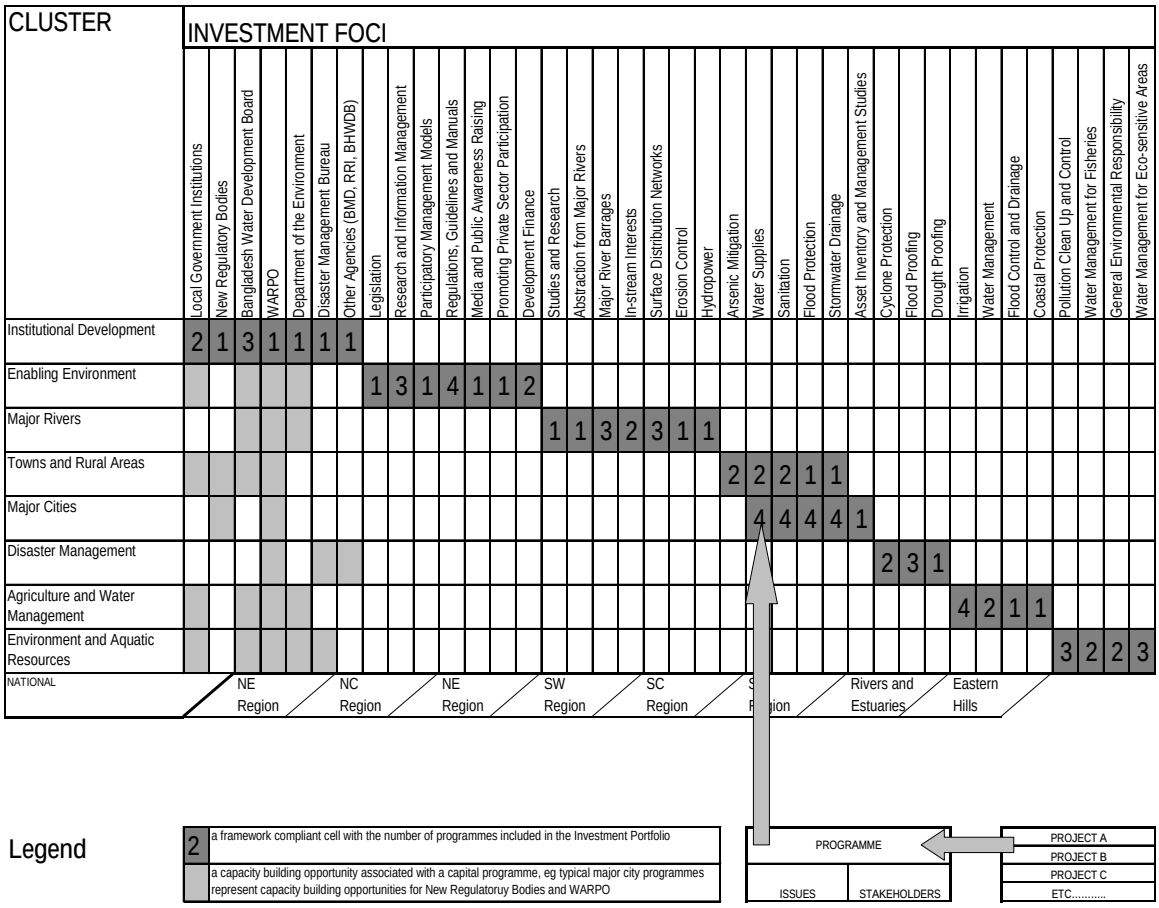
It will be increasingly obvious to the reader that this Plan is not a shopping list of investment projects. This would be both prescriptive and against the spirit of consultation and participation which is stressed so clearly by the NWPo. Equally, for as long as Bangladesh has need of international financial support in order to develop and manage its water sector, it will be beneficial to involve the donor community in the consultative, participatory process instead of simply making a wish-list available in the old fashioned way, hence clause 3.3 c) of the Terms of Reference which define the Plan as a "..long term planning framework…capable of continuous evolution rather than…..a rigid blueprint.".

Even so, it is necessary to establish the boundaries within which such deliberations can take place, decisions made and pledges given if the associated political, strategic, socio-economic and environmental imperatives are not to be compromised. The Terms of Reference indeed reflect this need when they refer for instance to the need to "…link analyses of the physical system with those of development and management options so as to meet the needs of sustainable development and protection of the natural environment.." (Para 3.8, Phase 3, clause iii).

The nature of these boundaries can be deduced directly and logically from certain analyses carried out during the Development Strategy phase of the NWMPP and described in section 6.2 above. It remains to present them in the form of the analytical framework as required by the Terms of Reference. And to do this, it is helpful to think in terms of a three dimensional array.

Its vertical axis can be conveniently allocated to the clusters with one of the two horizontal axes allocated to the investment foci and the other to the regions: Figure 6.3 refers.

Figure 6.3: The NWMP Framework



It will be seen that 36 investment foci are proposed, they derive directly from the multi-criteria analyses. Therefore, since there are 8 clusters and 8 regions, the entire array contains 2592 cells (36x8x**9** since an extra sheet in the cluster/focus plane is needed to gather everything up at the national level). Each of these cells represents a confluence of cluster, focus and region and as such could contain potential cross cutting or investment programmes. However, as per the Terms of Reference, the NWMP is only concerned with two specific types of cells. First, those which actually *link the physical system with rational and sustainable development and management options* in a way that is *compatible with the national goals* and second, those which represent additional vehicles for facilitated institutional reform and capacity building. The darker highlight identifies the first type of cell while the lighter highlight identifies

the second. It will also be seen that the front sheet shown in the figure obviously presents the national picture. The regional sheets will generally only have subsets of the highlighted cells. But the highlighted cells taken together, regionally or nationally, comprise the NWMP's ***"Analytical Framework to allow the systematic evaluation and assessment of water resources management options within the broader multi-sectoral resources allocation context".***

It will be obvious that any activity which cannot be accommodated within the featured cells will be incompatible with NWMP guidelines. And the corollary, which is that any activity that can be accommodated within the Framework Cells is compatible with the NWMP, is equally true – subject however, to a caveat that will be introduced shortly. First however, it is necessary to realize that a Framework Cell has no intrinsic significance it is merely a conceptual devise to guide programme selection, planning and decision making. Nonetheless, it is possible to consider them as containing programmes or bundles of programmes, each with their own issues, stakeholders AND component projects.

And here lies the caveat.

By definition, the Framework Cells are NWMP compliant and hence contained within the political, strategic, socio-economic and environment boundaries referred to earlier. Even so it remains possible to fill the cells with programmes made up of projects that themselves are not necessarily compliant. The solution to this lies with the Management Information System which will be introduced in due course. But before doing so it is necessary to consider the second formulation of the Plan, the Investment Portfolio.

6.3.2 The Investment Portfolio

Boundaries of course, are not enough by themselves. Conceptual and budgetary guidelines are also essential if the Plan is to result in investments that:

- reflect demand driven, stakeholder objectives (noting that stakeholders include Government, its responsible agencies, the donor community and development banks; local government institutions and NGO's as well as the beneficiaries);
- are consistent with official disbursement policies, conventional wisdom and to the greatest possible extent, international best practice;

and

- limit investment planning to options that are consistent with National Goals and regulations (both technical and economic), as well as with the broader social and environmental imperatives.

Furthermore, if a sectoral management plan such as this, is intended to be consistent with official disbursement policies, or even influence their evolution, it is necessary that such guidelines contain:

- meaningful budgetary indications
- the expected phasing of disbursements
- defendable demand assumptions
- expected streaming of benefits where relevant

and

- likely funding scenarios

The NWMP Investment Portfolio provides such guidelines. It is presented as Volume 3 and comprises a suite of 84 programmes, distributed to the clusters and foci as shown on Figure 6.2. Each programme has Development Objectives consistent with - and formative to - the Overall and Immediate Objectives of the NWMP. They also have their own immediate objectives to be used for monitoring purposes (section 15 refers). It is stressed however, that consistent with the Plan's participatory framework, the programmes are conceptual. As such they represent a comprehensive and integrated range of investment priorities and opportunities concluded by the development strategy studies and subsequent refinements as being necessary to mobilise and expedite the water sector's contribution to the National Goals. And since each programme is necessarily compliant with the Framework, by definition they do indeed, "link analyses of the physical system with those of development and management options so as to meet the needs of sustainable development and protection of the natural environment..".

Perusal of Volume 3 will show that each programme is presented according to a standard, stand-alone format.

Summary sheets provide basic data such as:

- relationship to the NWMP framework
- MIS reference numbers
- cost estimates
- timing
- basic financial monitoring data
- brief descriptions
- hyperlinks to the MIS files
- potential funding modalities
- cumulative disbursements
- key monitoring indicators

The summary sheets are supported by description sheets covering:

- relevance to the NWPo
- purpose of programme
- financing arrangements
- institutional arrangements
- linkages
- geographical location
- programme outline
- objectives and indicators
- existing documentation
- risks and assumptions

6.3.3 The Management Information System

The need for the well managed, reliable information is stressed in the Terms of Reference, which suggests a Management Information System that will meet at least five demands[2]:

- Enhanced water management planning capabilities (including the application of compliance criteria during project appraisal
- Enhanced water and associated land resource management capabilities

[2] It is suggested however, that this list is incomplete without "research".

and regular NWMP updating

- Effective management of information

and

- Effective monitoring and evaluation of development activities within the water sector
- Effective monitoring of changes to the natural resource endowment

Accordingly, a Management Information System has been prepared. When fully operational it will have three components as follows:

- trained human resources;
- a graphic user interface (GUI) comprising user friendly menus leading into a series of access portals supported by search engines serving the above needs;

and,

- the data itself, stored in several linked databases including the NWRD, and a geographical information system.

It will be noted that unlike the Plan itself which is agglomerated at the conceptual programme level, the MIS has been designed and set up to work at Project level and above.

The MIS is located on the WARPO Local Area Network and described briefly in Section 9 below. More detailed descriptions are available in "The WARPO Management Information System" and its two Annexes "Projects Database User Manual" and "Programmes Database User Manual" (June 2001).

6.4 *Institutional Development and the Enabling Environment*

The parlous state of the global water sector is increasingly attracting the concerned attention of the world's experts. Demand for clean freshwater continues to expand while its availability and manageability continue to fall as natural riverine rhythms are disrupted by the effects of human development. Equally, the same process results in a steady deterioration in water quality and increased turbidity; both of which have tangible and negative knock-on effects in the context of Bangladesh's National Goals. Despite seasonal shortages in certain of its regions, Bangladesh experiences severe flooding each year. Its location at the tail end of major international and trans-boundary river systems means that not only does it have the problems of local provenance as discussed in Part A of this document, but also that it suffers from upstream watershed mismanagement (manifested inter-alia in terms of changed annual hydrographs, reduced overall discharges and increased turbidity) and unregulated abstractions.

An overwhelming consensus has emerged among the global community of experts, that the success of technical approaches required to solve such problems as floods, droughts, water quality, pollution, urban services, poverty and the like, are often limited in the absence of supporting initiatives targeted at institutional reform, cost recovery and the enabling environment. In fact it is fair to say that in general, technical approaches are more concerned with the symptoms than the cause, the

perceived needs rather than the macro-forces that produce them. Parallel institutional strategies are therefore necessary to address these macro-forces. Furthermore, the most promising approaches seem always to comprise a combination of:

Subsidiarity, in terms of and

- decentralisation
- devolution
- participation

Accountability, in terms of

- demand driven concepts
- buyer-seller relationships for both commodity and service delivery
- downwards accountability as opposed to upwards accountability within decentralised institutional hierarchies
- regulation (which is usually separated from supply)

In reality, actual combinations are defined by a particular country's own political philosophy as are implementation modalities which are quite varied and increasingly so. But despite its various manifestations, the trend is steady and consolidating, and increasingly represents a powerful and encouraging nexus between political goodwill and donor largesse.

The need for the latter is clearly acknowledged by the NWPo which is highly institutional in nature. Furthermore, at issue and adequately acknowledged as such by the NWPo, are the twin siblings of institutional definition and institutional capacity development. Ideally, institutional constructs that are defined by the demands on them will result in the enabling environment without which decentralisation (and the cost recovery/cost sharing opportunities that it represents) will never happen. In other words, institutional definition concerns the role that institutions play while development concerns their ability to play those roles

At stake therefore are two issues. First is the need to formulate and implement an institutional landscape that is:

- demand driven
- characterised by the comparative advantages of subsidiarity

and

- strengthened by a transparent, easily understood legal framework and regulatory system: an enabling environment as it were.

Secondly it is necessary to strengthen the capacity of the restructured institutions in order that they may better play the new roles required of them.

Hence the inclusion in the NWMP of cluster targeted at Institutional Development and the Enabling Environment. They are described in Section 7.

6.5 *Capital Programmes*

Despite the cross cutting importance of the two institutional clusters, which are targeted at the macro-forces, there remain massive water management challenges of

a technical nature each of which will be solved only by means of capital investment programmes: investments which, it is intended, are justified by the sustainability benefits reasonably expected to accrue to the institutional programmes. Between them the investment programmes will address the whole gamut of priorities and opportunities likely to characterise Bangladesh's water sector for the next 25 years, the NWMP planning horizon. It should be understood however, that certain of the investments made during the lifetime of the Plan will have lifetimes extending way beyond the 25 year planning horizon, and of those, some will have to respond to demand scenarios which extend "..well into the next century.." (NWMPP ToR 3.3 (a))

The capital programmes are agglomerated in the six clusters:

- Major Rivers
- Major Cities
- Agriculture and Water Management
- Towns and Rural Areas
- Disaster Management
- Environment and Aquatic Resources

and are described in section 8.

6.6 *Regional Plans*

It will be obvious from Part A that most of the priorities and opportunities for improved water management in Bangladesh are unevenly distributed among the country's eight regions. Volume 4 is provided accordingly.

It comprises a series of 8 regionally specific water management plans, each of which is essentially a subset of the overall Plan. They identify particular regional issues while addressing such issues as regional targets; water demand; programmes specific to or shared by the region in question and implementation schedules. It also contains a section dealing with programmes having National significance.

6.7 *Phasing*

Implementation of the Plan, which has three phases, began conceptually in financial year 2000-2001 (when it simply scooped up programmes in place or mobilised during that year) and is due to finish at the end of financial year 2024-2025.

The three phases of the Plan are defined as follows:

- **Years 1 to 5** **Firm Phase**
- **Years 6 to 10** **Indicative Phase**
- **Years 11 to 25** **Perspective**

Even so the Plan has both impacts and implications which will last well beyond 2025. Longer term impacts will be felt in the case of infrastructure with lifetimes that go beyond that date. This will include structures, buildings, all underground pipework, wellfields and open drainage systems. Furthermore, although it is generally unreasonable to design infrastructure against design scenarios extending more than 25 years, provision in the form of land acquisition for instance, will nonetheless have to be made for future expansion.

Equally, the operation and maintenance implication will never cease, although it is intended that the institutional restructuring and cost recovery mechanisms delivered by the Plan will result in arrangements that are consistent with the needs of sustainable long term operation and maintenance.

Monitoring of the Plan will be a continuous process for which WARPO will be responsible; but there will also be annual reviews and five yearly reformulations running synchronously with the Five Year Planning process and beginning in 2007.

6.8 *Cost*

Overall cost estimates for each of the cluster are presented in Figure 6.4 along with an indication of the percentage of overall costs taken up by each cluster. Residual Costs are the remaining costs of each programme commenced but not completed within the 25-year period.

6.9 *Overall Assumptions*

As will be seen in much of the text that follows, implementation of the NWPo will depend on great changes on both the supply and demand side of the water resources sector. Of fundamental importance will be the coordinating role that the NWPo anticipates for WARPO. It will be essential that WARPO be rapidly recognised as the NWMP's official champion and vision holder by all water sector stakeholders. It is therefore assumed first, that WARPO's position as such will be made clear by Government in terms of:

- **rapid** progress towards the preparation and implementation of the capacity building programme (NWMP Programme ID 006, which will be introduced in section 7);
- introduction of sustainable long term funding arrangements;

and

- new institutional arrangements that disassociate WARPO from any one water sector agency in the eyes of all the others – this may require a shift to a neutral agency such as the Prime Minister's Office or the Planning Commission; or a simpler change to the constitution of the NWRC that allows its Chair to rotate around each of its member agencies, at least as an interim measure.

Elsewhere within the institutional landscape traditional roles will have to change; familiar job descriptions and prescriptive institutional mandates will be replaced by more responsive alternatives, and responsibilities will be decentralised. On the demand side, users will have to pay water fees where there were none before, they will have to take more responsibility for the conservation and wise use of water, as well the infrastructure which delivers or removes it. And they will be both protected and constrained by new regulatory mechanisms.

Finally, new players largely from the private sector, will eventually enter the field as both suppliers and users, a process which will both result in and depend on the successful introduction of the alternative funding sources called for in the NWPo, and described in Section 13.

Changes of this kind usually come with a political cost. The overriding assumption is therefore that the same vision, vigour and political will displayed by Government when preparing the NWPo can be sustained throughout the lifetime of the NWPo; albeit leaving room for flexibility that responsive sustainable development demands.

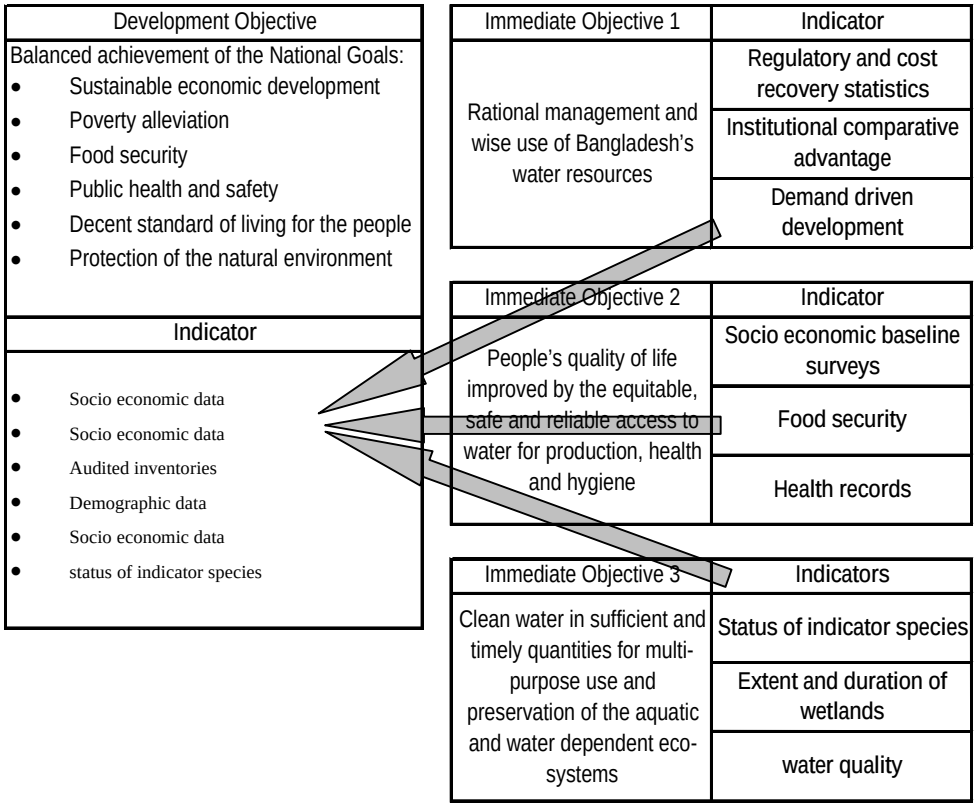
Figure 6.4: NWMP Cost Estimates by Cluster

CLUSTER	Estimated Cost Tkm (mid 2000 prices) ST	MT	LT	Residual	Total	Percentage of Overall NWMP Budget
Institutional Development	3,780.18	6,722.55	7,981.33	1,452.00	19,936.06	0.02 2.18%
Enabling Environment	841.50	939.91	1,793.06	-	3,574.46	0.00 0.39%
Major Rivers	8,436.57	14,301.40	155,196.14	45,285.88	223,219.99	0.24 24.41%
Towns and Rural Areas	29,512.00	88,274.00	133,699.25	13,403.75	264,889.00	0.29 28.96%
Major Cities	22,077.51	93,946.20	185,562.74	10,344.06	311,930.51	0.34 34.11%
Disaster Management	4,980.47	7,809.36	13,707.03	668.19	27,165.05	0.03 2.97%
Agriculture and Water Management	1,657.75	7,239.77	29,524.87	7,186.19	45,608.58	0.05 4.99%
Environment and Aquatic Resources	3,091.77	5,472.82	9,676.57	-	18,241.17	0.02 1.99%
TOTAL	74,377.75	224,706.00	537,140.99	78,340.08	914,564.81	

6.10 *Overall Indicators*

Overall indicators for the NWMP are suggested in Figure 6.5, while key indicators at cluster and programme level are presented in the relevant sections which follow.

Figure 6.5: Overall Indicators for the NWMP



7 Institutional and Enabling Framework

7.1 *Institutional Development*

7.1.1 Objectives of Institutional Development

The sustainability and productivity of a nation's water resources depend as much on the institutional framework for development, management and governance of the sector as they do on the resource itself. This is especially so given water's fundamental importance to life and livelihood as well as its unitary and fungible nature. These characteristics result in water management imperatives that are complex, essential for the viability of many other sectors while extending across political jurisdictions and geographical or ethnic boundaries. Equally, the same imperatives are just as important in areas of plenty as well as of dearth. This is especially so when quality, turbidity, erosion, accretion or potential disasters are involved.

The associated institutional challenge is clear; but as the preamble to Section 5 of the NWPo so clearly puts it, well coordinated and "…properly functioning institutions are essential for effective implementation and administration of the country's water and related environmental resource management policies and directives….". Experience elsewhere suggests that properly functioning institutions are characterised by clear, demand driven mandates and nested hierarchies that are consistent with subsidiarity principles. In order to replicate the benefits in Bangladesh, the Government is committed to restructuring and strengthening where appropriate, existing institutions as well creating new ones where the need is indicated, especially at the community level.

Again quoting Policy, this time clause a of Section 5, The Government "will formulate a framework for institutional reforms to guide all water sector related activities. It will periodically review the mandates of all water sector related institutions and redefine their respective roles, as necessary, to ensure efficient and effective institutions commensurate with changing needs and priorities.". One such review was carried out by WARPO as part of the development strategy studies that precede and inform this Plan. The exercise identified the need for a cluster of 10 programmes, each suitable for implementation under the ægis of the NWMP during its short and medium terms, that together will facilitate establishment of the required framework of properly functioning institutions. These programmes are described below. First however, it is necessary to propose development objectives for the institutional development of Bangladesh's water sector, and then to present them in the form of a suitable subsidiarity model.

Objectives for the Institutional Development of Bangladesh's water sector are suggested in Figure 7.1 which also demonstrates their relationship with the relevant Immediate Objective of the overall Plan, which at cluster level becomes the Development Objective of that cluster, because it cannot be achieved as a result of the cluster alone. Figure 7.2 suggests an appropriate subsidiarity model.

Figure 7.1: Objectives of Institutional Development

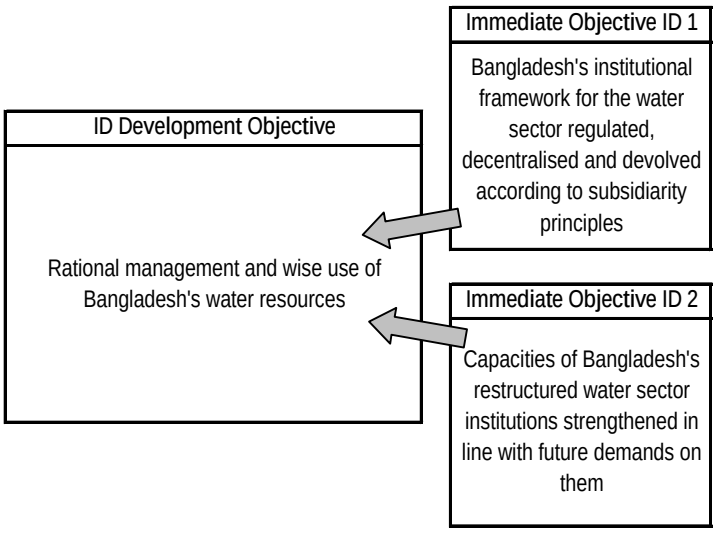
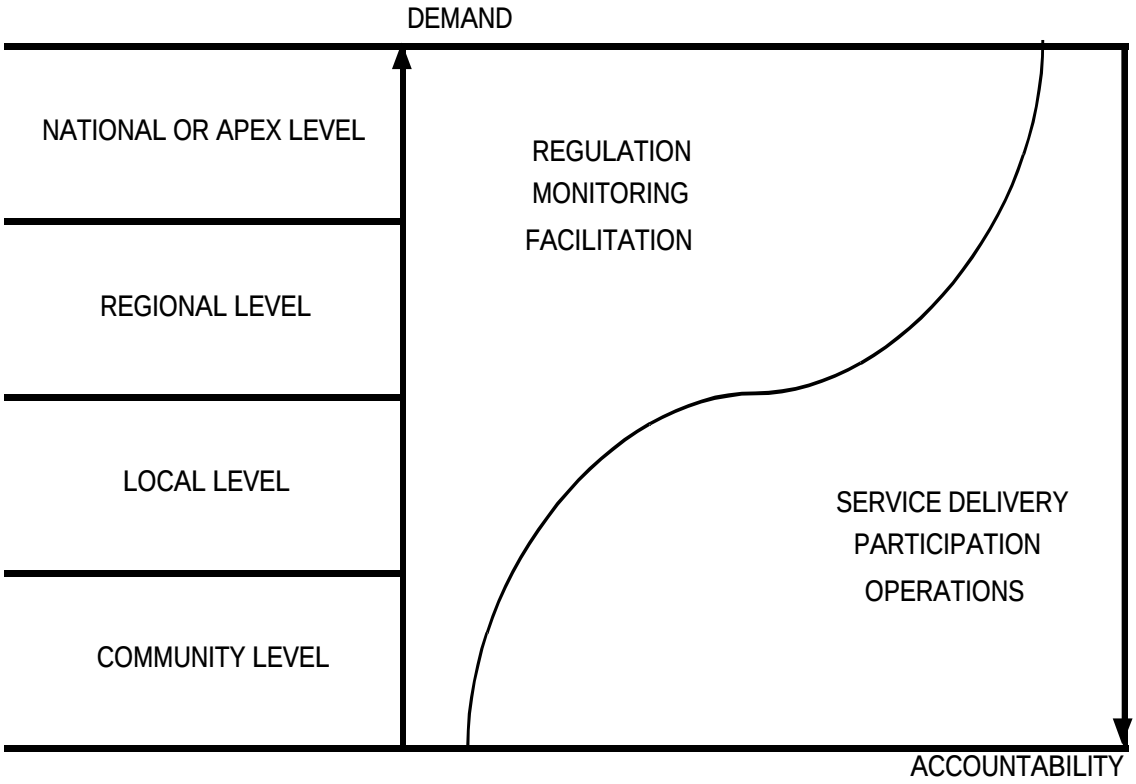


Figure 7.2: Water Sector Subsidiarity Model



7.1.2 Programmes for Institutional Development

Ten programmes are suggested in order to achieve the Institutional Development Immediate Objectives. Those addressing the first are summarised in Table 7.1 and those addressing the second in Table 7.2. Detailed descriptions of each of the

programmes can be found in Volume 3, the Investment Portfolio. The terms MIS Ref (Column 1) and "Key Programme Objective" (column 4) and are explained in sections 9 and 15 respectively.

Table 7.1: Programmes Targeted at Institutional Change (Immediate Objectives ID 1)

MIS Ref	Title	Description	Key Programme Objective
ID 001	Local Government Needs Assessment for Water Management	The NWPo creates new roles for and places new responsibilities on Local Government Institutions. In particular NWPo §4.2.e requires LGI's to implement FCD/I projects having a command area less than or equal to 1000ha, while NWPo §4.2.f calls upon LGI's to coordinate stakeholder participation at all stages of water sector project cycles. Furthermore, as a result of NWPo §4.4.d LGI's will become progressively responsible for the management of all FCD schemes up to 5000ha, as well as for the raising of operation and maintenance tariffs through local resources. This programme assesses the implications of these challenges in terms of the institutional framework and human resource requirements and presents them in the form of a institutional capacity building and human resource development programme document.	Outline management structure, procedures and human resource requirements for local water sector development and management by LGI's agreed by all stakeholders
ID 002	Independent Regulatory Bodies for Water Supply and Sanitation Service Sector	Initially, this programme will begin by studying options for the establishment of a regulatory framework for water supply and sanitation as well as the institutional demands thereof. This preliminary stage will be followed by the establishment and mandating of the institutions themselves. It is anticipated that existing institutions will be able to accept some of the responsibility; even so a clear need for new, specialist agencies is foreseen.	Independent regulatory bodies for water supply and sanitation services established and fully functional
ID 003	FCD and FCD/I Management Rationalisation	This programme is intended to facilitate the transfer of FCD/I scheme management as per policy. Three steps will be involved. In the short term BWDB will receive capacity building with respect to environmental and social issues, while in consultation with the stakeholders a range of transfer options will be identified and prepared. Finally these options will be pilot tested at selected locations during the short and medium term.	100% of transferred FCD/I schemes considered sustainable under decentralised management by Programme year 16
ID 004	BWDB Regional and Sub-regional Management Strengthening	According to its Act 2000, BWDB is responsibility for controlling the flow of water in all rivers and aquifers. To this end it is the strategy of GoB to prepare integrated river improvement initiatives which give due importance to all stakeholders. This programme is intended to provide the necessary support to BWDB to enable it to prepare such initiatives at regional and sub-regional levels consistent with the GoB strategy.	BWDB internal organisation structured to plan, develop and manage river improvement programmes with established capacity

Table 7.2: Programmes Targeted at Institutional Capacity Building (Immediate Objectives ID 2)

MIS Ref	Title	Description	Key Programme Objective
ID 005	Local Government Capacity Building for Water Management	The NWPo creates new roles for and places new responsibilities on Local Government Institutions. In particular NWPo §4.2.e requires LGI's to implement FCD/I projects having a command area less than or equal to 1000ha, while NWPo §4.2.f calls upon LGI's to coordinate stakeholder participation at all stages of water sector project cycles. Furthermore, as a result of NWPo §4.4.d LGI's will become progressively responsible for the management of all FCD schemes up to 5000ha, as well as for the raising of operation and maintenance tariffs through local resources. This programme is intended to deliver the necessary capacity building and human resource development in response to the needs assessments carried out under Programme ID 001 (Local Government Needs Assessment for Water Management). The programme will begin with the establishment of a Central Training Unit and thereafter comprise a long and sustained effort beginning in the short term of the NWMP and continuing throughout the remainder of its 25 years. The programme will include training for both LGED and DPHE to strengthen their abilities to provide technical support for LGIs.	LGI water management operational capacity consistent with the needs of decentralized water management in Bangladesh
ID 006	WARPO Capacity Building	WARPO has suffered considerably in the past from a lack of permanence, with adequate funding support being provided only during national plan preparations and little in-between. Furthermore, prevailing employment conditions then, make the appointment and retention of suitable staff difficult. This programme intends to render WARPO sustainable while building its capacity such that it becomes a centre of excellence characterized by committed high calibre staff. This will be achieved by revision of WARPO's legal establishment, restructuring of WARPO staffing, relocation to a permanent suitable office and various capacity building programmes.	WARPO established as a centre of excellence
ID 007	Department of Environment Capacity Building	As far as aquatic resources are concerned, DoE is mandated to protect water quality and ensure efficiency of use and in particular to monitor (and establish standards of) effluent disposal to prevent water pollution. This programme allows for institutional capacity building of DoE including the establishment of representational offices down to District level.	Department of Environment capacity building programme completed
ID 008	Disaster Management Bureau Capacity Building	This programme will provide the resources necessary to continue ongoing capacity building activities throughout the short and medium terms in order that the DMB can address its mandate in an increasingly effective fashion.	Disaster Management Bureau capacity building programme completed
ID 009	Capacity Building for Other Organisations	The NWPo §4.02(o) requires the GoB or its responsible agencies to undertake comprehensive and integrated analysis of relevant hydrological factors across all related water-using sectors for the purpose of managing the river systems and providing early warning systems of natural disasters like flood and drought. NWPo §4.13 also requires water bodies like haors,, baors and beels are preserved for maintaining the aquatic environment and facilitating drainage. This programme provides for capacity building of three key agencies involved in these activities, namely: Bangladesh Meteorological Department, River Research Institute and Bangladesh Haor and Wetland Development Board.	Reliable predictions of extreme climatic events (both short and long term), and morphological changes; and effective wetland management procedures

ID 010	BWDB Capacity Building	This programme is intended to strengthen BWDB in several ways: improved flood forecasting and warning; strengthened surface and groundwater monitoring and dissemination; support for erosion and accretion forecasting; support for drought forecasting; re-orientation programmes especially with regard to the social and environmental dimensions of water resources management, MIS, HRD and other related fields of BWDB; a new central office and upgraded regional centres	BWDB capacity building programme completed

7.1.3 Costs of Institutional Development

Cost estimates for the Institutional Development Programmes are summarised below in Table 7.3. Details of how these estimates were derived is provided in Volume 3 part 1.

Table 7.3: Estimated Costs of Institutional Development

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
ID 001	Local Government Needs Assessment for Water Management	170.0	-	-	-	170.0
ID 002	Independent Regulatory Bodies for Water Supply and Sanitation Service Sector	75.0	1,200.0	-	-	1,275.0
ID 003	FCD and FCD/I Management Rationalisation	550.0	750.0	-	-	1,300.0
ID 004	BWDB Regional and Sub-regional Management Strengthening	178.8	71.2	-	-	250.0
ID 005	Local Government Capacity Building for Water Management	968.0	2,420.0	7,260.0	1,452.0	12,100.0
ID 006	WARPO Capacity Building	405.0	255.0	-	-	660.0
ID 007	Department of Environment Capacity Building	292.0	73.0	-	-	365.0
ID 008	Disaster Management Bureau Capacity Building	660.0	1,100.0	440.0	-	2,200.0
ID 009	Capacity Building for Other Organisations	150.0	150.0	-	-	300.0
ID 010	BWDB Capacity Building	331.3	703.3	281.3	-	1,316.0
	TOTAL	3,780.2	6,722.5	7,981.3	1,452.0	19,936.1

7.1.4 Assumptions

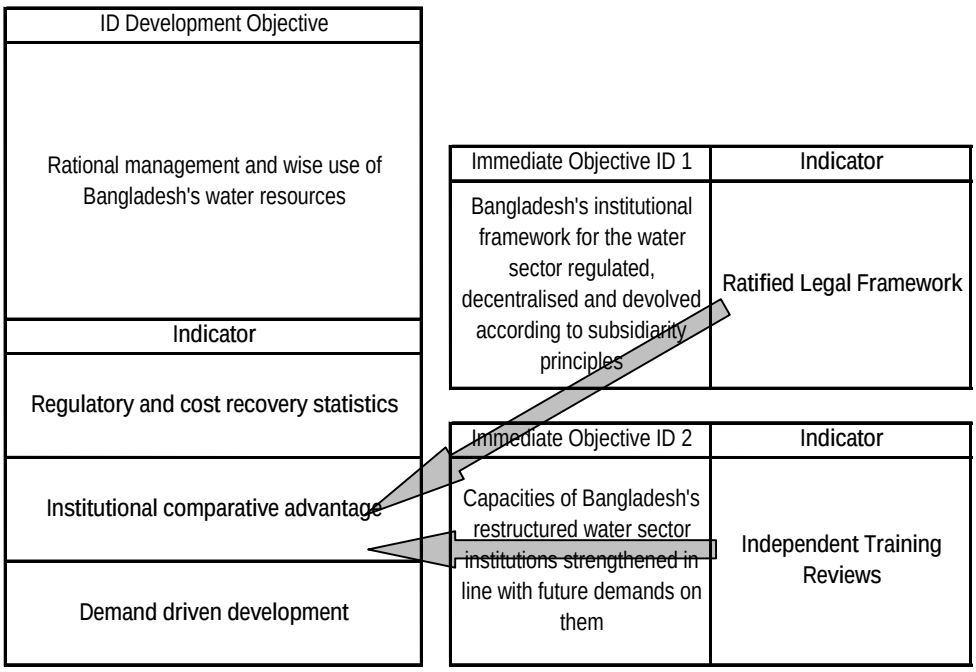
Success for this cluster assumes three things. First, that Government commitment to change can be maintained and justified for a sufficiently long period. Secondly, that the private sector can be successfully mobilised and regulated (there is a danger that these are mutually exclusive concepts). And thirdly, that any initial resistance to change, especially, but not exclusively at the grass roots level can be overcome by a painstaking cycle of needs assessment and sensitisation.

It should also be understood that the recent history of other countries, regardless of political philosophy, confirms that the success of any mono-sectoral institutional development strategy, will remain limited in the absence of pan-sectoral civil service reforms and adequate concomitant remuneration/compensation packages for retained/released personnel respectively.

7.1.5 Indicators of Institutional Development

Key indicators for successful institutional development are suggested in Figure 7.3

Figure 7.3: Key Indicators for the Institutional Development (ID) Cluster



7.2 *The Enabling Environment*

7.2.1 Objectives of the Enabling Environment

It will be recalled from sub-section 6.4 that an institutional restructuring and capacity building strategy of the type recommended is greatly enhanced by a parallel strategy towards the establishment of an enabling environment. This is especially where new institutional paradigms and players are involved. The NWPo is concerned with both and key examples are provided in Table 7.4.

Table 7.4: New Paradigms and Players for Bangladesh's Water Sector

New Paradigms	New Players or Old Players with New Roles
• 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	• Local Government Institutions • Non Government Organisations • Community Groups • Domestic Private Sector • Foreign Private Sector

However, new constructs such as these require significant changes in the way things are done. For instance:

- new rules and regulations have to be introduced, supported where necessary by suitable regulatory mechanisms, which must also be prepared;
- new procedures have to be introduced;

- data and information management requirements change, especially with respect to planning and monitoring
- new accountability relationships must be introduced.

The result is an enabling environment for the new paradigms and players. The Development Strategy and other studies have suggested that a four pronged approach to implementing the necessary changes in Bangladesh is necessary in Bangladesh.

First, it is essential that all players, old and new, are fully aware of their rights and responsibilities as planners, developers, regulators, suppliers and users of water sector infrastructure and services. Furthermore, the decentralist model that the NWPo addresses, also introduces new planning and consultative procedures. These must be consistent across the institutional spectrum in terms of both application and arbitration.

Secondly, all planning, management and monitoring information should be timely, reliable, well organised, accessible and supported by sound research and augmented by the same means according to need.

Thirdly, since the whole re-structuring process will be highly participatory in character, it is essential that all participants are aware:

- that water is a finite resource with economic value
- of the new legal, policy and regulatory framework concerning its management and exploitation

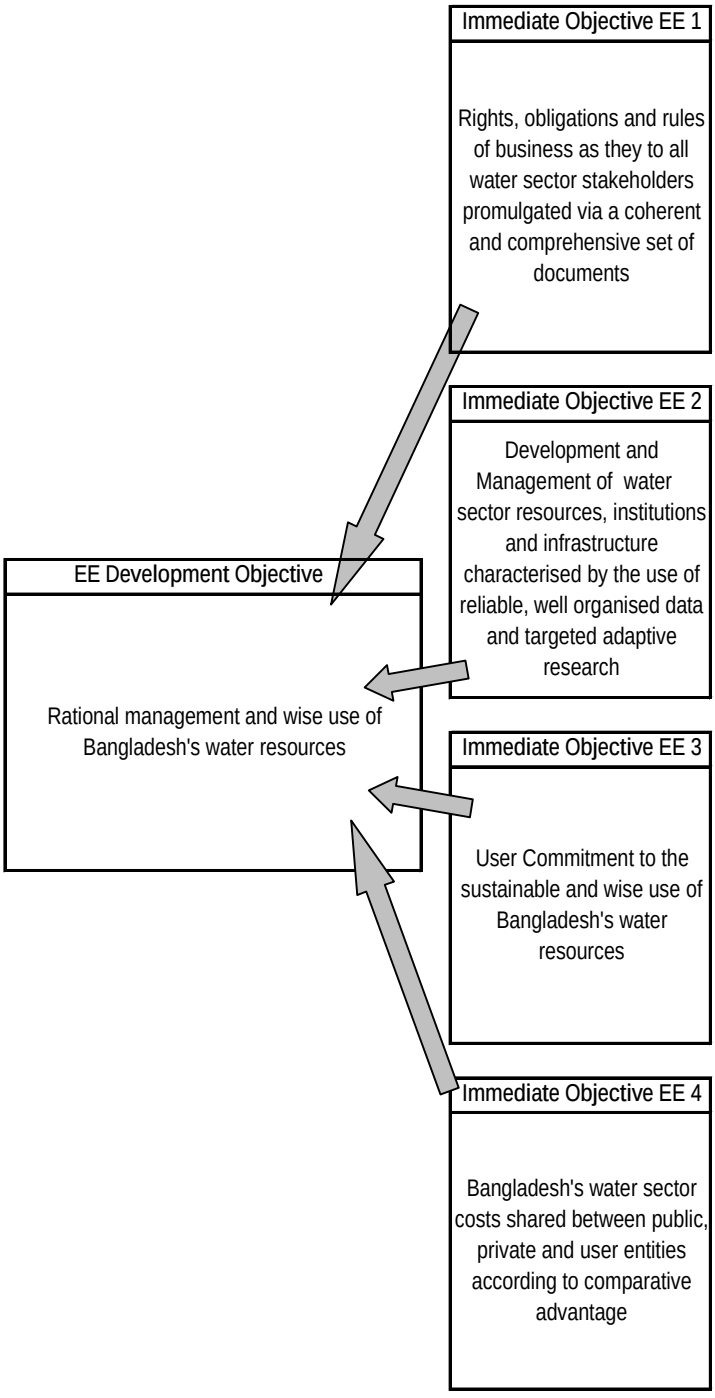
and

- of their rights and obligations as water suppliers or users.

Fourthly, global experience of water sector reform increasingly confirms a significant nexus between sustainability and cost sharing – cost sharing in terms of both capital and recurring costs. This has been a major constraint in Bangladesh to date, to the extent that it is discussed substantively in sub-sections 13.2 and 13.3 below.

This four pronged strategy defines the Immediate Objectives of the Enabling Environment Cluster: Figure 7.4 refers.

Figure 7.4: Objectives of the Enabling Environment



7.2.2 Programmes for the Enabling Environment

Thirteen programmes are suggested as the means to establishing the necessary enabling environment. They are presented in Tables 7.5 to 7.8 from which it may be noticed that, despite their relevance to the enabling environment, issues of mapping/aerial photography and international collaboration (not only in the context of shared resources, but also in terms of participating in the global water

management debate) do not have specific programmes. This is not to say that mapping is adequate over the whole country (see text box); rather, it is assumed that the specific mapping needs for a given project or programme will be addressed during the preparation or execution of that project or programme, and paid for from that project or programme's budget. Equally, the Plan acknowledges the importance of international collaboration by means of specific mention, and indeed budget provision, in each Programme that represents a potential vehicle for enhanced or facilitated international activity.

Mapping in Bangladesh

The Survey of Bangladesh is the country's official national organisation for topographic surveying and cartography. In the specific case of the water sector however, several other line agencies, including: BWDB, IWTA, LGED and WARPO (which has a growing capability in GIS driven thematic mapping) are also repositories and/or sources for maps (and aerial photography). Access to maps and photography tends to be fraught with complex bureaucratic procedures that generally involve several officials and considerable delay. Furthermore, it is often the case that maps are only available for rent not purchase, and the situation is even worse for non- government applicants. The following figure provides an indication of the extent of spatial coverage by scale of those maps and photographs, currently in use and of direct relevance to water sector planning/design activities. It should be noted however, that the DLRS maintains 100% coverage of Mouza (land acquisition) maps of indirect, but nonetheless important interest, and a 1:10,000 mapping programme for the entire FAP study area was formulated in 1994, but so far is still awaiting completion.

It should be noted however that i) with the exception of the 1:15,840 series, most large-scale mapping is associated with and was generated by specific projects or programmes, and ii) that despite being in regular use, the reliability of some of the older maps has been compromised by river morphology since they were first produced.

Table 7.5: Programmes for the Enabling Environment (Immediate Objective EE 1)

MIS Ref	Title	Description	Key Programme Objective
EE 001	Support to the Preparation of New Legislation	As acknowledged by the NWPo and other sources, the existing legal framework does not reflect the decentralized participatory characteristics intended for the water sector. As such it needs revision and supplementation in a number of key areas. This programme is intended to provide support in the form of technical assistance and study that will i) assist in identifying where and how legislation needs to be revised or augmented; ii) facilitate the preparation of a Water Resources Act and iii) result in an appropriate registration process for the community based organisations.	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	The NWPo calls for the decentralisation and/or devolution of the water sector. Various models have already been proposed, most of which are prescribed by the size of scheme involved. The programme is intended to test the efficacy of the models proposed to date as well as other potential options to be identified on the basis of comprehensive stakeholder consultation.	A range of appropriate and replicable institutional models for decentralized water management in Bangladesh
EE 003	Water Resources Legislation - Preparation of Supporting Ordinances	Programme EE 001is intended to result in a new Water Resources Act; this complementary programme is intended to address the need for legal commentary, under-laws and precedents to the new Act that will shape and arbitrate its enforcement. Inter-alia these will incorporate or address experiences gained while field testing institutional structures and modalities under Programme EE 002	An easily understood legal framework for water sector development and management
EE 004	Project Preparation Procedures - Guidelines and Manual	This programme is intended to prepare enforceable guidelines and advisory manuals covering the processes and procedures considered necessary during the preparation of water sector initiatives.	Water sector programme and project preparation regulated by an approved set of guidelines and manuals
EE 005	Regulatory and Economic Instruments	This programme is intended to prepare enforceable guidelines and advisory manuals concerning standards, regulation and economic instruments for the water sector.	Regulatory and Economic instruments in force
EE 006	Field Testing & Finalisation of Guidelines for Participatory Water Management	A set of Guidelines For Participatory Water Management was issued in February 2001. While the document represents an excellent point of departure, it needs more work if it is to be made consistent with conventional wisdom and international best practice. This programme is intended to finalise the Guidelines via a process of pilot testing and evaluation complemented by further research, international technical assistance and study tours.	Guidelines for Participatory Water Management applied to all relevant programmes and projects

Table 7.6: Programmes for the Enabling Environment (Immediate Objective EE 2)

MIS Ref	Title	Description	Key Programme Objective
EE 007	NWRD Improved Data Collection and Processing Facilities	Given that water resource planning and management requires a very wide range of information drawn from myriad institutional sources, this programme is intended to familiarize the many stakeholder institutions with the potential benefits that well organized, accessible data represents and to facilitate the realization of that potential. Beginning with a process of consultations with all stakeholder institutions, principles of common standards; access protocols and data pricing options will be agreed and a proposal written. Other objectives include the establishment of one-stop data retrieval and the availability of all reports in digital format. This programme is relevant to the NWPo as it provides improved, better organised management of information, and is in keeping with the NWPo call for a systematic, comprehensive overhaul of the sector's data systems.	All water sector reports archived in digital format and available to all users in hard or soft copy
EE 008	Water Resources Management Research and Development Studies	NWPo §4.15 of the NWPo recognizes the important contribution that well focused and coordinated research can play in facilitating the wise and sustainable use of water resources. In particular, the Policy calls for strengthened research capacity at water resource and agricultural institutions. It also prescribes focused research into important flood control and management; water resources management; sociological and institutional issues. This programme comprises ten specific research programmes that are not contained within any other programmes, and that are not already ongoing.	Research playing a Key role in quinquennial NWMP updates
EE 009	Water Resources Management Long Term Research and Development	The NWPo recognizes the important contribution that well focused and coordinated research can play in facilitating the wise and sustainable use of water resources. In particular, the Policy calls for strengthened research capacity at water resource and agricultural institutions. This programme simply provides funds for unspecified research in the long term.	Bangladesh's water sector considered to represent a regional center of research excellence

Table 7.7: Programmes for the Enabling Environment (Immediate Objective EE 3)

MIS Ref	Title	Description	Key Programme Objective
EE 010	Raising Public Awareness in the Wise Use and Management of Water	Public awareness campaigns by all relevant agencies in the water sector are to be seen as an important vehicle for the active promotion of all the key components in the NWPo and the NWMP, fostering increased consultation and participation, and increased awareness of all water sector issues at local, regional and national levels. This programme will consider, assess and implement various publicity campaigns around the country to this end, such as radio broadcasts, newspaper articles, cinema advertising, promotional videos, rural trade fairs, extension services, etc.	Effective public demand for sustainable water resources management.

Table 7.8: Programmes for the Enabling Environment (Immediate Objective EE 4)

MIS Ref	Title	Description	Key Programme Objective
EE 011	Private Sector Participation in Water Management	One of the main objectives of the NWPo is to "…improve the investment climate for the private sector in water development and management" (NWPo §3.01e) To this end, the ongoing Infrastructure Development Company Ltd. (IDCOL) has already been established and provides 'top-up' funds to private led projects. This programme continues in the same vein by promoting the creation of a legal and regulatory framework to aid investor/provider confidence, and also in improving access of the rural and urban poor to adequate credit facilities. Special tax/duty privileges to attract foreign investment to the water sector, and establishment and public awareness raising of consumer rights in relation to private water supply schemes will also be undertaken.	Full but regulated access to water sector investment and service delivery opportunities to the private sector
EE 012	Water and Environment Funds	Regulatory and economic instruments are an important part of demand management in a modern decentralized water sector. This programme is intended to broaden the scope and increase the utility and effectiveness of such instruments in Bangladesh particularly those pertaining to the abstraction of both surface and groundwater; arsenic mitigation, effluent scrubbing and cost recovery across the board.	Increased pollution clean up and arsenic mitigation catalysed by grants and subsidies
EE 013	Alternative Financing Methods for Water Management	The availability of and access to adequate financial resources for operations and maintenance; emergency work; rehabilitation; replacement and new development is a major sustainability issue in Bangladesh's water sector. The current trend to decentralise management responsibility is expected to take the pressure off central finances. This programme will study needs and opportunities for alternative financing (such as an independent regulatory framework), and then promote various local and international sources of finance (thirteen different sources have been identified at this stage). The NWPo recognises the importance of promoting alternative financing in such clauses as: "..improve the investment climate for the private sector in water development and management" (NWPo §3.01e), and; "the formulation of options for investment and management" (NWPo §4.051).	Increasing use of non-traditional financing for water sector development and management

7.2.3 Costs of the Enabling Environment

Cost estimates for the Enabling Environment Programmes are summarised below in Table 7.9. Details of how these estimates were derived is provided in Volume 3.

Table 7.9: Estimated Costs of the Enabling Environment

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
EE 001	Support to the Preparation of New Legislation	12.5	-	-	-	12.5
EE 002	Field Testing of Participatory Management Models	40.0	60.0	-	-	100.0
EE 003	Water Resources Legislation - Preparation of Supporting Ordinances	12.0	30.0	78.0	-	120.0
EE 004	Project Preparation Procedures - Guidelines and Manuals	16.1	55.4	88.6	-	160.0
EE 005	Regulatory and Economic Instruments	152.0	-	-	-	152.0
EE 006	Field Testing and Finalisation of the Guidelines for Participatory Water Management	7.0	35.0	28.0	-	70.0
EE 007	NWRD Improved Data Collection and Processing Facilities	15.0	-	-	-	15.0
EE 008	Water Resources Management Research and Development Studies	400.0	400.0	-	-	800.0
EE 009	Water Resources Management Long Term Research and Development	-	100.0	1,500.0	-	1,600.0
EE 010	Raising Public Awareness in the Wise Use and Management of Water	54.0	90.0	36.0	-	180.0
EE 011	Private Sector Participation in Water Management	35.0	-	-	-	35.0
EE 012	Water and Environment Funds	26.7	13.3	-	-	40.0
EE 013	Alternative Financing Methods for Water Management	71.3	156.3	62.5	-	290.0
	TOTAL	841.5	939.9	1,793.1	-	3,574.5

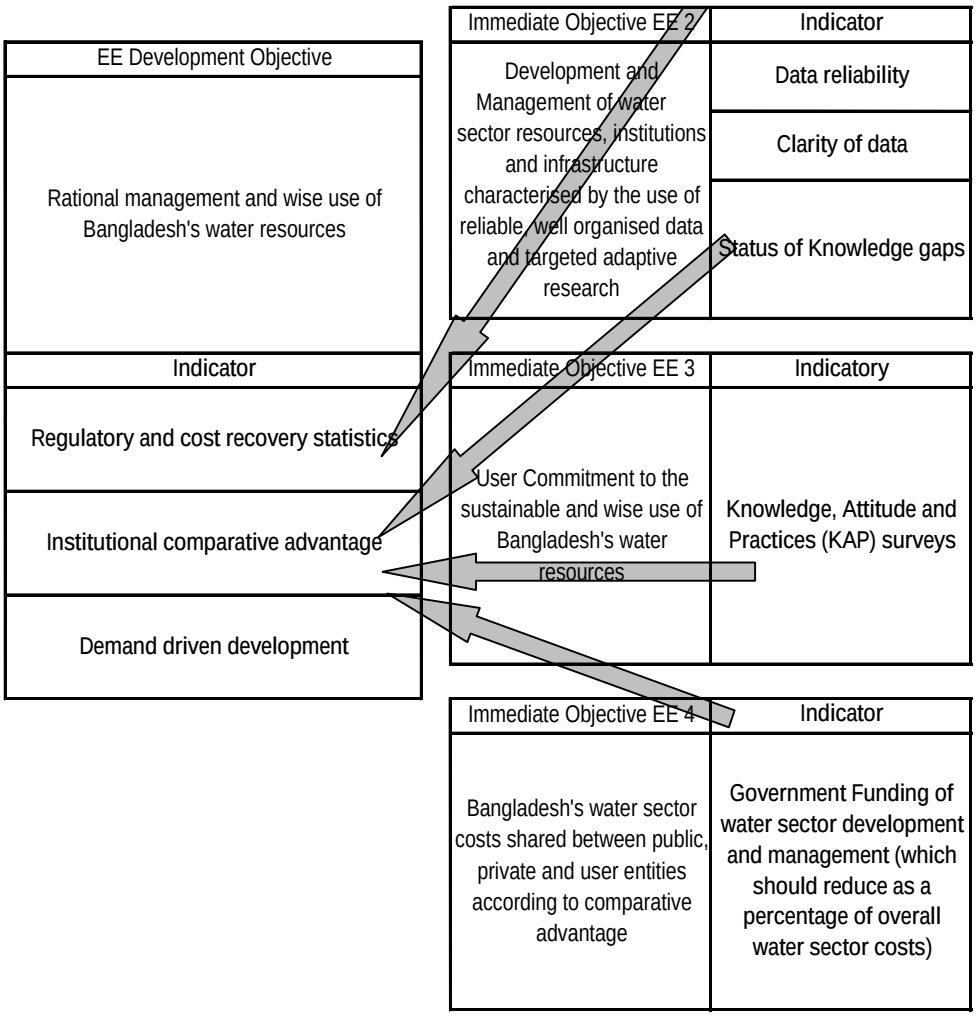
7.2.4 Assumptions

Again, ongoing long-term Government commitment to change is assumed. In this context it is important to note that decentralisation of water sector functions to local institutions clearly requires that such local institutions have been established, mandated and operationalised. This Plan therefore assumes that the Government succeeds in removing the delays noted elsewhere in this document with respect to local council elections and the like. In addition however, it is also assumed that steps towards the enabling environment can be maintained a pace consistent with the investment programmes dependent on it, especially those requiring alternative forms of financing (an issue which is addressed in Section 13 "Funding the NWMP"). Finally, it assumed that Government commitment to change is complemented by the necessary determination to enforce the regulations that will be developed within this cluster.

7.2.5 Indicators of the Enabling Environment

Key indicators of an enabling environment are suggested in Figure 7.5.

Figure 7.5: Key Indicators of the Enabling Environment



8 The NWMP Investment Programmes

8.1 *Programmes for Main Rivers*

8.1.1 Objectives for the Main Rivers

Bangladesh is a land of rivers. Across its borders flow 57 significant rivers, including three of the worlds largest, the Ganges, the Brahmaputra and the Meghna that between them are largely responsible for delta which comprises the physical territory of Bangladesh with the exception of the Chittagong hills and other smaller, less significant parcels of high ground. As well as the international or transboundary[3] rivers, the country is also drained by a complex network of myriad local rivers many of which are interconnected and most of which overtop during the monsoon season.

The economic life of Bangladesh is no more separable from that of its rivers than is that of the natural environment itself and a wide range of stakeholders depend on the sustainable and wise use of these rivers. These stakeholders can be grouped as follows:

Water users such as:

- Industry — Which depends on river flows for both consumption and discharge purposes
- Water supply services — Which depend on river flows where groundwater is not an appropriate source
- Agriculture — Which depends on river water for irrigation in certain regions as well as for processing
- Fisheries — Which relies not only on the rivers as a specific piscine environment; but also, by means of regular flooding, as the means by which standing waters are restocked and gene pools kept adequately diversified
- The power sector — Which includes hydropower generation
- The physical environment — Which includes wetlands of global importance, several threatened and/or important species, as well as every living thing that lives in or drinks freshwater.

In-stream interests which include:

- Navigation — Bangladesh, despite being one of its smaller countries, has the world's largest fleet of freshwater transport vessels; these are vital for human communications as well as the flow of goods
- Inland wetlands — Inland wetland integrity is compromised not only by water quantity and quality; but also by depths and drainage rates; these depend partially on the drainage impediment represented by rivers flowing under natural conditions. Excessive abstraction from such rivers reduces the natural impediment resulting in unnatural drawdowns of the wetlands themselves

[3] Trans-boundary in local parlance signifies a river that crosses only one international border – an international river crosses two or more.

- The brackish margins — tropical brackish margins support biomes that are essential to extensive marine food chains, such as that represented by the bay of Bengal's rich fisheries. Yet such biomes are highly sensitive to salinity levels that very throughout the year with the hydrological regimes of the rivers which flow through them. When natural river flows (and indeed flood cycles) are disrupted, incalculable damage can result to the brackish margins

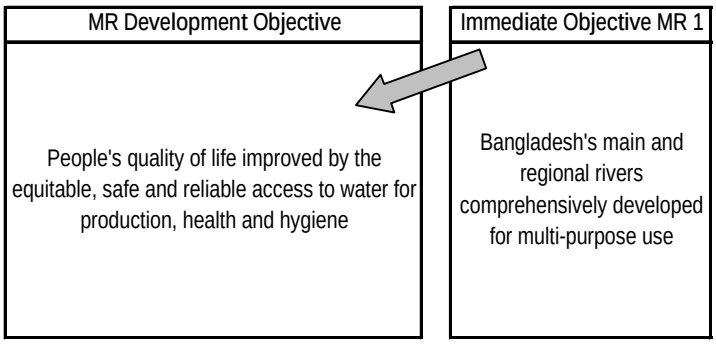
And potential victims of:

- Floods — Notwithstanding the fact that regular flooding is vital to Bangladesh's agriculture, fisheries and brackish margins, when combined with cyclones or especially high tides they have resulted and will continue to result in catastrophic loss of life, livelihoods and property.
- Land loss — The seasonal nature of Bangladesh's rivers, coupled with the large loads of largely non-cohesive sediments, results in unstable charlands along the major rivers. These represent home and farm for some of the country's poorer inhabitants, yet are subject to frequent loss by erosion. Equally, the same processes threaten the integrity of key infrastructure.
- Droughts — Droughts are as characteristic of Bangladesh's hydrological year as floods. Despite the county's huge and renewable groundwater reserves reliable river flows represent the only option for drought mitigation ion some locations.

Yet despite these huge and wide ranging demands on the rivers, development of them remains constrained by uncertainties and unknowns while outstanding opportunities remain un-seized. Consequently, this cluster is concerned with closing the knowledge gaps while implementing rationally planned capital works that make the best use of the river system, whether in terms of abstraction, protection or in-stream interests.

The immediate objective of the cluster is suggested in Figure 8.1.

Figure 8.1: Immediate Objective of the Main Rivers Cluster



8.1.2 Programmes for the Main Rivers

Twelve programmes are suggested in order to achieve the Immediate Objectives of major river development. They are summarised in Table 8.1; but detailed descriptions of each can be found in Volume 3, the Investment Portfolio.

Table 8.1 : Programmes for the Main Rivers (Immediate Objective MR 1)

MIS Ref	Title	Description	Key Programme Objective
MR 001	Main River Studies and Research Programmes	This Programme comprises a series of studies to establish a cost-effective approach to long-term development of the river systems for multi-purpose use. The studies will each contribute to the understanding of individual river development prospects as well as to an overall integrated development plan, set within the context of the international water-sharing issues. Topics covered include a regional development plan for the Meghna and Brahmaputra rivers, master planning of major river training and hydro-power development, Brahmaputra Barrage study, and feasibility studies of development of the Ganges Dependent Area.	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	This Programme provides for investments in augmenting dry season surface water availability for multi-purpose use through abstraction from the main rivers by means other than barrages (barrages are covered in MR 003 to MR 005). The programme is conditional upon the outcome of the studies conducted under Programme MR 001. The principal options that this programme may take up are main river pump stations and dredging and associated works at distributary offtakes (works on the Gorai are considered under MR 003 however).	Increased irrigated areas, environmental health, navigability and other conditions
MR 003	Ganges Barrage and Ancillary Works	This Programme comprises the investment portion the diversion works associated with the integrated development of the water resource system in the GDA. Other aspects of the GDA development in Bangladesh are covered in other programmes under MR, AW, EA and ID. It has three main construction elements: (i) dredging and training works at the Gorai offtake to provide immediate additional flows for environmental purposes; (ii) a barrage across the Ganges to control dry season Ganges flows and provide substantially greater flows for multi-purpose use; and (iii) a Gorai headworks structure to control wet and dry season flows entering the GDA, enabling planned and manageable development to take place.	Increased dry season water availability in the GDA in Bangladesh
MR 004	Meghna Barrage and Ancillary Works	This programme provides for a feasibility study and for investment in river control works as part of an integrated development programme for the NE and SE regions, assumed to be based on construction of a barrage at Bhairab on the Meghna river. The programme is conditional upon the development strategy for these regions to be established under Programme MR 001. Cost provisions are also made for construction of a barrage, headworks and ancillary works on the Meghna river. Other aspects of the overall development are covered in other programmes under MR, AW, EA and ID.	Increased dry season water availability in the NE and SE regions
MR 005	Brahmaputra Barrage and Ancillary Works	The outcome of the study in MR 001 will determine a course of action for further development of the main river systems of the country. On the assumption that this leads to a decision to build a barrage to harness the Brahmaputra waters to meet national needs, this programme makes provision for a feasibility study of the identified option(s), detailed engineering and for the necessary investment in a barrage, headworks and ancillary works. Other programmes to develop the distribution systems and management capacity would complement this programme.	Increased dry season water availability in the NW, NC and NE regions
MR 006	Regional River Management and Improvement	The aim of the programme is to ensure that river management plans are prepared and implemented in a comprehensive and cost-effective manner. It represents the upper tier of three levels of river system management, the other two being the responsibilities of Local Government and community groups. It provides the resources to plan, develop and maintain the regional river systems in an integrated manner, interfacing with these other institutions and responsive to stakeholder needs. The programme acknowledges that a fully replicable approach will	Sustainable river development and management works

MIS Ref	Title	Description	Key Programme Objective
		take a number of years to establish and incorporates both technical support and investment capital on a long-term basis. It has many linkages with other programmes.	
MR 007	Ganges Dependent Area Regional Surface Water Distribution Networks	This programme provides for the capital investments necessary to develop both regional and local river distributary systems as part of the overall GDA development. This provision takes into account that part of these works will be developed under Programme AW 005. Three main link channels have been identified to serve both the Ganges left and right banks. The links would be sized to accommodate supplementary flows for salinity control, as well as for development of LLP irrigation and other consumptive needs.	Increased dry season water availability in the GDA in Bangladesh
MR 008	North East and South East Regional Surface Water Distribution Networks	Provision is made in this programme for the capital investment in both regional and local river system development, based on augmentation of the surface water from a barrage on the Meghna, if this is selected as a preferred option under Programme MR 001 above. The feasibility of the barrage would be studied further in Programme MR 004, which would also determine the scope of the distribution network required.	Increased dry season water availability in the Northeast and Southeast Regions
MR 009	North Central and North West Regional Surface Water Distribution Networks	Provision is made in this programme for the capital investment in both regional and local river system development, based on augmentation of the surface water from a barrage to divert Brahmaputra waters, if this is selected as a preferred option under Programme MR 001 above. The feasibility of the barrage would be studied further in Programme MR 005, which would also determine the scope of the distribution network required.	Increased dry season water availability in the Regions
MR 010	Main Rivers Erosion Control at Selected Locations	River bank erosion is a major problem in all the main rivers. A review will conducted under MR 001 to assess the experience gained in implementing river training works over the last decade since preparation of a Master Plan under FAP1. This review will look at all possibilities of minimising the socio-economic impacts of erosion and will formulate an updated strategy for dealing with the problem. This programme MR 010 provides for the subsequent investments to be determined by that strategy.	Socio-economic impacts of erosion minimised
MR 011	River Dredging for Navigation	This Programme seeks to restore the IWT waterways in a cost-effective manner, with a structured approach recognising both the technical and management issues that have to be overcome. A comprehensive national dredging management plan would be prepared covering short to long-term dredging requirements, as well as dredger operations and the role of the private sector. The programme also makes provision for both capital dredging of the major rivers, much of it being deferred maintenance, and maintenance dredging thereafter. Dredging of other waterways is included in MR 006.	Navigation traffic enabled
MR 012	Hydropower Development and Upgrading	The purpose of this programme is to review in detail the potential for further investment in HEP, identify suitable modalities of development and provide for the necessary downstream investment. The study would focus on: expansion of Kaptai generation capacity; integrated development of the Sangu and Matamuhuri rivers for hydropower generation and other uses; power generation at barrages; and micro-HEP schemes. Micro-HEP appears particularly worthy of pursuit, especially in more remote areas, such as in the CHT, where early exploitation of local resources of power generation could bring high social benefit.	Profitable hydropower generation

8.1.3 Costs of the Main River Programmes

Cost estimates for the Main River Programmes are summarised below in Table 8.2. Details of how these estimates were derived are provided in Volume 3 part 3.

Table 8.2: Estimated Costs of the Main River Programmes

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
MR 001	Main Rivers Studies and Research Programmes	600.0	1,000.0	400.0	-	2,000.0
MR 002	Main Rivers Abstraction Projects	448.0	2,240.0	1,792.0	-	4,480.0
MR 003	Ganges Barrage and Ancillary Works	4,900.0	-	45,958.0	-	50,858.0
MR 004	Meghna Barrage and Ancillary Works	-	-	15,728.0	-	15,728.0
MR 005	Brahmaputra Barrage and Ancillary Works	-	-	51,473.1	35,499.9	86,973.0
MR 006	Regional River Management and Improvement	1,900.0	3,724.8	9,363.8	1,211.4	16,200.0
MR 007	Ganges Dependent Area Regional Surface Water Distribution Networks	-	1,113.9	7,797.1	-	8,911.0
MR 008	North East and South East Regional Surface Water Distribution Networks	-	-	2,576.0	-	2,576.0
MR 009	North Central and North West Regional Surface Water Distribution Networks	-	-	4,287.3	8,574.7	12,862.0
MR 010	Main Rivers Erosion Control at Selected Locations	-	3,440.0	12,900.0	-	16,340.0
MR 011	River Dredging for Navigation	177.0	975.0	390.0	-	1,542.0
MR 012	Hydropower Development and Upgrading	411.6	1,807.7	2,530.8	-	4,750.0
	TOTAL	8,436.6	14,301.4	155,196.1	45,285.9	223,220.0

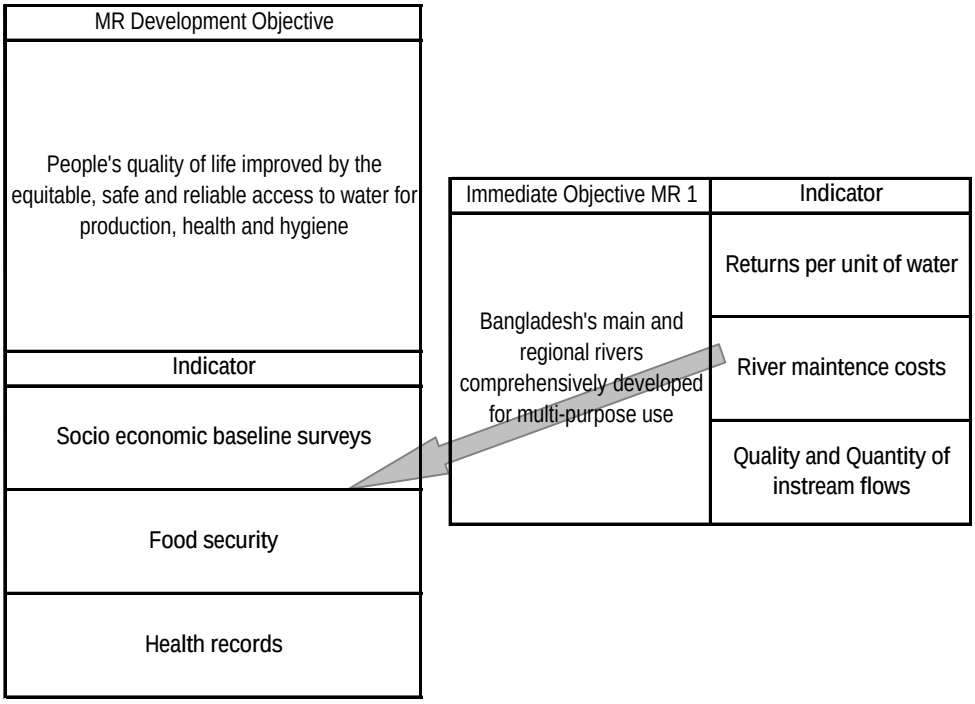
8.1.4 Assumptions

Key assumptions for this cluster are first that India and Bangladesh cooperation over transboundary riparian flows continues and expands. Secondly, it is assumed that fully viable integrated development solutions will be forthcoming from the studies which begin the cluster. Thirdly, it is assumed that not more than one barrage will be built at a time, although the preparation for one can go ahead while another is being built. Finally a much more comprehensive collaboration between BWDB and other water sector stakeholders is assumed and furthermore that this will in turn result in a systems rather than project oriented approach.

8.1.5 Indicators

Indicators for the Major Rivers Cluster are suggested in Figure 8.2.

Figure 8.2: Key Indicators for the Major River (MR) Cluster

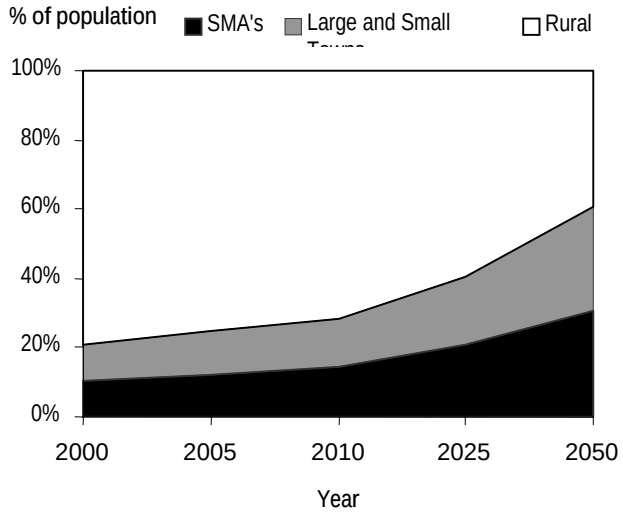


8.2 *Programmes for Towns and Rural Areas*

8.2.1 Objectives for the Towns and Rural Areas

Like many emerging economies, that of Bangladesh is characterised by a clear and steady urbanisation of its population – Figure 8.3 refers.

Figure 8.3: Urbanisation Projection for the Bangladeshi Population to 2050



This trend is beginning to place great strain on urban water sector infrastructure and will continue to do so. Water supply systems are becoming grossly inadequate in comparison to the demands placed on them. This problem, along with losses by leakage (which have been estimated to be as high as 50%), is resulting in reductions of pressure which in turn compromises the validity of any quantitative cost recovery using point of demand metering while creating the opportunity for the influx of contaminants. Furthermore, many water sources are contaminated with arsenic at levels up to 500% higher than WHO standards.

Formal sanitation coverage is equally inadequate, even where it exists. In fact, the majority of urban dwellers are forced to use either hanging or pit latrines, or even the open air for the purpose of defecation; thereby compounding the risk of poor hygiene already made extant by the lack of adequate clean water.

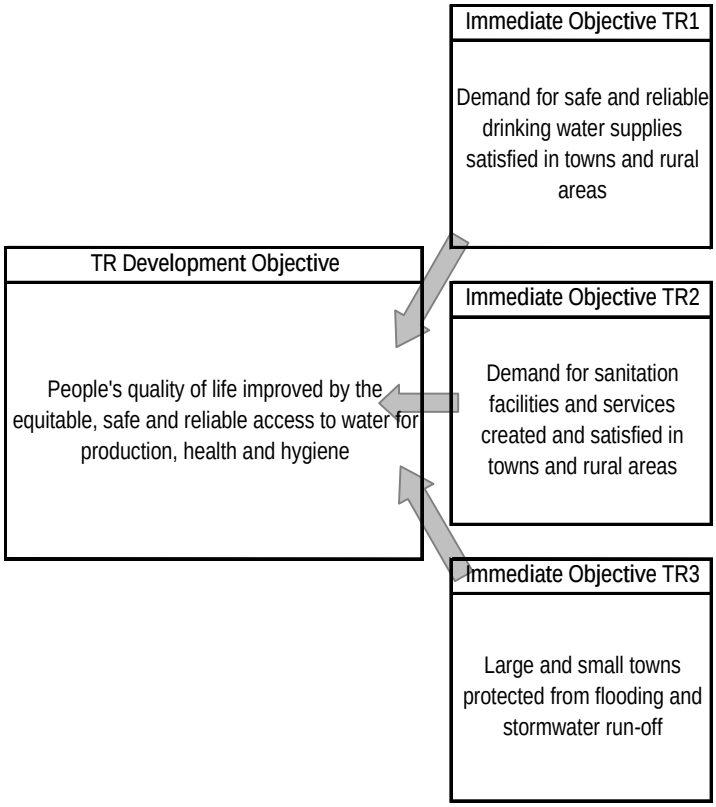
And the unremitting rise in urban populations creates a demand for building land which is often satisfied by the in-filling of essential waterways. This and the increased run-off due to building activities overloads the already parlous drainage systems.

Finally, many urban areas remain unprotected from the regular riverine flooding that characterises much of the country during the monsoon season.

Despite the gradually increasing rise in overall population, the rural urban migration projections over the next fifty years reflected in Figure 8.3 above suggest that rural populations will begin to stabilise during the lifetime of the NWMP. Even so, most rural dwellers suffer from the same lack of water supply and sanitation facilities as do the urban dwellers. Furthermore, arsenic contamination poses the same threats in the rural areas as it does in the towns and villages and as such must be addressed with high priority.

Accordingly the Towns and Rural Area cluster is concerned with making water safe and accessible: safe in terms of quality and its potential for causing loss of life, livelihood and essential infrastructure; and, accessible in terms of reliable and convenient delivery systems. Hence, the immediate objectives for the cluster which are suggested in Figure 8.4 below.

Figure 8.4: Immediate Objectives of the Towns and Rural Area Cluster



8.2.2 Programmes for the Towns and Rural Areas

Eight programmes are suggested in order to achieve the Immediate water sector Objectives of Towns and Rural Area development. They are summarised in Table 8.3; but detailed descriptions of each can be found in Volume 3, the Investment Portfolio. Since however, water supply and sanitation represent quintessentially demand driven investments, and given also that infrastructure (or provisions for it in the form of land acquisition) must anticipate rather than respond to demand build-up, it is necessary at this point to describe briefly the relationship between capacity and demand that has been assumed during preparation of the cluster. Table 8.3 below expresses assumed the water supply and sanitation demand profiles in terms of population forecasts and service coverage specifications up to 2050. Figure 8.5 which follows is a dimensionless model indicating the way by which capacity should always provided ahead of demand.

Table 8.3: Water and Sanitation Demand Profiles to 2050

ITEM	YEAR				
	2000	2005	2010	2025	2050
Population					
large towns	9,780,000	12,220,000	14,910,000	24,980,000	46,900,000
small towns	4,190,000	5,240,000	6,390,000	10,710,000	20,100,000
rural areas	102,000,000	104,800,000	107,100,000	107,700,000	88,000,000
totals	115,970,000	122,260,000	128,400,000	143,390,000	155,000,000
Water Supply Service Coverage					
large towns	75%	93%	97%	100%	100%
small towns	82%	100%	100%	100%	100%
rural areas	92%	100%	100%	100%	100%
Sanitation Service Coverage					
large towns	65%	65%	100%	100%	100%
small towns	55%	90%	100%	100%	100%
rural areas	40%	80%	100%	100%	100%

Figure 8.5: Demand/Capacity Model of Water Supply Delivery Infrastructure

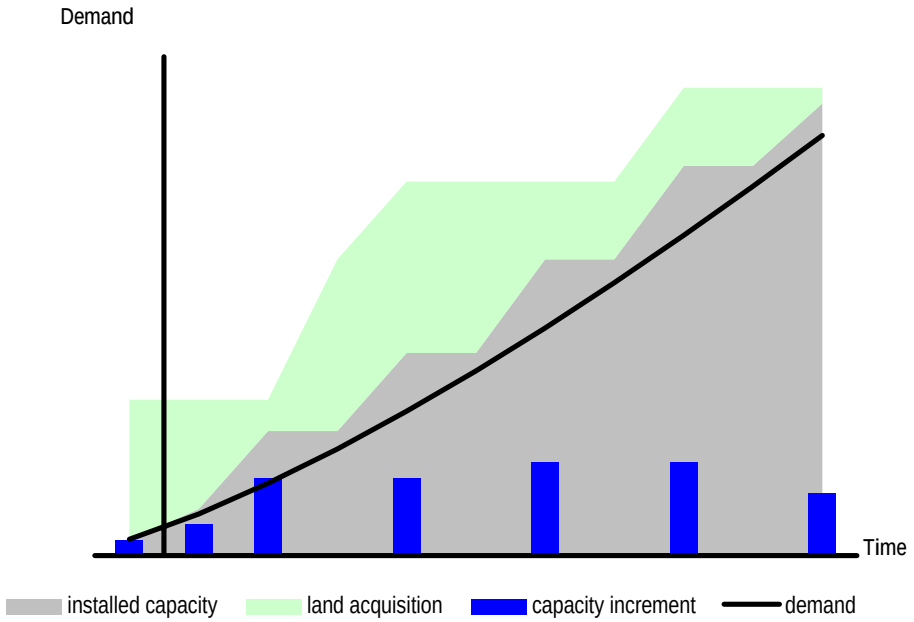


Table 8.4: Programmes for the Towns and Rural Areas (Immediate Objective TR 1)

MIS Ref	Title	Description	Key Programme Objective
TR 001	Urban Arsenic Mitigation	Arsenic contamination of groundwater water supplies has become a serious health hazard in Bangladesh affecting some 76 million people. This is recognised by NWPo §4.06a of the NWPo which requires the Government to "facilitate availability of safe….drinking water through various means". This programme will provide short term arsenic mitigation measures for water supplies (such as arsenic filters and household removal facilities in all urban areas except those comprising the Statistical Metropolitan Areas (See the Major City cluster). More permanent measures will be introduced in the medium and long terms (see Programme TR 003).	Arsenic free potable water available to 100% of large and small town populations
TR 002	Rural Arsenic Mitigation	Arsenic contamination of groundwater water supplies has become a serious health hazard in Bangladesh affecting some 76 million people. This is recognised by NWPo §4.06a of the NWPo which requires the Government to "facilitate availability of safe….drinking water through various means". This programme will provide short term and medium term arsenic mitigation measures for water supplies (such as arsenic filters and household removal facilities in all rural. More permanent measures will be introduced in the long term (See Programme TR 004) .	Arsenic free potable water available to 100% of rural population
TR 003	Large and Small Town Water Supply and Distribution Systems	The preamble to NWPo §4.6 of the NWPo highlights the water supply problems facing Bangladesh's urban areas (large and small). Water tables are receding due to heavy groundwater abstraction. Furthermore, saline intrusion in coastal aquifers and contamination elsewhere further compromises the drinking water supplies for urban inhabitants. In accordance with the Government's policy to to "Facilitate availability of safe and affordable drinking water supplies." (NWPo §4.6.a), this programme is intended to provide resources for the implementation of piped water supply schemes fed from DTW or surface water sources in order to serve 90% of the population (of each town) with piped drinking water supplies.	100% of large and small town population have access to formal water supplies
TR 004	Rural Water Supply and Distribution Systems	The preamble to NWPo §4.6 of the NWPo recognises that "The rural areas of Bangladesh suffer from a lack of quality drinking water". This situation is worsening due to heavy withdrawals of groundwater (the principle source for most of the rural areas) for irrigation a trend which is exacerbated by agro-chemical and saline pollution of groundwater. Although the rural population is expected to increase relatively slowly over the next 25 years, from 102 million in 2000 to 107.7 million in 2025, it is nonetheless the GoB's intention to "facilitate the availability of safe and affordable drinking water supplies through various means" (NWPo §4.6.a). It is estimated that 92% of the rural population normally have access to potable water, mainly through shallow HTWs. The thrust of this programme is therefore to improve the quality of water supply services (reliability and access) in areas already served as well as extending the coverage to 100% by 2005.	100% of rural population has access to formal water supplies

Table 8.5: Programmes for the Towns and Rural Areas (Immediate Objective TR 2)

MIS Ref	Title	Description	Key Programme Objective
TR 005	Large and Small Town Sanitation and Sewerage System	§4.6.c of the NWPo "mandates relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health." The population of large (>50,000) and small towns is expected to more than double over the next 25 years, from 14 million in 2000 to 36 million in 2025. At present, between 55% (small towns) and 65% (large towns) of the population is adequately served by sanitation facilities, mainly by pit latrines with/without septic tanks. In the poor areas and fringe communities, people are dependant on 'hanging latrines' and open defecation which exacerbates pollution and public health problems and increases the likelihood of epidemic outbreaks of waterborne and water-related diseases. This programme aims to provide appropriate sanitation facilities and raise and sustain service coverage at 100% by 2010.	100% of large and small town populations have access to sanitation facilities
TR 006	Rural Sanitation	§4.6.c of the NWPo "mandates relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health." The population of rural areas is expected to increase slightly over the next 25 years, from 102 million in 2000 to 108 million in 2025. At present, only 40% of the population has access to pit latrine facilities, the other 60% relying on 'hanging latrines' and open defecation which exacerbates pollution and public health problems and increases the likelihood of epidemic outbreaks of waterborne and water-related diseases. This programme aims to provide appropriate sanitation facilities for the whole rural population and raise and sustain service coverage at 100% by 2010.	100% of rural populations have access to sanitation facilities

Table 8.6: Programmes for the Towns and Rural Areas (Immediate Objective TR 3)

MIS Ref	Title	Description	Key Programme Objective
TR 007	Large and Small Town Flood Protection	§4.2.9.i of the NWPo states that "..critical areas such as district and Upazila towns, important commercial centres, and places of historical importance will be gradually provided reasonable degree of protection against flood". The low areas of many of the towns in Bangladesh are vulnerable to flooding during monsoon. Significant damage was caused during the 1988 and 1998 floods due either to absence of embankments, embankment failure or the inability of protected areas to drain during times of heavy rainfall because of high water levels outside. This programme will undertake measures such as: raising of exsiting embankment crest levels; repair of damaged embankments; and, provision of erosion protection works where necessary. New flood protection works will also be involved consisting mainly of constructing embankments on riverbanks with integral drainage sluices.	All large and small towns protected from 1: 100 year floods
TR 008	Large and Small Town Stormwater Drainage	NWPo §4.6 says that "Lack of proper sanitation and drainage facilities, ... are the primary causes of diseases in the urban areas". Storm water drainage is an increasing problem in urban areas, as the construction of buildings and paved areas has progressively increased run-off. At the same time, pressures on land has caused natural drainage channels to be filled in and built upon. Encroachment on watercourses and water bodies has progressively reduced natural drainage. No urban areas have adequate storm drainage at present. This programme provides resources for a nationwide installation/upgrading and maintenance of stormwater drainage facilities in large and small towns. These will most probably be gravity systems which although cost-effective, will require regular adequate maintenance.	Stormwater drainage installed in all large and small towns

8.2.3 Costs of the Towns and Rural Area Programmes

Cost estimates for the Towns and Rural Area Programmes are summarised below in Table 8.7. Details of how these estimates were derived are provided in Volume 3 part 4. Residual costs are notional only, in that they are required not to finish the programme, but rather to maintain capacity ahead of demand in the early years after the Plan.

Table 8.7: Estimated Costs of Programmes for the Towns and Rural Areas

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
TR 001	Urban Arsenic Mitigation	439.0	-	-	-	439.0
TR 002	Rural Arsenic Mitigation	663.0	522.0	-	-	1,185.0
TR 003	Large and Small Town Water Supply and Distribution Systems	2,500.0	13,500.0	26,055.0	2,000.0	44,055.0
TR 004	Rural Water Supply and Distribution Systems	9,500.0	30,000.0	32,234.0	2,500.0	74,234.0
TR 005	Large and Small Town Sanitation and Sewerage Systems	2,500.0	6,200.0	25,194.0	1,000.0	34,894.0
TR 006	Rural Sanitation	5,500.0	14,750.0	10,372.0	1,000.0	31,622.0
TR 007	Large and Small Town Flood Protection	2,410.0	5,302.0	5,844.3	903.8	14,460.0
TR 008	Large and Small Town Stormwater Drainage	6,000.0	18,000.0	34,000.0	6,000.0	64,000.0
	TOTAL	29,512.0	88,274.0	133,699.3	13,403.8	264,889.0

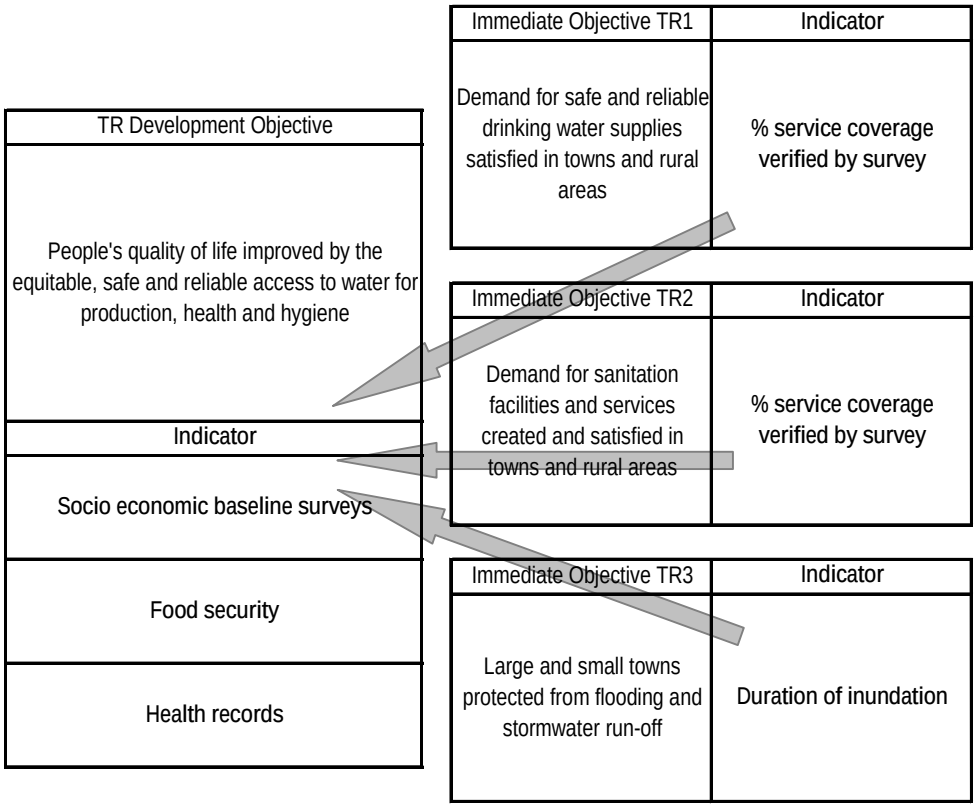
8.2.4 *Assumptions*

The key assumption for this cluster is that the private sector will be willing to participate in the financing of water supply and sanitation facilities (see section 13 "Funding the NWMP"). This in turn assumes that adequate regulation will be unencumbered by political and other vested interests, and that cost recovery is achievable (again see Section 13) in line with NWPo Guidelines.

8.2.5 *Indicators*

Indicators for the Towns and Rural Areas Cluster are suggested in Figure 8.6.

Figure 8.6: Key Indicators for the Towns and Rural Areas Cluster



8.3 *Programmes for Major Cities*

8.3.1 *Objectives for the Major Cities*

The major cities addressed in this section comprise the four Statistical Metropolitan Areas (SMA's) of Dhaka, Khulna, Chittagong and Rajshahi[4]. As far as the water sector is concerned, their problems echo those of the Towns and Rural areas and

[4] Although it is noted that GoB is considering reclassifying of Barisal and Sylhet as SMA's at the time of writing.

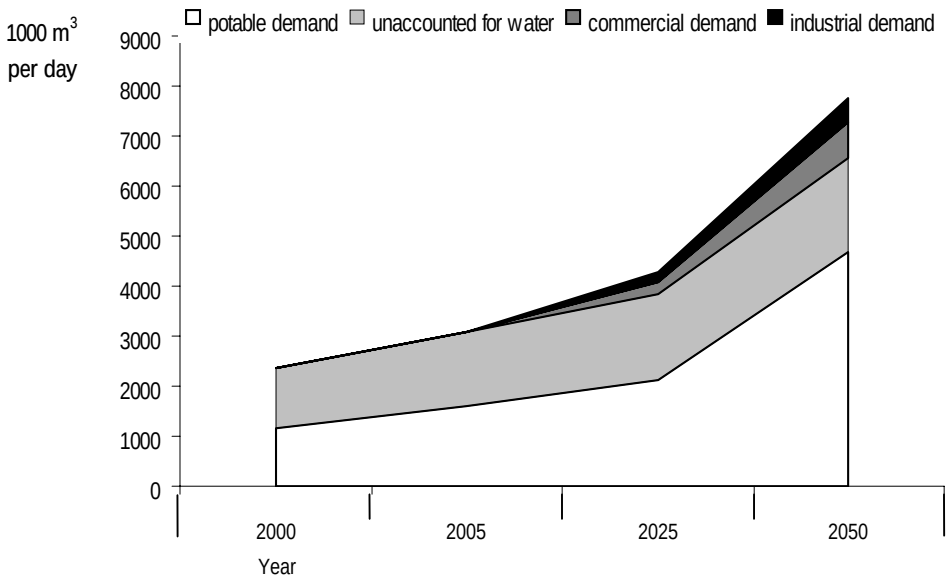
differ from them only in terms of consumption rates, scale and institutional implication.

Consumption rates rise as socio-economic conditions continue to improve in the major cities. Assumed increases in demand for water in the SMA's are as shown in the following table, while the overall scale of the resulting demand is shown in Figure 8.7.

Table 8.8: Assumed Increases in Unit Demand for Freshwater in the SMA's

Source of demand	unit	2000	2005	2010	2025	2050
Potable	lcd	90	95	100	125	150
Unaccounted for water	% of lcd	100	90	80	40	35
Commercial	% of lcd	0	0	10	15	15
Industrial	% of lcd	0	0	10	10	10

Figure 8.7: Water Demand Profiles for the Major Cities



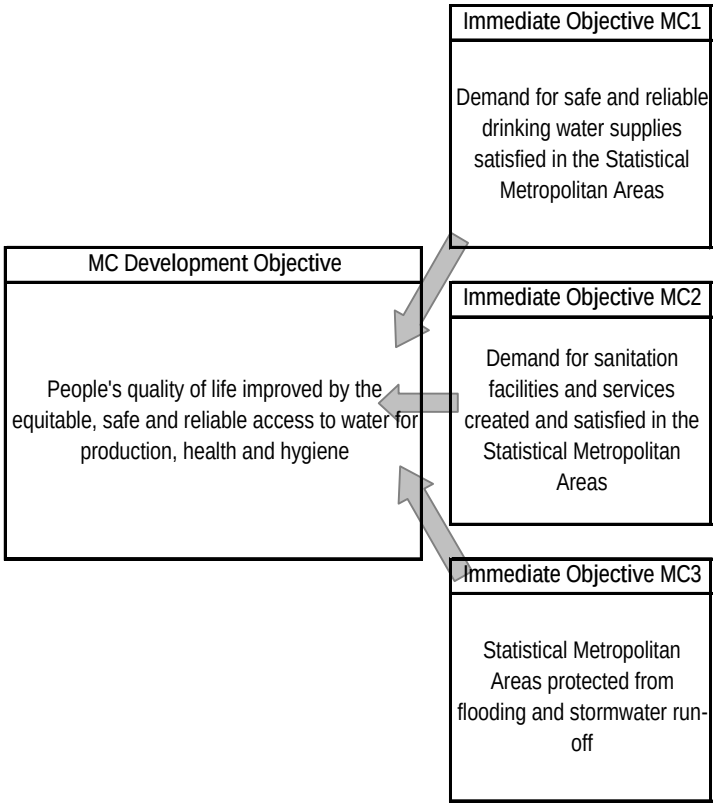
The institutional differences arise as a result of the disinvestment and increased participation of the private sector called for in the NWPo. It is hoped however, that these particular differences will gradually disappear as a result of successful implementation of the new paradigm within the more sophisticated milieu of the SMA's where they will first be introduced. The challenges associated with attracting the interest of the private sector and thereafter mobilising and regulating it is covered by programmes within the Institutional Development and Enabling Environment Clusters. The alternative funding modalities that will result is discussed in Sections 13.2 and 13.3 "Financing Investment" and "Financing Recurring Costs" respectively.

So much for water supply. As far as sanitation and drainage are concerned, it is assumed that these will follow similar demand increased, and for the same reasons, except that the benefits of improved drainage will rise at a faster rate due to the increasing value of economic activity that is to be protected. The same applies to flood protection.

Only Rajshahi has complete urban flood protection infrastructure; but this needs some minor repair and erosion protection works. For the other SMA's however, the flood protection works remain incomplete to one degree or another. These needs are also addressed in the cluster, which begins with a technical inventory and asset management study of the water supply and sanitation sectors.

On this basis, the Objectives for the Major Cities Cluster are suggested in Figure 8.8.

Figure 8.8: Immediate Objectives of the Major Cities Cluster



8.3.2 Programmes for the Major Cities

Seventeen programmes are suggested in order to achieve the Immediate water sector Objectives of Major City development. They are summarised in Table 8.9; but detailed descriptions of each can be found in Volume 3, the Investment Portfolio.

Table 8.9: Programmes for the Major Cities (Immediate Objective MC 1)

MIS Ref	Title	Description	Key Programme Objective
MC 001	Inventory and Asset Management Plan of Water Supply & Sanitation Sector	Much of the water supply and sanitation infrastructure in Bangladesh is either poorly maintained due to lack of investment in operation and maintenance or reaching the end of its useful life. However, without a detailed and clear understanding of the existing situation there is little point in carrying out major investment. Before any new investment is made on these rapidly deteriorating systems it is essential to obtain a better understanding of the condition and performance of the existing underground and above ground assets. Such an exercise is commonly referred to as an asset management plan (AMP) and is the intention of this programme.	Detailed development plan for water supply and sanitation facilities in the SMA's
MC 002	Dhaka Bulk Water Supply and Distribution Systems	Water allocation for domestic and municipal use is the first priority under the NWPo. This programme, which responds to both the NWPo and the National Policy for Safe Water Supply and Sanitation (NPSWSS), aims to address the need for "…safe and affordable drinking water supplies through various means..." for all inhabitants, especially the urban poor (NWPo §4.6.a). The population of Dhaka is expected to treble over the next 25 years, from 9 million in 2000 to 27 million in 2025. At present, only 76% of the population is served by the main public water supply system, the rest being dependant on unreliable and increasingly polluted local sources. This programme deals with the massive task of rehabilitation, improvement and extension of the city's water supply systems in order to raise and sustain coverage levels at 100% by 2010. It will be accomplished through the development of new water sources, improvement and expansion of the existing DTW-fed system, and the introduction of safe hand-pumps fed by small DTW systems in peri-urban and poor common communities.	100% of Dhaka's population have access to formal water supplies
MC 003	Chittagong Bulk Water Supply and Distribution Systems	Water allocation for domestic and municipal use is the first priority under the NWPo. This programme, which responds to both the NWPo and the National Policy for Safe Water Supply and Sanitation (NPSWSS), aims to address the need for "…safe and affordable drinking water supplies through various means..." for all inhabitants, especially the urban poor (NWPo §4.6.a). The population of Chittagong is expected to more than double over the next 25 years, from 2.5 million in 2000 to 6 million in 2025. At present, only 55% of the population is served by the main public water supply system, the rest being dependant on unreliable and increasingly polluted local sources. This programme deals with the massive task of rehabilitation, improvement and extension of the city's water supply systems in order to raise coverage levels to 95% by 2010, and then to sustain it at 100% beyond that date. It will be accomplished through the development of new water sources, improvement and expansion of the existing DTW-fed system in peri-urban and poor common communities.	100% of Chittagong's population have access to formal water supplies

MIS Ref	Title	Description	Key Programme Objective
MC 004	Khulna Bulk Water Supply and Distribution Systems	Water allocation for domestic and municipal use is the first priority under the NWPo. This programme, which responds to both the NWPo and the National Policy for Safe Water Supply and Sanitation (NPSWSS), aims to address the need for "…safe and affordable drinking water supplies through various means..." for all inhabitants, especially the urban poor (NWPo §4.6.a). The population of Khulna is expected to more than double over the next 25 years, from 1.1 million in 2000 to 2.4 million in 2025. At present, only 51% of the population is served by the main public water supply system, the rest being dependant on unreliable and increasingly polluted local sources. This programme deals with the massive task of rehabilitation, improvement and extension of the city's water supply systems in order to raise and sustain coverage levels at 100% by 2010. It will be accomplished through the development of new water sources, improvement and expansion of the existing DTW-fed system in peri-urban and poor common communities.	100% of Khulna's population have access to formal water supplies
MC005	Rajshahi Bulk Water Supply and Distribution Systems	Water allocation for domestic and municipal use is the first priority under the NWPo. This programme, which responds to both the NWPo and the National Policy for Safe Water Supply and Sanitation (NPSWSS), aims to address the need for "…safe and affordable drinking water supplies through various means..." for all inhabitants, especially the urban poor (NWPo §4.6.a). The population of Rajshahi is expected to triple over the next 25 years, from 0.7 million in 2000 to 2.3 million in 2025. At present, only 40% of the population is served by the main public water supply system, the rest being dependant on unreliable and increasingly polluted local sources. This programme deals with the massive task of rehabilitation, improvement and extension of the city's water supply systems in order to raise and sustain coverage levels at 100% by 2010. It will be accomplished through the development of new well fields, improvement and expansion of the existing DTW-fed system, and the introduction of safe hand-pumps fed by small DTW systems in peri-urban and poor common communities.	100% of Rajshahi's population have access to formal water supplies

Table 8.10: Programmes for the Major Cities (Immediate Objective MC 2)

MIS Ref	Title	Description	Key Programme Objective
MC 006	Dhaka Sanitation and Sewerage System	The NWPo "mandates relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health." (NWPo §4.6.c). The population of Dhaka is expected to treble over the next 25 years, from 9 million in 2000 to 27 million in 2025. At present, about 68% of the population is adequately served by sanitation facilities. The main public sewerage system is in poor condition and is inadequately maintained, and as such is likely to exacerbate pollution and public health problems and increase the likelihood of epidemic outbreaks of waterborne and water-related diseases. This programme aims to ensure that by 2010, there are appropriate sanitation facilities for 98% of the city's population.	100% of Dhaka's population have access to sanitation facilities

MIS Ref	Title	Description	Key Programme Objective
MC 007	Chittagong Sanitation and Sewerage System	The NWPo "mandates relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health." (NWPo §4.6.c). The population of Chittagong is expected to more than double over the next 25 years, from 2.5 million in 2000 to 6.1 million in 2025. At present, about 52% of the population is adequately served by sanitation facilities, mainly by pit latrines with/without septic tanks. Only one part of the city is served by a smallbore sewerage system which is in poor condition. There is no conventional waterborne sewerage system. In the slums and other disadvantaged areas, more than 95% are dependant on 'hanging latrines' and open defecation which exacerbates pollution and public health problems and increases the likelihood of epidemic outbreaks of waterborne and water-related diseases. This programme aims to raise and sustain appropriate service coverage to 100% of Chittagong inhabitants by 2010.	100% of Chittagong's population have access to sanitation facilities
MC 008	Khulna Sanitation and Sewerage System	The NWPo "mandates relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health." (NWPo §4.6.c). The population of Khulna is expected to more than double over the next 25 years, from 1.1 million in 2000 to 2.4 million in 2025. At present, about 51% of the population is adequately served by sanitation facilities, mainly by pit latrines with/without septic tanks. In one part of the city there is a smallbore sewerage system which is now defunct. There is no conventional waterborne sewerage system. In the slums and other disadvantaged areas, people are dependant on 'hanging latrines' and open defecation which exacerbates pollution and public health problems and increases the likelihood of epidemic outbreaks of waterborne and water-related diseases. This programme aims to raise and sustain appropriate service coverage to 100% by 2010.	100% of Khulna's population have access to sanitation facilities
MC 009	Rajshahi Sanitation and Sewerage System	The NWPo "mandates relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health." (NWPo §4.6c). The population of Rajshahi is expected to more than triple over the next 25 years, from 0.7 million in 2000 to 2.3 million in 2025. At present, about 70% of the population is adequately served by sanitation facilities, mainly by pit latrines with/without septic tanks. There is no conventional waterborne sewerage system. In the slums and other disadvantaged areas, people are dependant on 'hanging latrines' and open defecation which exacerbates pollution and public health problems and increases the likelihood of epidemic outbreaks of waterborne and water-related diseases. This programme aims to raise and sustain appropriate service coverage to 100% by 2010.	100% of Rajshahi's population have access to sanitation facilities

Table 8.11: Programmes for the Major Cities (Immediate Objective MC 3)

MIS Ref	Title	Description	Key Programme Objective
MC 010	Dhaka Flood Protection	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i) After Dhaka was severely affected by the 1988 flood, the western flood embankment was constructed. During the 1998 flood it afforded some relief to parts of the city but the eastern part was extensively inundated. There are significant areas of existing development in Dhaka where reconstruction and the associated opportunity to raise land will not occur for many years. This programme will provide flood control infrastructures along right bank of the Balu River, which will include construction of a flood embankment, flood wall and drainage sluices.	Dhaka protected from 1:100 year flood
MC 011	Dhaka Stormwater Drainage	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i). The progressive expansion and urbanization of Dhaka increases the need for storm drainage as the increase in paved surfaces hastens runoff rates and reduces infiltration thereby causing urban flooding. Each heavy rainstorm causes inconvenience and sometimes major damage and disruption as a result of ineffective or inadequate drainage. This 38500TkM programme will mitigate Dhakas' drainage problem by providing a properly planned, comprehensive drainage system ranging from collection of water at local street level to disposal of accumulated drainage water at pump stations.	Dhaka served by stormwater drainage
MC 012	Chittagong Flood Protection	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i). The low areas of Chittagong city are vulnerable to flooding during cyclones and spring tides. Local flooding is also caused by heavy rainfall and poor internal drainage. This programme is to provide an embankment or flood wall on the Karnaphuli River banks, proper maintenance of the existing sea dyke along with construction of new wave protection works, drainage sluices etc. In addition, this programme provides for the installation of pumps for selected areas and maintenance of internal drains. The short to medium term beneficiaries of the programme will comprise some 3.1 million estimated to be at risk of the cyclone threat once every forty years or less.	Chittagong protected from 1:100 year flood
MC 013	Chittagong Stormwater Drainage	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i) The progressive expansion and urbanization of Chittagong City increases the need for storm drainage as the increase in paved surfaces hastens runoff rates and reduces infiltration thereby causing urban flooding. Each heavy rainstorm causes inconvenience and sometimes major damage and disruption as a result of ineffective or inadequate drainage. This programme will mitigate Chittagongs' stormwater drainage problem by providing a properly planned, comprehensive drainage system ranging from collection of water at local street level to disposal of accumulated drainage water at pump stations.	Chittagong served by stormwater drainage
MC 014	Khulna Flood Protection	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i). Some of the lower,	Khulna protected from 1:100 year flood

MIS Ref	Title	Description	Key Programme Objective
		southern parts of Khulna are vulnerable to flooding during spring tides and a flood protection embankment with tidal sluices has been constructed to provide protection. However, the protected area is vulnerable to waterlogging when the drainage sluices cannot be operated due to high external water levels. In other parts of the city, local flooding is caused by heavy rainfall due to inadequate storm drainage. This programme contains measures to address these problems.	
MC 015	Khulna Stormwater Drainage	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i) . The progressive expansion and urbanization of Khulna City increases the need for storm drainage as the increase in paved surfaces hastens runoff rates and reduces infiltration thereby causing urban flooding. This programme will mitigate Khulnas' stormwater drainage problem by ensuring a properly planned, comprehensive drainage system ranging from collection of water at local street level to disposal of accumulated drainage water at pump stations.	Khulna served by stormwater drainage
MC 016	Rajshahi Flood Protection	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i). Rajshahi already has a flood embankment system; but this needs protection against erosion damage. This programme will deliver suitable remedial measures necessary to ensure the flood embankment groynes remain effective as flood protection for the city of Rajshahi.	Rajshahi protected from 1:100 year flood
MC017	Rajshahi Stormwater Drainage	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i). The progressive expansion and urbanization of Rajshahi City increases the need for storm drainage as the increase in paved surfaces hastens runoff rates and reduces infiltration thereby causing urban flooding. This programme will mitigate Rajshahis' stormwater drainage problem by ensuring a properly planned, comprehensive drainage system ranging from collection of water at local street level to disposal of accumulated drainage water at pump stations	Rajshahi served by stormwater drainage

8.3.3 Costs of the Major City Programmes

Cost estimates of the Major City Programmes are summarised below in Table 8.12. Details of how these estimates were derived is provided in Volume 3. Again, residual costs are notional only, in that they are required not to finish the programme, but rather to maintain capacity ahead of demand in the early years after the Plan.

Table 8.12: Estimated Costs of the Major City Programmes

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
MC001	Inventory and Asset Management Plan of Water Supply & Sanitation Sector	12.5	-	-	-	12.5
MC002	Dhaka Bulk Water Supply and Distribution Systems	5,200.0	25,900.0	61,550.0	2,500.0	95,150.0
MC003	Chittagong Bulk Water Supply and Distribution Systems	1,100.0	6,000.0	15,917.0	1,000.0	24,017.0
MC004	Khulna Bulk Water Supply and Distribution Systems	450.0	2,500.0	4,429.0	500.0	7,879.0
MC005	Rajshahi Bulk Water Supply and Distribution Systems	250.0	1,500.0	2,937.0	400.0	5,087.0
MC006	Dhaka Sanitation and Sewerage Systems	6,000.0	19,000.0	62,176.0	2,500.0	89,676.0
MC007	Chittagong Sanitation and Sewerage Systems	450.0	3,550.0	9,479.0	500.0	13,979.0
MC008	Khulna Sanitation and Sewerage Systems	150.0	900.0	4,114.0	500.0	5,664.0
MC009	Rajshahi Sanitation and Sewerage Systems	125.0	850.0	2,749.0	150.0	3,874.0
MC010	Dhaka Flood Protection	2,410.0	2,410.0	489.9	113.1	5,423.0
MC011	Dhaka Stormwater Drainage	4,000.0	18,400.0	14,475.0	1,625.0	38,500.0
MC012	Chittagong Flood Protection	438.5	438.5	-	-	877.0
MC013	Chittagong Stormwater Drainage	-	7,600.0	4,400.0	-	12,000.0
MC014	Khulna Flood Protection	166.5	233.1	44.4	-	444.0
MC015	Khulna Stormwater Drainage	500.0	1,900.0	1,143.0	181.0	3,724.0
MC016	Rajshahi Flood Protection	75.0	225.0	100.0	-	400.0
MC017	Rajshahi Stormwater Drainage	750.0	2,539.6	1,559.4	375.0	5,224.0
	TOTAL	22,077.5	93,946.2	185,562.7	10,344.1	311,930.5

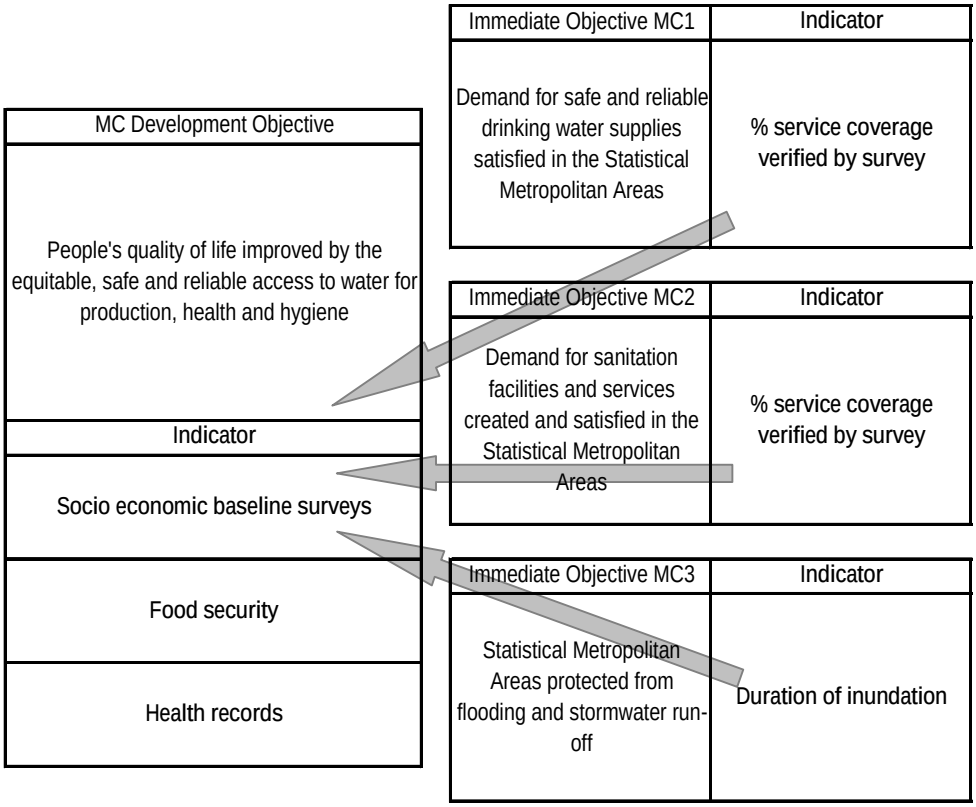
8.3.4 Assumptions

The key assumption for this cluster is that the private sector will be willing to participate in the financing of water supply and sanitation facilities (see section 13 "Funding the NWMP"). This in turn assumes that adequate regulation will be unencumbered by political and other vested interests, and that cost recovery is achievable (again see Section 13) in line with NWPo Guidelines.

8.3.5 Indicators

Indicators for the Major City Programmes are suggested in Figure 8.9.

Figure 8.9: Key Indicators for the Major Cities Programmes



8.4 *Programme for Disaster Management*

8.4.1 Objectives for Disaster Management

Although it is a truism that no country can divorce socio-economic activity from its need for adequate, manageable and timely supplies of freshwater, it is equally true to say that the life and culture of some countries is far more extensively shaped by their hydrology than others. Among such countries, Bangladesh must surely be one of the more extreme examples and this is particularly so with respect to the enormous potential threat to socio-economic activity, and life itself that Bangladesh's vast water resources represent when in spate.

There are three causes of flooding in Bangladesh:

- In-stream flows large enough to cause overtopping;
- Surface run-off resulting from intense precipitation events especially in the north east where they are blown in by fierce Nor'westers;

And,

- Sea level rises due to cyclone and or tidal surges.

While these represent significant and direct individual threats, in combination they become even more so. Large in-stream flows combined with say spring tides and a cyclone event (such as happened as recently as 1998) result in massive loss of life, livelihood, infrastructure and equipment. Equally, the impeded drainage caused by high river water levels greatly exacerbates the harm caused by intense rainfall events.

As well as these dangers which are clearly directly related to floods, there are also other indirect threats. These include disrupted communications when highways and railways become inundated; drought and land loss due to increased erosion (but this is addressed in the Main Rivers Cluster).

Prevention of flooding is not justified however: the costs would be prohibitive while the actuarial ramifications would remain uncertain. The approach adopted for the NWMP therefore addresses mitigation rather than prevention of flood related disasters. It has four facets:

- improved warning and preparedness systems (the relevant programmes for which are included in the institutional development cluster);
- social measures based on improved or more appropriate dissemination and response procedures (again the relevant programmes for which are included in the institutional development cluster);
- physical and social mitigation measures such as elevated platforms, cyclone shelters, raised highways and the like;

and,

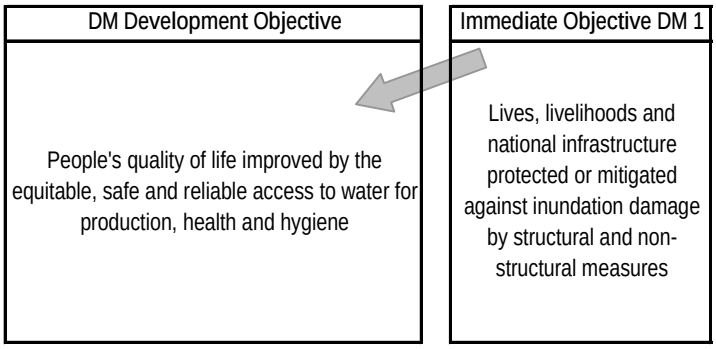
- multiple use of infrastructure, made possible for instance by designing cyclone shelters such that they can be used as schools or other community facilities, or by ensuring the accessibility of raised highway or railway embankments as safe havens for potential flood victims.

And in full consideration of the proven gender related dimension to flood deaths[5] wherever meaningful, the interventions will include options or facilities for women.

The Objectives of the Disaster Management Programmes are suggested in Figure 8.10.

[5] Women for instance i) are often expected to remain behind to look after household chattels, ii) have their movements in rising, fast moving waters fatally hindered by traditional garments or iii) are marginalized or denied access to shelters without gender specific sanitation facilities.

Figure 8.10: Objectives of the Disaster Management Programmes



8.4.2 *Programmes for Disaster Management*

Six programmes are suggested in order to achieve the Immediate water sector Objectives of Disaster Management. They are summarised in Table 8.13; but detailed descriptions of each can be found in Volume 3, the Investment Portfolio.

Table 8.13: Programmes for the Disaster Management (Immediate Objective DM 1)

MIS Ref	Title	Description	Key Programme Objective
DM 001	Cyclone Shelters and Killas	This programme is for the cyclone risk areas and is relevant to the NWPo as it provides "flood proofing systems to manage natural disasters: (NWPo §4.2.o) and takes special account the particular needs of women and children (NWPo §3.b) while motivating the people themselves to develop different flood proofing measures. The programme will provide safe havens in the form of proven infrastructure comprising raised and covered cyclone shelters and killas (raised mounds) where both humans and livestock can take refuge. Short to medium term beneficiaries of the programme will comprise some 1.72 million people estimated to be at a risk of serious cyclone threat at least once every 30 years or less. In the long term the programme will be extended to cover lower risk areas corresponding to a maximum return periods of 1:100 years and will be closely linked with programme DM 002 "Bari-level Cyclone Shelter".	775 multi-purpose shelters and 1369 killas constructed in cyclone prone areas
DM 002	Bari-level Cyclone Shelters	This programme is for the cyclone risk areas and is relevant to the NWPo as it provides "flood proofing systems to manage natural disasters: (NWPo §4.2.o) and takes special account the particular needs of women and children (NWPo §3.b) while motivating the people themselves to develop different flood proofing measures. Over three million people live or subsist in areas exposed to significant risk of destruction and loss of life due to cyclone strike. This programme is intended to provide safe havens in the form of $12m^2$ concrete framed buildings on raised $72m^2$ earth platforms, one in each bari in the coastal areas. A total of 43,768 bari-level-cyclone-shelters will be raised over 15 years, benefiting some 1.72 million people in the short/medium term.	43776 bari-level cyclone shelters
DM 003	Flood Proofing in the Charlands and Haor Basin	NWPo §4.2.o of the NWPo requires the Government, through it's responsible agencies, to develop flood proofing systems to manage natural disasters, and clause p of the same section requires that appropriate measures are provided, in designated flood risk zones, to protect life, property and vital infrastructure etc. This programme is concerned with providing proven cost effective technologies for flood proofing such as encouraging raised dwellings and the construction of communal flood shelters.	3500000 charland and haor basin inhabitants in flood proofed dwellings
DM 004	National, Regional and Key Feeder Roads - Flood Proofing	In line with Policy's call for coping with floods in relation to vital infrastructure (NWPo §4.2.p.ii), this programme targets the flood proofing needs of key portions of Bangladesh's highway network. As with current practice, the National Highways, Regional Roads and Type A Feeder Roads will be raised by the central Roads and Highways Department (RHD). Type B Feeder Roads and Rural Roads will be raised by the Local Government Engineering Department (LGED). The programme also has collateral benefits since the raised embankments comprise safe havens while facilitating the movement of relief goods during flood emergencies. This is a long term programme with national coverage, however it has been assumed that embankment raising will be carried out when a particular road is due for major maintenance or re-surfacing, with priority given to high risk areas in the case of national and regional roads..	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	In line with Policy's call for coping with floods in relation to vital infrastructure (NWPo §4.2.p.ii), this programme targets at	100% of all high risk railways raised by 1m

MIS Ref	Title	Description	Key Programme Objective
		the flood proofing needs of key portions of Bangladesh's railway network. The Railway Department will be responsible for implementation of this programme. The programme has collateral benefits since the raised embankments comprise safe havens while facilitating the movement of relief goods during flood emergencies. This is a long term programme with coverage in six hydrological regions and work is expected to proceed as part of the network upgrading programmes. However, a significant risk to this programme is that the disruption to services that is inevitable when line raising is in progress, may well persuade the railway operators that it is cheaper to lose income for a few hours or days each year than to incur expenditure raising lines while simultaneously losing revenues for that period.	and 100% of low risk railway raised by .5m
DM 006	Supplementary Irrigation and Drought Proofing of Rural Water Supplies	This programme aims to promote supplementary irrigation during the drought-prone aman season, as well as including efforts to drought-proof rural water supplies.	Increased quality of life in target areas

8.4.3 Costs of the Disaster Management Programmes

Cost estimates for the Disaster Management Programmes are summarised in Table 8.14 Below. Details of how these estimates were derived are provided in Volume 3.

Table 8.14: Estimated Costs of the Disaster Management Programmes

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
DM 001	Cyclone Shelters and Killas	1,978.9	3,298.2	4,617.5	-	9,894.6
DM 002	Bari-level Cyclone Shelters	94.0	360.3	1,100.7	192.9	1,747.9
DM 003	Flood Proofing in the Charlands and Haor Basin	519.9	1,299.7	779.8	-	2,599.4
DM 004	National, Regional and Key Feeder Roads - Flood Proofing	1,744.8	2,181.0	6,542.9	436.2	10,904.8
DM 005	Railway Flood Proofing	156.3	195.4	586.2	39.1	977.0
DM 006	Supplementary Irrigation and Drought Proofing of Rural Water Supplies	486.6	474.8	80.0	-	1,041.4
	TOTAL	4,980.5	7,809.4	13,707.0	668.2	27,165.1

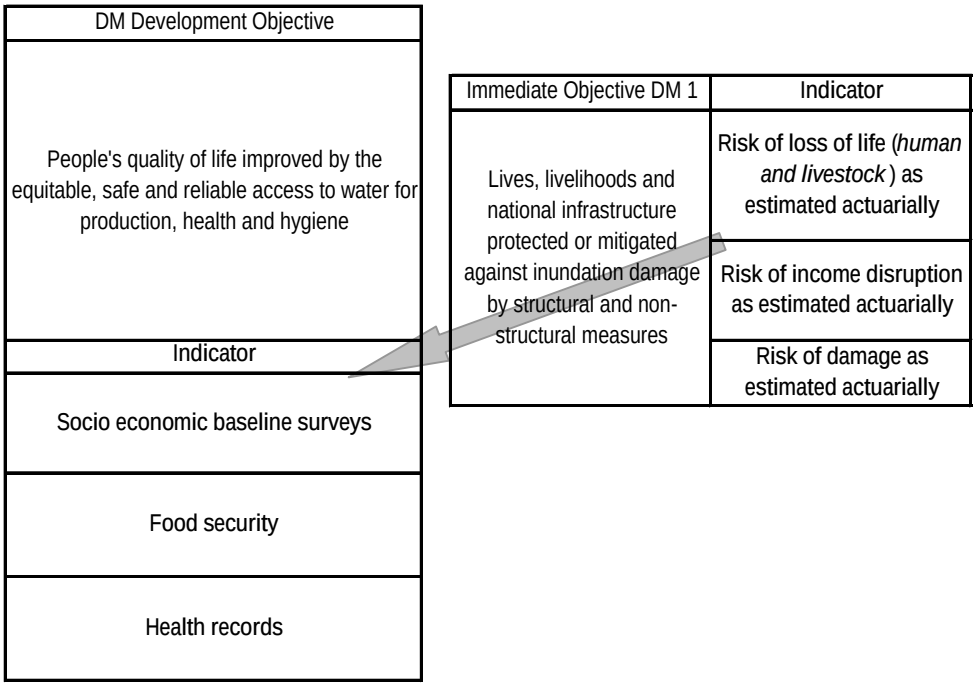
8.4.4 Assumptions

This cluster has two critical assumptions. The first is that the poorer members of society will have equal access to flood proofed facilities (which may become attractive to more powerful interests after flood proofing). And secondly, that private railway operators will comply with policy by taking particular lengths of track out of service for as long as necessary to raise them in accordance with policy.

8.4.5 Indicators

Indicators for the Disaster Management Programmes are suggested in Figure 8.11.

Figure 8.11: Key Indicators of Disaster Management

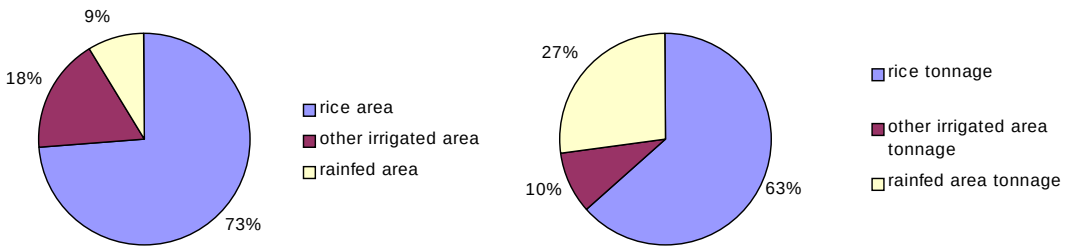


8.5 *Programme for Agriculture and Water Management*

8.5.1 Objectives for Agriculture and Water Management

Agriculture is the largest sector of the Bangladeshi economy as well as being its largest employer. In the terms of areas and tonnage, the sector is dominated by irrigated rice, Figure 8.12 refers.

Figure 8.12: Crops in Bangladesh compared by Areas and Tonnage



However, substantive questions concerning the long term role that rice will play in the Bangladeshi economy may be justified. As an import substitute the economics of rice remain convincing; equally, it is reasonable to expect Bangladesh to retain a degree of comparative advantage as net exporter of rice, especially when fertiliser regimes are better understood by the farmers whereupon substantial yield increases

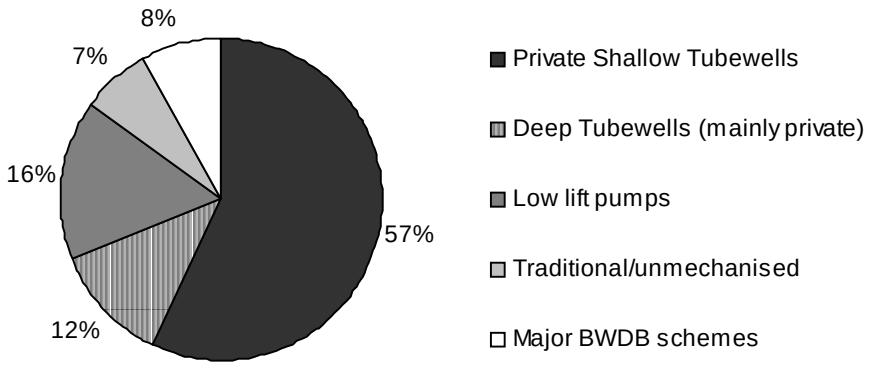
will be achieved at little extra cost. Even so three trends may tend to mitigate against this.

First, as the economy continues to industrialise and grow, experience elsewhere suggests it to be likely that local demand for rice will decrease in relation to other staples. Second, forecasts made during the development strategy studies suggest that the returns of irrigated rice against family labour will decrease against most current crops, this trend is likely to increase as the demand for more, higher value crops widens. This raises the possibility that farmers may shift to more productive farming systems once a suitable market emerges and is understood by them. Third, climate change studies have indicated that by the middle of this century, evaporation precipitation ratios may increase significantly during the pre-saturation and establishment phase of the Kharif I and Rabi rice crops. For paddy this will mean a significant increase in irrigation water requirements, made more so by the fact that effective rainfall will be low on the flooded fields. However, long term diversification towards dry foot crops may obviate this challenge by reducing irrigation demand and increasing the effectiveness of such rainfall that does fall.

Furthermore, just as coastal arthropod production has expanded so massively in response to export demand, so might the production of higher value irrigated crops.

As well as being dominated by rice, the irrigation sector is also dominated by private shallow tubewells and to a lesser extent deep tubewells, as confirmed by Figure 8.13.

Figure 8.13: Percentage of Total Irrigated Area by Irrigation Method



Yet for 44% of the country groundwater is not available or accessible in sufficient or economically viable quantities for irrigation purposes. In such areas surface supplies are used, where low lift pumping proves to be the cheapest form of irrigation, provided that sufficient water is available nearby.

Surface water irrigation schemes however, have also proved more challenging to operate and maintain, and this is especially true of large schemes under the centralised control of BWDB. Consequently there is a large rehabilitation and

upgrading challenge which itself must be faced within the context of the major institutional restructuring required by the NWPo.

This will result in four levels in the civil administrative hierarchy for the water sector. For instance, the management of FCD and FCD/I schemes up to 5000 ha will become the responsibility of local and community organisations, with operation and maintenance funded through local mechanism based largely on cost recovery models as per NWPo Guidelines. Responsibility for larger schemes will become shared between private sector interests (leasing, concessions or management services), local governments and community organisations. Finally, ownership of such schemes that fall below 1000ha will be transferred to local government institutions.

Accordingly there is a need not only to render the schemes suitable for and indeed worth transferring, but also to invest in the equipment and facilities necessary to maintain them over the long term; increase water use efficiency and raise the returns per unit of water or labour. In some areas this will mean the introduction or strengthening of conjunctive use (i.e. the use of both surface and groundwater) and/or the extension of surface distribution networks. And this itself introduces interesting institutional questions. Vested interests still prefer expensive high level surface schemes, whereas distribution systems based on low level canals from which water is abstracted by individual or group pumpsets are not only cheaper to build and maintain, they are also preferred by the farmers because of the increased self determinacy and equitability involved.

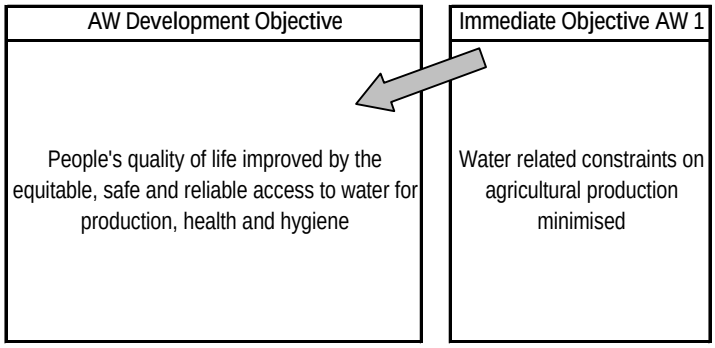
Indeed, there is increasing evidence of a tangible demand for small-scale community managed schemes aimed at resolving local water management problems where shallow flooding occurs or where, through conservation or channel development, enhancements may be made to support fisheries and irrigation.

Management of water resources in the coastal areas presents particular problems given the inter-actions between upland freshwater flows and tidally driven saline flows. These are rendered more complex by the impacts that the coastal polder systems have had on sedimentation patterns and the sustainability of the drainage networks. Furthermore, sea-level rise and increased tidal ranges will bring about further hydrological and morphological changes. Government has recognised that, together with management of erosion and accretion, these problems must be addressed through a fully integrated approach involving both structural and non-structural interventions. To this end, a Master Plan study has been completed of the Meghna estuary and an Integrated Coastal Zone Management Plan is in preparation. Along with other studies undertaken, these plans are expected to provide a basis for developing sustainable solutions in the coastal areas.

Government should attach importance to the sustainable land use management of the Land reclaimed from the sea and make appropriate programmes in agriculture and forestry sectors.

As a consequence of the foregoing this cluster is therefore concerned with expanded wise use of efficiently applied and equitably distributed water: a suitable objective is suggested in Figure 8.14.

Figure 8.14: Objective of the Agriculture and Water Management Programmes



8.5.2 *Programmes for Agriculture and Water Management*

Eight programmes are suggested in order to achieve the Immediate Objectives for Agriculture and Water Management. They are summarised in Table 8.15; but detailed descriptions of each can be found in Volume 3, the Investment Portfolio.

Table 8.15: Programmes for Agriculture and Water Management (Immediate Objective AW)

MIS Ref	Title	Description	Key Programme Objective
AW 001	Promotion of Expanded Minor Irrigation and Improved On-farm Water Management	It is the policy of the Government to "Encourage and promote continued development of minor irrigation" (NWPo §4.7.a) and to "Encourage future groundwater development for irrigation by both the public and the private sectors" (NWPo §4.7.b). With the ultimate goal of increased agricultural productivity, this programme involves the improvement of irrigation pumping efficiency, promotion of lower cost force-mode tubewell pumps, and a farmer education/training component to improve on-farm water management and the wise use of water	Average return per unit of water increased in minor irrigation areas
AW 002	Improved Performance of Existing Public Surface Water Irrigation Schemes	It is the policy of the government to "encourage future groundwater development for irrigation by both the public and private sectors" (NWPo §4.7.b). Even so experience confirms that current performance of existing public irrigation schemes is not satisfactory. This programme is intended to address both challenges by means of the following approaches: full participation of beneficiaries; command area development; conjunctive use of surface and groundwater; rehabilitation; improved O&M and appropriate beneficiary contributions to both capital and recurring costs.	Increased returns per unit of water and labour on public irrigation areas
AW 003	New Public Surface Water Irrigation Schemes	The preamble NWPo §4.7 requires government to continue promoting the development of surface water irrigation where feasible and to focus where practical on the conjunctive use of groundwater and surface water. The overall objective of this programme is to increase agricultural production and reduce demand on groundwater abstraction by promoting and implementing new surface water irrigation schemes.	Increased area under public surface water irrigation
AW 004	New Public Deep Tubewell Irrigation Schemes	It is the policy of the Government that "support of private development of groundwater irrigation for promoting agricultural growth will continue" (NWPo §4.7). GoB policy is that TW irrigation should be a private rather than a public sector activity.	Increased area under public deep tubewell irrigation

MIS Ref	Title	Description	Key Programme Objective
		However, subsidised DTW irrigation development in socially-deprived areas where irrigation is otherwise unaffordable may be justified on social and economic grounds; where drilling is difficult or costly and where surface water is limited. This programme will deal with the installation of an estimated 2000 new deep tube wells to meet these needs.	
AW 005	Improved Water Management at Local Government Level	Implementation of the NWPo will result in a four tiered civil-administrative hierarchy for the water sector: central, regional, local and community. The BWDB will remain responsible for water management issues as they affect or occur in the main and regional rivers. Equally, management of certain schemes below 5000ha will become the responsibility of community based organisations. Water courses, whether natural or man-made, that will be the management responsibility of neither BWDB nor community organisations will become the responsibility of LGI's. Furthermore, actual ownership of all schemes except municipal water schemes will be transferred to the LGI's. This programme is intended to rehabilitate, upgrade and restore as appropriate, the water courses involved as well as to provide the LGI's with the necessary appurtenant equipment and facilities.	Local rivers, feeders canals and main drains restored, rehabilitated, upgraded as appropriate
AW 006	Improved Water Management at Community Level	Implementation of the NWPo will result in a four tiered civil-administrative hierarchy for the water sector: central, regional, local and community. The BWDB will remain responsible for water management issues as they affect or occur in the main and regional rivers. Local rivers and scheme delivery systems will become the management (and in some cases property) of LGI's while management of certain schemes below 5000ha will become the responsibility of community based organisations. This programme is intended to rehabilitate, upgrade and restore as appropriate, the water courses and field distribution/collection systems involved as well as to assist in providing with the necessary appurtenant equipment and facilities.	Sustainable sub-secondary water use efficiencies of 60% for paddy and 75% for dryfoot crops
AW 007	Rationalisation of Existing FCD Infrastructure	The NWPo states that "Ownership of FCD and FCDI projects with command area of 1000 ha or less will gradually be transferred to the local governments, beginning with the ones that are being satisfactorily managed and operated by the beneficiary/ community organisations." (NWPo §4.4.f) and that is also the policy of the government to "Investigate thoroughly, important flood control and management issues, such as the efficacy of coastal polders, for guiding future policy on structural interventions" (NWPo §4.15.c). This programme will assess and rationalise all existing FCD schemes by specifying and implementing the appropriate course of action for each scheme according to the following options: a) continuation of the present situation; b) handover to beneficiaries or local govt.; c) rehabilitation and improvement; d) complete withdrawal.	Increased returns per unit of water and labour in public irrigation areas
AW 008	Land Reclamation, Coastal Protection and Afforestation	NWPo Article 4.2(r) states that the Government will "*Plan and implement schemes for reclamation of land from the sea and rivers*". In line with this Article, studies will be undertaken for reclamation of land from estuary region and sea. The NWPo also recognises the importance of coastal embankments/polders with the statement that it is the policy of the government to "Investigate thoroughly, important flood control and management issues, such as the efficacy of coastal polders, for guiding future policy on structural interventions." (NWPo §4.15.c). Another purpose of this programme is to embank and where necessary provide arborial protection to accreted land thereby protecting life/property/livelihoods from tides, or scend.	1550 km^2 of new coastal land protected; and land reclamation and accretion study document.

8.5.3 *Costs of the Agriculture and Water Management Programmes*

Estimated costs of the Agriculture and Water Management Programmes are summarised below in Table 8.16. Detailed of how these estimates were derived are provided in Volume 3.

Table 8.16: Estimated Costs of the Agriculture and Rural Development Programmes

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
AW 001	Promotion of Expanded Minor Irrigation and Improved On-farm Water Management	90.0	108.0	112.0	-	310.0
AW 002	Improved Performance of Existing Public Surface Water Irrigation Schemes	163.8	818.8	2,292.5	-	3,275.0
AW 003	New Public Surface Water Irrigation Schemes	-	2,041.7	4,083.3	-	6,125.0
AW 004	New Public Deep Tubewell Irrigation Schemes	440.0	1,100.0	660.0	-	2,200.0
AW 005	Improved Water Management at Local Government Level	440.0	855.0	3,937.5	262.5	5,495.0
AW 006	Improved Water Management at Community Level	20.0	173.0	630.0	42.0	865.0
AW 007	Rationalisation of Existing FCD Infrastructure	-	914.9	13,675.1	6,881.7	21,471.7
AW 008	Land Reclamation, Coastal Protection and Aforestation	504.0	1,228.5	4,134.4	-	5,866.9
	TOTAL	1,657.8	7,239.8	29,524.9	7,186.2	45,608.6

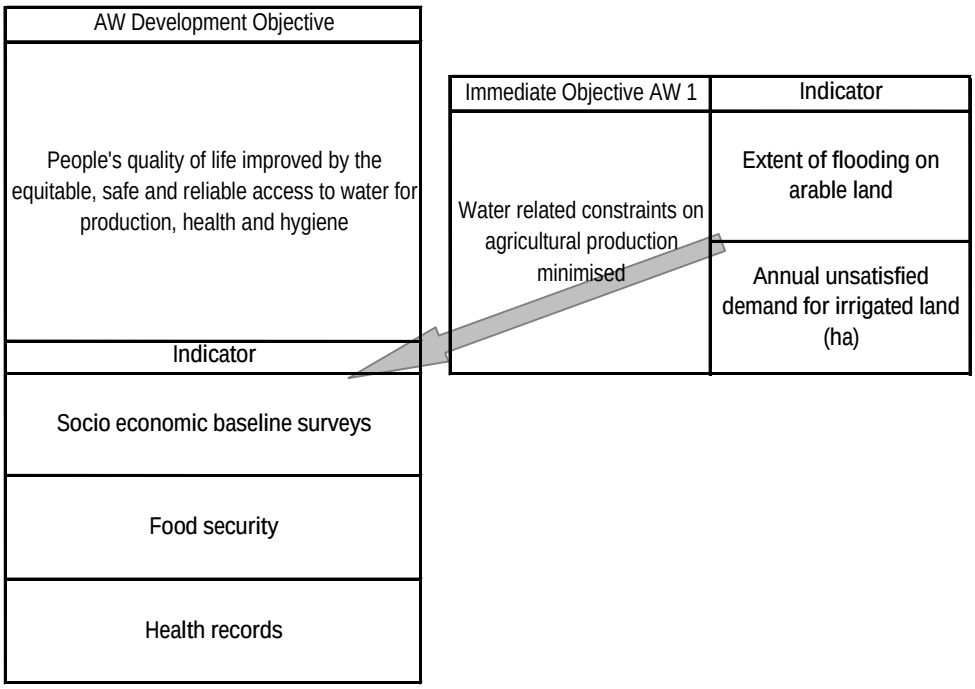
8.5.4 *Assumptions*

The principle assumption behind this cluster is that farmers can be persuaded to invest in increased efficiency in terms of both water and energy. Equally, it is assumed that the establishment of Local Government Institutions will continue as per schedule or even accelerate. Finally, it is necessary to assume that decentralisation of the water sector can actually be accomplished in Bangladesh; but this key issue is reflected in the long view adopted by the NWMP, as well as the importance placed on consultation and sensitisation at all levels of society and the civil administrative hierarchy.

8.5.5 *Indicators*

Indicators for the Agriculture and Rural Management Programmes are suggest in Figure 8.15.

Figure 8.15: Key Indicators for Agriculture and Water Management



8.6 *Programmes for the Environment and Aquatic Resources*

8.6.1 Objectives for the Environment and Aquatic Resources

Bangladesh's overwhelming social and economic dependence on its water resources will already be clear from the preceding text. There is however, an equally profound nexus between environmental health and the state of the nation's water resources. And this nexus comprises at least four dynamics, each of which is steadily declining: a trend which is disturbing enough when considered in isolation; but made more so by the global significance of two crucial wetlands, namely the Haor basin of the NE and the Sundarbans in the SE, as well as the local economic significance of marine fisheries, the food chains for which depend heavily on healthy brackish margins.

The first threat concerns the deteriorating water quality which is arising due to uncontrolled industrial discharges, including that from some of the world's dirtiest industries such as tanning (which has somehow to be accommodated in view of Bangladesh's advantageous position in the global leather market). Pollution is also increasing as a result of poor sanitation country wide as well as ill guided agrochemical regimes.

Secondly, in-stream flows are reducing causing in particular salinity and salinity related problems (such as increased flocculation penetrating further up the estuaries) in the environmentally crucial brackish margins. Furthermore, natural and beneficial floods are reducing as a result of flood defence works or embankments for roads or railways, which lead to the third problem as this same infrastructure has seriously compromised connectivity between water bodies that is essential for the long term aquatic biodiversity, productivity and gene pools, the effects of which are already

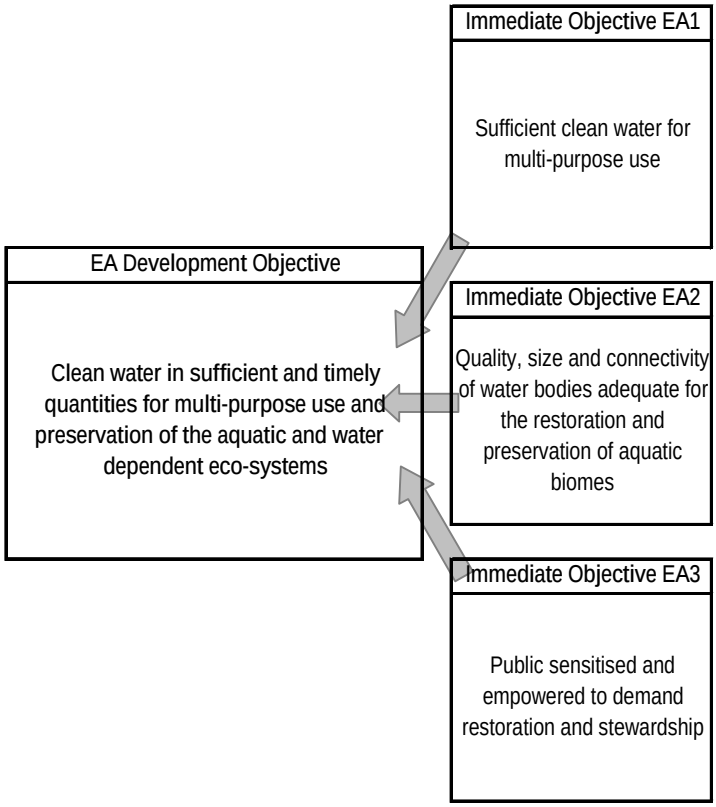
detectable in the form of declining capture fisheries which remain essential protein sources for the county's poor.

Finally there is the problem of encroachment on wetlands with similar effects on the aquatic biomes.

All these problems are exacerbated by the low socio-economic conditions which pertain across the country which results in the understandable; but nonetheless pernicious lack of grass roots demand (as yet)[6] for the application and enforcement of suitable environmental standards.

This cluster is therefore concerned with creating a public demand for a clean, sustainable environment; with cleaning up the existing mess, with ensuring that it does not happen again while restoring stream flows and connectivity of water bodies to levels consistent with the environmental demands placed upon them. Objectives for the cluster are suggested in Figure 8.16.

Figure 8.16: Objectives for the Environment and Aquatic Resources Programmes



6 It would be grossly unfair however, to let this comment pass without acknowledging the valuable campaigning work which is being to characterise the NGO movement in Bangladesh.

8.6.2 *Programmes for the Environment and Aquatic Resources*

Ten programmes are suggested in order to achieve the Immediate Objectives for the Environment and Aquatic Resources. They are summarised in Table 8.17; but detailed descriptions of each can be found in Volume 3, the Investment Portfolio.

Table 8.17: Programmes for the Environment and Aquatic Resources (Immediate Objective EA 1)

MIS Ref	Title	Description	Key Programme Objective
EA 001	National Pollution Control Plan	NWPo states that "pollution of both surface and groundwater around various industrial centres of the country by untreated effluent discharge into water bodies is a critical water management issue." This programme is intended to result quickly in a widely-agreed and politically-endorsed Pollution Control Plan, with clear, time-bound deliverables based on progressive compliance with anti-pollution regulations, notably the national Water Quality Standards (WQS.)For the short term, the anticipated Plan is expected to concentrate on 'fast-track' pilot clean-up projects for major pollution hot-spots and the establishment of suitable non-regulatory and regulatory instruments to assist the general clean-up process. It will set priority water quality indicators, notably pollutant parameters, for 'clean' and dirty water. The Action Plan and its dependent activities will be reviewed and modified as necessary as an integral part of the five-yearly reformulations of the NWMP and implemented over the medium and long term accordingly.	National Pollution Control Plan agreed
EA 002	National Clean-up of Existing Industrial Pollution	NWPo states that "pollution of both surface and groundwater around various industrial centres of the country by untreated effluent discharge into water bodies is a critical water management issue." Furthermore, "Industrial polluters will be required under law to pay for the cleanup of water-body polluted by them." (NWPo §4.8.d). Based on the National Pollution Control Plan (Programme EA 001), this programme will address directly the clean-up of existing pollution black spots and the enforcement of the polluter-pays principle.	Multi-purpose water use not constrained by quality considerations
EA 003	National Water Quality Monitoring	This programme is intended to spread the water quality monitoring effort away from known pollution black-spots towards prevention of pollution of clean and relatively clean water. This approach is justified because time and resources are better spent providing an early warning of pollution problems at vulnerable sites where remedial action is possible before ecological damage becomes irreversible. Prime targets for this water quality monitoring will be water sources with potential for supplying large scale potable water supply and ecologically sensitive areas.	Reduction of gross/persistent pollution

Table 8.18: Programmes for the Environment and Aquatic Resources (Immediate Objective EA 2)

MIS Ref	Title	Description	Key Programme Objective
EA 004	National Fisheries Master Plan	The country's inland fisheries, which provide employment for some 2M full-time and 12M part-time fishermen, account for 3% of total GDP and 60% of the animal protein intake. Following the 1999 National Fisheries Policy, a national fisheries strategy and sector development programme are urgently required to address the threats to the fisheries industry including such problems as fragmentation and reduced water availability for natural water bodies, disrupted hydraulic connections between them and physical structures that constrain fish movements. The purpose of this programme is to develop a fisheries development plan which will include provisions for protection of fish stocks, and of other important aquatic species, and for prevention or mitigation of the above negative impacts.	Wild fish stocks conserved or increased
EA 005	National Fish Pass Programme	The NWPo requires that "Fisheries and wildlife will receive due emphasis in water resource planning in areas where their social impact is high" (NWPo §4.9.a); "Measures will be taken to minimise disruption to the natural aquatic environment in streams and water channels." (NWPo §4.9.b), and; "Water development plans will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding." (NWPo §4.9.e). Yet there has been a reduction in fish production in recent years due, at least in part, to structures that inhibit fish migration routes. As a response, this programme will screen all existing FCD/I projects and prepare and implement a plan for mitigation works. Emphasis will be given to 'fish-friendly' structures rather than separate dedicated fish-pass structures.	Sustainable increase in floodplain fish catches, in terms of both numbers and diversity
EA 006	Unspecified Regional Programmes	The purpose of this programme is to ensure that provision is made for particular regional environmental concerns that are not well reflected in the other EA Programmes. This allows for comparatively small, but locally important issues to be dealt with according to regional priorities. This also implies regional (and down to village level) participation in identifying the concerns, which are therefore left non-specific at this stage.	Improvement in region-specific environmental characteristics
EA 007	Improved Water Management in The Haor Basins of the North East Region	The Haor Basin contains the last major remaining semi-natural and large-scale freshwater wetlands of the country and includes important mother-fish sites. The Basin is under threat from encroachment of agriculture and capture fisheries. The purpose of the programme is to safeguard the water resources and to preserve the semi-natural characteristics of the whole Basin with special attention being paid to the ecologically important sites. This will be achieved by the development and implementation of a staged, environmentally responsible water management plan for the area.	Water-related regulations established

MIS Ref	Title	Description	Key Programme Objective
EA 008	Environmentally Critical Areas and Integrated Wetland Management	The country's aquatic habitat is rapidly shrinking as a result of abstractions (especially for irrigation); flood control and agricultural encroachment. And deteriorating water quality exacerbates the problems. Supported by other measures, safeguarding the water resources of the nation's water bodies is necessary to arrest the trend and provide for both the human and the natural environments (eg health, nutrition, livelihoods, fish and broader biodiversity). This programme is intended to provide the necessary protection and sustainable use measures in the water sector as part of a wider integrated wetlands management (IWM) programme.	Improved levels of protection extended to existing and new environmentally critical areas
EA 009	Improved Water Management and Salinity Control in the Sundarbans	Whilst action will be taken under Programme MR 003 to remedy the shortages of upland flows, and under MR 007 to ensure effective rejuvenation of the river systems within the Ganges Dependent Area, insufficient is known about the Sundarbans inter-acts with the water regime in this complex tidal area. The purpose of this programme is to improve knowledge of the inter-actions between the ecological health of the forest reserve and the aquatic environment within which it is situated. An extensive scoping exercise will precede data collection and assessment. Provision is also made for long-term monitoring of selected parameters.	Pending

Table 8.19: Programmes for the Environment and Aquatic Resources (Immediate Objective EA 3)

MIS Ref	Title	Description	Key Programme Objective
EA 010	Public Awareness Raising and Empowerment in respect of Environmental Issues	The NWPo states that "Protection and preservation of the natural environment is essential for sustainable development." (§4.12). However, despite the existing support of environmentally concerned organisations, NGO's and individuals within Bangladesh, any actions are unlikely to be successful without considerably increased public awareness of the environmental issues and how the affect on their own lives. This programme will therefore involve both government and NGO's and will include wide-ranging dissemination of information and strengthening of environmental NGOs. Means to ensure access of people to effective remedies (eg. Environmental law and effective courts) will also be established.	Effective public demand for sustainable environmental stewardship

8.6.3 Costs of the Environment and Aquatic Resources Programmes

Estimated costs of programmes for the Environment and Aquatic Resources are summarised below in Table 8.20. Details of how these estimates were derived are provided in Volume 3.

Table 8.20: Estimated Costs of Programmes for the Environment and Aquatic Resources

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
EA 001	National Pollution Control Plan	300.0	380.0	420.0	-	1,100.0
EA 002	National Clean-up of Existing Industrial Pollution	360.0	1,800.0	2,100.0	-	4,260.0
EA 003	National Water Quality Monitoring	1,304.3	1,334.7	3,362.2	-	6,001.2
EA 004	National Fisheries Master Plan	300.0	-	-	-	300.0
EA 005	National Fish Pass Programme	400.0	1,000.0	1,600.0	-	3,000.0
EA 006	Unspecified Regional Programmes	-	141.6	458.3	-	600.0
EA 007	Improved Water Management in the Haor Basins of the North East Region	80.0	333.3	586.7	-	1,000.0
EA 008	Environmentally Critical Areas and Integrated Wetland Management	85.7	178.6	535.7	-	800.0
EA 009	Improved Water Management and Salinity Control in the Sundarbans	150.0	100.0	-	-	250.0
EA 010	Public Awareness Raising and Empowerment in respect of Environmental Issues	111.8	204.5	613.6	-	930.0
	TOTAL	3,091.8	5,472.8	9,676.6	-	18,241.2

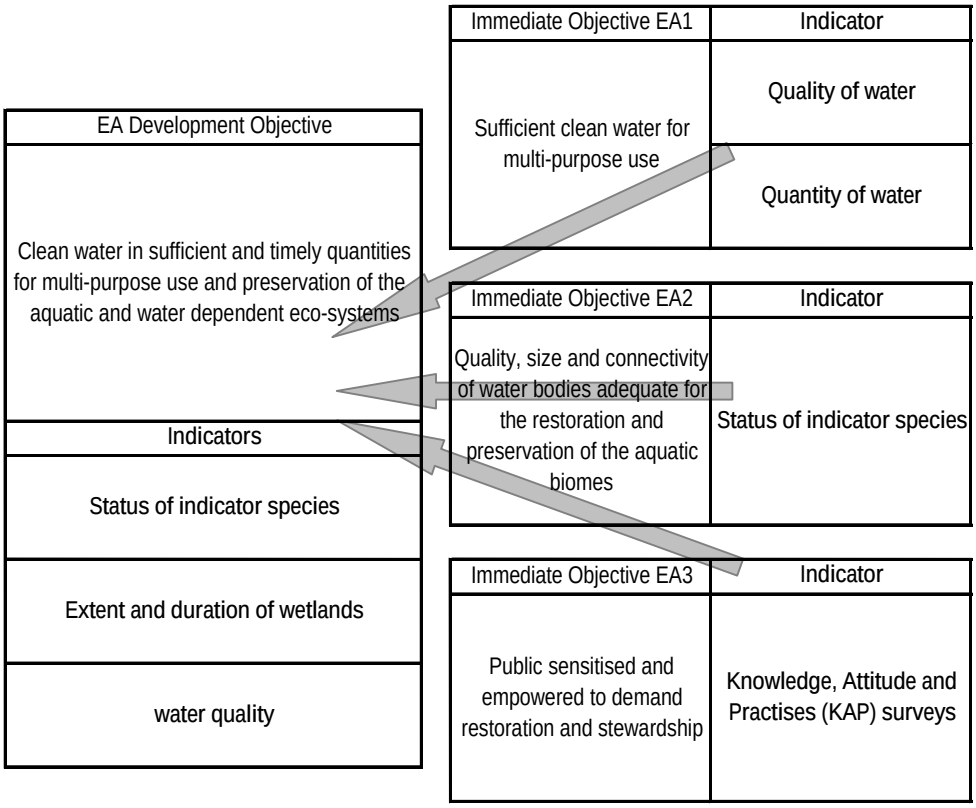
8.6.4 Assumptions

The key assumption for this cluster is that it will not be too late already to address the environmental decline that characterises the water sector, by the time that i) the necessary parameters are identified, quantified and able to be monitored; ii) public demand for environmental protection has been generated and mobilised; and iii) sustainable regulatory mechanisms have been promulgated. This assumption introduces in turn, two more. First, that environmental concerns can indeed be mainstreamed as grass roots issues and secondly that the vested interests of (justifiably) profit driven, but polluting industries can be contained within the necessary regulatory framework.

8.6.5 Indicators

Indicators for the Environment and Aquatic Resources Cluster are suggested in Figure 8.17.

Figure 8.17: Key Indicators for the Environment and Aquatic Resources Cluster



8.7 *Regional Distribution of Programmes*

As described in Part A of this document, Bangladesh comprises eight regions. Some of the programmes listed above have nationwide significance, others however concern single regions or combinations of several. Volume 4 "Regional Plans" discusses the strategic significance of these regional programme distributions which are merely summarised for the reader's convenience in the nine tables which close this section.

Table 8.21: Programmes Having National Significance

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
ID 001	Local Government Needs Assessment for Water Management	170.0	-	-	-	170.0
ID 002	Independent Regulatory Bodies for Water Supply and Sanitation Service Sector	75.0	1,200.0	-	-	1,275.0
ID 004	BWDB Regional and Sub-regional Management Strengthening	178.8	71.2	-	-	250.0
ID 005	Local Government Capacity Building for Water Management	968.0	2,420.0	7,260.0	1,452.0	12,100.0
ID 006	WARPO Capacity Building	405.0	255.0	-	-	660.0
ID 007	Department of Environment Capacity Building	292.0	73.0	-	-	365.0
ID 008	Disaster Management Bureau Capacity Building	660.0	1,100.0	440.0	-	2,200.0
ID 009	Capacity Building for Other Organisations	150.0	150.0	-	-	300.0
ID 010	BWDB Capacity Building	331.3	703.3	281.3	-	1,316.0
EE 001	Support to the Preparation of New Legislation	12.5	-	-	-	12.5
EE 002	Field Testing of Participatory Management Models	40.0	60.0	-	-	100.0
EE 003	Water Resources Legislation - Preparation of Supporting Ordinances	12.0	30.0	78.0	-	120.0
EE 004	Project Preparation Procedures - Guidelines and Manuals	16.1	55.4	88.6	-	160.0
EE 005	Regulatory and Economic Instruments	152.0	-	-	-	152.0
EE 006	Field Testing and Finalisation of the Guidelines for Participatory Water Management	7.0	35.0	28.0	-	70.0
EE 007	NWRD Improved Data Collection and Processing Facilities	15.0	-	-	-	15.0
EE 008	Water Resources Management Research and Development Studies	400.0	400.0	-	-	800.0
EE 009	Water Resources Management Long Term Research and Development	-	100.0	1,500.0	-	1,600.0
EE 010	Raising Public Awareness in the Wise Use and Management of Water	54.0	90.0	36.0	-	180.0
EE 011	Private Sector Participation in Water Management	35.0	-	-	-	35.0
EE 012	Water and Environment Funds	26.7	13.3	-	-	40.0
EE 013	Alternative Financing Methods for Water Management	71.3	156.3	62.5	-	290.0
MR 001	Main Rivers Studies and Research Programmes	600.0	1,000.0	400.0	-	2,000.0
MC 001	Inventory and Asset Management Plan of Water Supply & Sanitation Sector	12.5	-	-	-	12.5
EA 001	National Pollution Control Plan	300.0	380.0	420.0	-	1,100.0
EA 002	National Clean-up of Existing Industrial Pollution	360.0	1,800.0	2,100.0	-	4,260.0
EA 003	National Water Quality Monitoring	1,304.3	1,334.7	3,362.2	-	6,001.2
EA 004	National Fisheries Master Plan	300.0	-	-	-	300.0
EA 010	Public Awareness Raising and Empowerment in respect of Environmental Issues	111.8	204.5	613.6	-	930.0
	TOTAL	7,060.3	11,631.7	16,670.2	1,452.0	36,814.3

Table 8.22: Programmes for the North West Region

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
Exclusive to Region						
MC 005	Rajshahi Bulk Water Supply and Distribution Systems	250.0	1,500.0	2,937.0	400.0	5,087.0
MC 009	Rajshahi Sanitation and Sewerage Systems	125.0	850.0	2,749.0	150.0	3,874.0
MC 016	Rajshahi Flood Protection	75.0	225.0	100.0	-	400.0
MC 017	Rajshahi Stormwater Drainage	750.0	2,539.6	1,559.4	375.0	5,224.0
AW 004	New Public Deep Tubewell Irrigation Schemes	440.0	1,100.0	660.0	-	2,200.0
Shared with other Regions						
ID 003	FCD and FCD/I Management Rationalisation	165.0	225.0	-	-	390.0
MR 006	Regional River Management and Improvement	273.6	536.4	1,348.4	174.4	2,332.8
MR 007	Ganges Dependent Area Regional Surface Water Distribution Networks	-	151.5	1,060.4	-	1,211.9
MR 009	North Central and North West Regional Surface Water Distribution Networks	-	-	2,143.7	4,287.3	6,431.0
TR 001	Urban Arsenic Mitigation	15.2	-	-	-	15.2
TR 002	Rural Arsenic Mitigation	22.9	18.1	-	-	41.0
TR 003	Large and Small Town Water Supply and Distribution Systems	770.3	4,159.7	8,028.2	616.2	13,574.4
TR 004	Rural Water Supply and Distribution Systems	2,540.4	8,022.3	8,619.7	668.5	19,850.9
TR 005	Large and Small Town Sanitation and Sewerage Systems	770.3	1,910.4	7,762.9	308.1	10,751.7
TR 006	Rural Sanitation	1,470.8	3,944.3	2,773.6	267.4	8,456.0
TR 007	Large and Small Town Flood Protection	742.6	1,633.7	1,800.7	278.5	4,455.5
TR 008	Large and Small Town Stormwater Drainage	1,848.7	5,546.2	10,476.2	1,848.7	19,719.9
DM 004	National, Regional and Key Feeder Roads - Flood Proofing	413.5	516.9	1,550.7	103.4	2,584.4
DM 005	Railway Flood Proofing	50.5	63.1	189.3	12.6	315.6
DM 006	Supplementary Irrigation and Drought Proofing of Rural Water Supplies	200.5	195.6	33.0	-	429.1
AW 001	Promotion of Expanded Minor Irrigation and Improved On-farm Water Management	37.1	44.5	46.1	-	127.7
AW 002	Improved Performance of Existing Public Surface Water Irrigation Schemes	40.6	202.8	567.7	-	811.0
AW 003	New Public Surface Water Irrigation Schemes	-	100.0	200.1	-	300.1
AW 005	Improved Water Management at Local Government Level	63.4	123.1	567.0	37.8	791.3
AW 006	Improved Water Management at Community Level	2.9	24.9	90.7	6.0	124.6
AW 007	Rationalisation of Existing FCD Infrastructure	-	274.5	4,102.5	2,064.5	6,441.5
EA 005	National Fish Pass Programme	120.0	300.0	480.0	-	900.0
EA 006	Unspecified Regional Programmes	-	17.7	57.3	-	75.0
EA 008	Environmentally Critical Areas and Integrated Wetland Management	19.5	40.7	122.0	-	182.2
	TOTAL	11,207.7	34,265.8	60,025.5	11,598.6	117,097.6

Table 8.23: Programmes for the North Central Region

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
Exclusive to Region						
MC 002	Dhaka Bulk Water Supply and Distribution Systems	5,200.0	25,900.0	61,550.0	2,500.0	95,150.0
MC 006	Dhaka Sanitation and Sewerage Systems	6,000.0	19,000.0	62,176.0	2,500.0	89,676.0
MC 010	Dhaka Flood Protection	2,410.0	2,410.0	489.9	113.1	5,423.0
MC 011	Dhaka Stormwater Drainage	4,000.0	18,400.0	14,475.0	1,625.0	38,500.0
Shared with other Regions						
ID 003	FCD and FCD/I Management Rationalisation	31.3	42.8	-	-	74.1
MR 006	Regional River Management and Improvement	214.7	420.9	1,058.1	136.9	1,830.6
MR 009	North Central and North West Regional Surface Water Distribution Networks	-	-	2,143.7	4,287.3	6,431.0
TR 001	Urban Arsenic Mitigation	47.6	-	-	-	47.6
TR 002	Rural Arsenic Mitigation	71.9	56.6	-	-	128.5
TR 003	Large and Small Town Water Supply and Distribution Systems	427.2	2,306.7	4,452.0	341.7	7,527.6
TR 004	Rural Water Supply and Distribution Systems	1,552.5	4,902.5	5,267.6	408.5	12,131.1
TR 005	Large and Small Town Sanitation and Sewerage Systems	427.2	1,059.4	4,304.9	170.9	5,962.3
TR 006	Rural Sanitation	898.8	2,410.4	1,695.0	163.4	5,167.6
TR 007	Large and Small Town Flood Protection	411.8	905.9	998.6	154.4	2,470.8
TR 008	Large and Small Town Stormwater Drainage	1,025.2	3,075.6	5,809.5	1,025.2	10,935.6
DM 004	National, Regional and Key Feeder Roads - Flood Proofing	579.3	724.1	2,172.2	144.8	3,620.4
DM 005	Railway Flood Proofing	45.5	56.9	170.6	11.4	284.3
DM 006	Supplementary Irrigation and Drought Proofing of Rural Water Supplies	45.3	44.2	7.4	-	96.9
AW 001	Promotion of Expanded Minor Irrigation and Improved On-farm Water Managemer	8.4	10.0	10.4	-	28.8
AW 002	Improved Performance of Existing Public Surface Water Irrigation Schemes	3.1	15.3	42.7	-	61.0
AW 003	New Public Surface Water Irrigation Schemes	-	100.0	200.1	-	300.1
AW 005	Improved Water Management at Local Government Level	49.7	96.6	444.9	29.7	620.9
AW 006	Improved Water Management at Community Level	2.3	19.5	71.2	4.7	97.7
AW 007	Rationalisation of Existing FCD Infrastructure	-	52.1	779.5	392.3	1,223.9
EA 005	National Fish Pass Programme	22.8	57.0	91.2	-	171.0
EA 006	Unspecified Regional Programmes	-	17.7	57.3	-	75.0
EA 008	Environmentally Critical Areas and Integrated Wetland Management	5.9	12.2	36.7	-	54.8
	TOTAL	23,480.3	82,096.5	168,504.5	14,009.3	288,090.6

Table 8.24: Programmes for the North East Region

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
Exclusive to Region						
EA 007	Improved Water Management in the Haor Basins of the North East Region	80.0	333.3	586.7	-	1,000.0
Shared with other Regions						
ID 003	FCD and FCD/I Management Rationalisation	63.2	86.3	-	-	149.5
MR 006	Regional River Management and Improvement	309.7	607.1	1,526.3	197.5	2,640.6
MR 008	North East and South East Regional Surface Water Distribution Networks	-	-	901.6	-	901.6
TR 001	Urban Arsenic Mitigation	60.7	-	-	-	60.7
TR 002	Rural Arsenic Mitigation	91.6	72.1	-	-	163.8
TR 003	Large and Small Town Water Supply and Distribution Systems	245.1	1,323.5	2,554.4	196.1	4,319.1
TR 004	Rural Water Supply and Distribution Systems	1,243.7	3,927.6	4,220.1	327.3	9,718.7
TR 005	Large and Small Town Sanitation and Sewerage Systems	245.1	607.8	2,470.0	98.0	3,421.0
TR 006	Rural Sanitation	720.1	1,931.1	1,357.9	130.9	4,139.9
TR 007	Large and Small Town Flood Protection	236.3	519.8	573.0	88.6	1,417.6
TR 008	Large and Small Town Stormwater Drainage	588.2	1,764.7	3,333.3	588.2	6,274.5
DM 003	Flood Proofing in the Charlands and Haor Basin	173.1	432.8	259.7	-	865.6
DM 004	National, Regional and Key Feeder Roads - Flood Proofing	52.3	65.4	196.3	13.1	327.1
DM 005	Railway Flood Proofing	7.5	9.4	28.1	1.9	46.9
DM 006	Supplementary Irrigation and Drought Proofing of Rural Water Supplies	38.0	37.0	6.2	-	81.2
AW 001	Promotion of Expanded Minor Irrigation and Improved On-farm Water Managemer	7.0	8.4	8.7	-	24.2
AW 002	Improved Performance of Existing Public Surface Water Irrigation Schemes	4.1	20.5	57.4	-	82.0
AW 003	New Public Surface Water Irrigation Schemes	-	400.2	800.3	-	1,200.5
AW 005	Improved Water Management at Local Government Level	71.7	139.4	641.8	42.8	895.7
AW 006	Improved Water Management at Community Level	3.3	28.2	102.7	6.8	141.0
AW 007	Rationalisation of Existing FCD Infrastructure	-	105.2	1,572.6	791.4	2,469.2
EA 005	National Fish Pass Programme	46.0	115.0	184.0	-	345.0
EA 006	Unspecified Regional Programmes	-	17.7	57.3	-	75.0
EA 008	Environmentally Critical Areas and Integrated Wetland Management	20.3	42.3	126.8	-	189.4
	TOTAL	4307.0	12594.9	21565.3	2482.6	40949.8

Table 8.25: Programmes for the South West Region

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
Exclusive to Region						
MC 004	Khulna Bulk Water Supply and Distribution Systems	450.0	2,500.0	4,429.0	500.0	7,879.0
MC 008	Khulna Sanitation and Sewerage Systems	150.0	900.0	4,114.0	500.0	5,664.0
MC 014	Khulna Flood Protection	166.5	233.1	44.4	-	444.0
MC 015	Khulna Stormwater Drainage	500.0	1,900.0	1,143.0	181.0	3,724.0
EA 009	Improved Water Management and Salinity Control in the Sundarbans	150.0	100.0	-	-	250.0
Shared with other Regions						
ID 003	FCD and FCD/I Management Rationalisation	147.4	201.0	-	-	348.4
MR 006	Regional River Management and Improvement	549.1	1,076.5	2,706.1	350.1	4,681.8
MR 007	Ganges Dependent Area Regional Surface Water Distribution Networks	-	962.4	6,736.7	-	7,699.1
TR 001	Urban Arsenic Mitigation	119.7	-	-	-	119.7
TR 002	Rural Arsenic Mitigation	180.8	142.4	-	-	323.2
TR 003	Large and Small Town Water Supply and Distribution Systems	315.1	1,701.7	3,284.2	252.1	5,553.2
TR 004	Rural Water Supply and Distribution Systems	1,446.6	4,568.2	4,908.4	380.7	11,304.0
TR 005	Large and Small Town Sanitation and Sewerage Systems	315.1	781.5	3,175.7	126.1	4,398.4
TR 006	Rural Sanitation	837.5	2,246.1	1,579.4	152.3	4,815.2
TR 007	Large and Small Town Flood Protection	303.8	668.3	736.7	113.9	1,822.7
TR 008	Large and Small Town Stormwater Drainage	756.3	2,268.9	4,285.7	756.3	8,067.2
DM 004	National, Regional and Key Feeder Roads - Flood Proofing	167.5	209.4	628.1	41.9	1,046.9
DM 005	Railway Flood Proofing	28.9	36.1	108.4	7.2	180.7
DM 006	Supplementary Irrigation and Drought Proofing of Rural Water Supplies	106.1	103.5	17.4	-	227.0
AW 001	Promotion of Expanded Minor Irrigation and Improved On-farm Water Managemer	19.6	23.5	24.4	-	67.6
AW 002	Improved Performance of Existing Public Surface Water Irrigation Schemes	39.6	198.0	554.4	-	792.0
AW 003	New Public Surface Water Irrigation Schemes	-	200.1	400.2	-	600.3
AW 005	Improved Water Management at Local Government Level	127.2	247.1	1,137.9	75.9	1,588.1
AW 006	Improved Water Management at Community Level	5.8	50.0	182.1	12.1	250.0
AW 007	Rationalisation of Existing FCD Infrastructure	-	245.2	3,664.9	1,844.3	5,754.4
AW 008	Land Reclamation, Coastal Protection and Afforestation	50.4	122.9	413.4	-	586.7
EA 005	National Fish Pass Programme	107.2	268.0	428.8	-	804.0
EA 006	Unspecified Regional Programmes	-	17.7	57.3	-	75.0
EA 008	Environmentally Critical Areas and Integrated Wetland Management	12.6	26.2	78.6	-	117.4
	TOTAL	7052.8	21997.7	44839.5	5293.8	79183.8

Table 8.26: Programmes for the South Central Region

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
Exclusive to Region						
	None					
Shared with other Regions						
ID 003	FCD and FCD/I Management Rationalisation	61.0	83.3	-	-	144.3
MR 006	Regional River Management and Improvement	281.2	551.3	1,385.8	179.3	2,397.6
TR 001	Urban Arsenic Mitigation	42.9	-	-	-	42.9
TR 002	Rural Arsenic Mitigation	64.8	51.0	-	-	115.8
TR 003	Large and Small Town Water Supply and Distribution Systems	238.1	1,285.7	2,481.4	190.5	4,195.7
TR 004	Rural Water Supply and Distribution Systems	935.0	2,952.6	3,172.5	246.1	7,306.2
TR 005	Large and Small Town Sanitation and Sewerage Systems	238.1	590.5	2,399.4	95.2	3,323.2
TR 006	Rural Sanitation	541.3	1,451.7	1,020.8	98.4	3,112.3
TR 007	Large and Small Town Flood Protection	229.5	505.0	556.6	86.1	1,377.1
TR 008	Large and Small Town Stormwater Drainage	571.4	1,714.3	3,238.1	571.4	6,095.2
DM 001	Cyclone Shelters and Killas	1,064.7	1,774.4	2,484.2	-	5,323.3
DM 002	Bari-level Cyclone Shelters	50.6	193.9	592.2	103.8	940.4
DM 004	National, Regional and Key Feeder Roads - Flood Proofing	291.4	364.2	1,092.7	72.8	1,821.1
DM 005	Railway Flood Proofing	4.5	5.7	17.0	1.1	28.3
DM 006	Supplementary Irrigation and Drought Proofing of Rural Water Supplies	28.7	28.0	4.7	-	61.4
AW 001	Promotion of Expanded Minor Irrigation and Improved On-farm Water Managemer	5.3	6.4	6.6	-	18.3
AW 002	Improved Performance of Existing Public Surface Water Irrigation Schemes	51.3	256.3	717.5	-	1,025.0
AW 003	New Public Surface Water Irrigation Schemes	-	100.0	200.1	-	300.1
AW 005	Improved Water Management at Local Government Level	65.1	126.5	582.8	38.9	813.3
AW 006	Improved Water Management at Community Level	3.0	25.6	93.2	6.2	128.0
AW 007	Rationalisation of Existing FCD Infrastructure	-	101.5	1,517.9	763.9	2,383.4
AW 008	Land Reclamation, Coastal Protection and Afforestation	201.6	491.4	1,653.8	-	2,346.8
EA 005	National Fish Pass Programme	44.4	111.0	177.6	-	333.0
EA 006	Unspecified Regional Programmes	-	17.7	57.3	-	75.0
EA 008	Environmentally Critical Areas and Integrated Wetland Management	1.1	2.3	7.0	-	10.4
	Total	5,015.0	12,790.3	23,459.2	2,453.7	43,718.2

Table 8.27: Programmes for the South East Region

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
Exclusive to Region						
	None					
Shared with other Regions						
ID 003	FCD and FCD/I Management Rationalisation	76.4	104.3	-	-	180.7
MR 006	Regional River Management and Improvement	95.0	186.2	468.2	60.6	810.0
MR 008	North East and South East Regional Surface Water Distribution Networks	-	-	1,674.4	-	1,674.4
TR 001	Urban Arsenic Mitigation	120.3	-	-	-	120.3
TR 002	Rural Arsenic Mitigation	181.7	143.1	-	-	324.8
TR 003	Large and Small Town Water Supply and Distribution Systems	280.1	1,512.6	2,919.3	224.1	4,936.1
TR 004	Rural Water Supply and Distribution Systems	1,252.6	3,955.4	4,250.0	329.6	9,787.6
TR 005	Large and Small Town Sanitation and Sewerage Systems	280.1	694.7	2,822.9	112.0	3,909.7
TR 006	Rural Sanitation	725.2	1,944.8	1,367.5	131.8	4,169.3
TR 007	Large and Small Town Flood Protection	270.0	594.1	654.8	101.3	1,620.2
TR 008	Large and Small Town Stormwater Drainage	672.3	2,016.8	3,809.5	672.3	7,170.9
DM 001	Cyclone Shelters and Killas	358.2	597.0	835.8	-	1,790.9
DM 002	Bari-level Cyclone Shelters	17.0	65.2	199.2	34.9	316.4
DM 004	National, Regional and Key Feeder Roads - Flood Proofing	240.8	301.0	902.9	60.2	1,504.9
DM 005	Railway Flood Proofing	19.4	24.2	72.7	4.8	121.1
DM 006	Supplementary Irrigation and Drought Proofing of Rural Water Supplies	21.9	21.4	3.6	-	46.9
AW 001	Promotion of Expanded Minor Irrigation and Improved On-farm Water Managemer	4.1	4.9	5.0	-	14.0
AW 002	Improved Performance of Existing Public Surface Water Irrigation Schemes	20.1	100.5	281.4	-	402.0
AW 003	New Public Surface Water Irrigation Schemes	-	814.6	1,629.3	-	2,443.9
AW 005	Improved Water Management at Local Government Level	22.0	42.8	196.9	13.1	274.8
AW 006	Improved Water Management at Community Level	1.0	8.7	31.5	2.1	43.3
AW 007	Rationalisation of Existing FCD Infrastructure	-	127.2	1,900.8	956.6	2,984.6
AW 008	Land Reclamation, Coastal Protection and Afforestation	126.0	307.1	1,033.6	-	1,466.7
EA 005	National Fish Pass Programme	55.6	139.0	222.4	-	417.0
EA 006	Unspecified Regional Programmes	-	17.7	57.3	-	75.0
EA 008	Environmentally Critical Areas and Integrated Wetland Management	0.4	0.9	2.8	-	4.1
	TOTAL	4,840.2	13,724.0	25,341.8	2,703.4	46,609.4

Table 8.28: Programmes for the Rivers and Estuaries Region

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
Exclusive to Region						
MR 002	Main Rivers Abstraction Projects	448.0	2,240.0	1,792.0	-	4,480.0
MR 003	Ganges Barrage and Ancillary Works	4,900.0	-	45,958.0	-	50,858.0
MR 004	Meghna Barrage and Ancillary Works	-	-	15,728.0	-	15,728.0
MR 005	Brahmaputra Barrage and Ancillary Works	-	-	51,473.1	35,499.9	86,973.0
MR 010	Main Rivers Erosion Control at Selected Locations	-	3,440.0	12,900.0	-	16,340.0
MR 011	River Dredging for Navigation	177.0	975.0	390.0	-	1,542.0
Shared with other Regions						
MR 006	Regional River Management and Improvement	91.2	178.8	449.5	58.1	777.6
TR 001	Urban Arsenic Mitigation	27.9	-	-	-	27.9
TR 002	Rural Arsenic Mitigation	42.1	33.2	-	-	75.3
DM 003	Flood Proofing in the Charlands and Haor Basin	346.8	866.9	520.1	-	1,733.8
DM 006	Supplementary Irrigation and Drought Proofing of Rural Water Supplies	30.2	29.4	5.0	-	64.6
AW 001	Promotion of Expanded Minor Irrigation and Improved On-farm Water Managemer	5.6	6.7	6.9	-	19.2
AW 005	Improved Water Management at Local Government Level	21.1	41.0	189.0	12.6	263.8
AW 006	Improved Water Management at Community Level	1.0	8.3	30.2	2.0	41.5
AW 008	Land Reclamation, Coastal Protection and Afforestation	50.4	122.9	413.4	-	586.7
EA 006	Unspecified Regional Programmes	-	17.7	57.3	-	75.0
EA 008	Environmentally Critical Areas and Integrated Wetland Management	1.0	2.0	6.1	-	9.1
	TOTAL	6,142.1	7,961.9	129,918.7	35,572.6	179,595.4

Table 8.29: Programmes for the Eastern Hills

MIS Ref	Title	COSTS (Tk M mid 2000)				
		ST	MT	LT	Residual	TOTAL
Exclusive to Region						
MR 012	Hydropower Development and Upgrading	411.6	1,807.7	2,530.8	-	4,750.0
MC 003	Chittagong Bulk Water Supply and Distribution Systems	1,100.0	6,000.0	15,917.0	1,000.0	24,017.0
MC 007	Chittagong Sanitation and Sewerage Systems	450.0	3,550.0	9,479.0	500.0	13,979.0
MC 012	Chittagong Flood Protection	438.5	438.5	-	-	877.0
MC 013	Chittagong Stormwater Drainage	-	7,600.0	4,400.0	-	12,000.0
Shared with other Regions						
ID 003	FCD and FCD/I Management Rationalisation	5.5	7.5	-	-	13.0
MR 006	Regional River Management and Improvement	85.5	167.6	421.4	54.5	729.0
TR 001	Urban Arsenic Mitigation	4.7	-	-	-	4.7
TR 002	Rural Arsenic Mitigation	7.0	5.5	-	-	12.6
TR 003	Large and Small Town Water Supply and Distribution Systems	224.1	1,210.1	2,335.5	179.3	3,948.9
TR 004	Rural Water Supply and Distribution Systems	529.2	1,671.3	1,795.8	139.3	4,135.6
TR 005	Large and Small Town Sanitation and Sewerage Systems	224.1	555.7	2,258.3	89.6	3,127.8
TR 006	Rural Sanitation	306.4	821.7	577.8	55.7	1,761.7
TR 007	Large and Small Town Flood Protection	216.0	475.2	523.9	81.0	1,296.1
TR 008	Large and Small Town Stormwater Drainage	537.8	1,613.4	3,047.6	537.8	5,736.7
DM 001	Cyclone Shelters and Killas	556.1	926.8	1,297.5	-	2,780.4
DM 002	Bari-level Cyclone Shelters	26.4	101.3	309.3	54.2	491.2
DM 006	Supplementary Irrigation and Drought Proofing of Rural Water Supplies	16.1	15.7	2.6	-	34.4
AW 001	Promotion of Expanded Minor Irrigation and Improved On-farm Water Managemer	3.0	3.6	3.7	-	10.2
AW 002	Improved Performance of Existing Public Surface Water Irrigation Schemes	5.1	25.5	71.4	-	102.0
AW 003	New Public Surface Water Irrigation Schemes	-	326.7	653.3	-	980.0
AW 005	Improved Water Management at Local Government Level	19.8	38.5	177.2	11.8	247.3
AW 006	Improved Water Management at Community Level	0.9	7.8	28.4	1.9	38.9
AW 007	Rationalisation of Existing FCD Infrastructure	-	9.1	136.8	68.8	214.7
AW 008	Land Reclamation, Coastal Protection and Afforestation	75.6	184.3	620.2	-	880.0
EA 005	National Fish Pass Programme	4.0	10.0	16.0	-	30.0
EA 006	Unspecified Regional Programmes	-	17.7	57.3	-	75.0
EA 008	Environmentally Critical Areas and Integrated Wetland Management	24.9	51.9	155.7	-	232.5
	TOTAL	5,272.3	27,643.2	46,816.3	2,774.0	82,505.7

9 The Management Information System

9.1 *The Need for an MIS*

One of the objectives of the NWPo regarding the nations' water resources, is to achieve: *"..management of these resources in an efficient and equitable way"* (NWPo. Section 3. Clause a)

The Government recognises that efficient resource management begins with access to all necessary information. The well-known saying 'knowledge equals power' is particularly apt in this instance. Effective and efficient management is greatly facilitated by the availability of sufficient reliable and well organised information; whereas lack of the same results in management that is ad-hoc at best, and utter confusion at worse. And this risk rises with the complexity of the institutional framework involved.

The current institutional framework for the Bangaldeshi water sector the water sector of Bangladesh is unquestionably complex comprising as it does some 35 central Government organisations, affiliated with 13 different Ministries all of which can be identified as having functions or responsibilities relevant to the water sector. This results in:

- compartmentalisation, fragmentation and wide dispersal of information;
- duplication of effort in data collection/storage;
- protectionism and secrecy;

and,

- interagency turf wars.

It is therefore GoB policy to *"develop a central database and management information system (MIS) consolidating information from various data collection and research agencies on the existing hydrological systems, supply and use of national water resources, water quality, and the eco-system."* (NWPo. Section 4.15. Clause a). Furthermore, the NWPo assigns responsibility for establishing such a system to WARPO as the technical secretariat of the apex body of the water sector, namely NWRC.

9.2 *Objectives*

A Management Information System (MIS) is an organised way of storing, accessing, and manipulating data in order to increase the efficiency and effectiveness of the management, monitoring, evaluation and analytical processes.

The NWMP Development Strategy Report (WARPO 2001), elaborates this point by stating that *"The MIS will have two main functions: first to keep track of actions being taken to implement the NWMP; and second, to determine the extent to which policy objectives are being achieved."*

With the type of technology widely available today, corporate Management Information Systems are usually electronic computer-based systems within which the

data is stored in digital format. This type of system has been employed whilst developing the MIS for the NWMP Project. Based on the NWMP Terms of Reference, the WARPO MIS has the following ultimate objectives:

- enhanced water sector planning capabilities;
- enhanced water and land resource management capabilities;
- effective management of information;
- effective monitoring and evaluation of development activities in the water sector;
- effective monitoring of changes to natural resources endowment;

and,

- enhanced research capabilities within the water sector.

These objectives can be effectively summarised by Objective EE2, which the reader will remember as being:

Development and management of water sector resources, institutions and infrastructure characterised by the use of reliable, well organised data and targeted, adaptive research

Although the ToR strictly required the NWMP team only to "**recommend** a comprehensive and coherent data collection, processing and analysis system", in reality an MIS has been provided to WARPO with some functions already fully operational[7]. These are described shortly; but first it is necessary to clarify the difference between an MIS and a database for the convenience of the unfamiliar reader.

A database simply comprises the data itself, albeit organised in a particular way, whereas the MIS is both the portal through which the user accesses the data and specifies how that data is to be used or analysed; and, the software by which this is achieved.

9.3 *Operational Functions*

9.3.1 NWMP Programmes Database

In order to keep track of actions taken to implement the NWMP at programme level, the MIS contains a working Programmes Database currently containing records of all NWMP Programmes as detailed in the Investment Portfolio. Accessed via the MIS 'Programmes Portal', this database allows the user to:

---

7 For further information, see:
"The WARPO Management Information System (MIS)";
"MIS Document Annex A: Projects Database User Manual";
and
"MIS Document Annex B: Programmes Database User Manual",
issued by the Consultants to WARPO June 2001.

- input programme data;
- store programme data in a logical, consistent and systematic format;
- amend or update data as programmes proceed;
- instantly view additional relevant programme data (maps, costing info., etc.);
- make customised searches through programme data;
- locate/create programme records via the NWMP framework;

and,

- display and print programme records.

9.3.2 NWMP Projects Database

To aid planners in determining the extent to which policy objectives are being met; to aid preparation of the NWMP; and as a suggested format for consistent water sector project-monitoring data storage, a working Projects Database has been provided. It is accessed through the 'Projects Portal' within the MIS, and allows the user to:

- input new project data;
- obtain an objective assessment of a potential projects' compliance with policy;
- store project data in a logical, consistent and systematic format;
- amend or update project data;
- make customised searches through project data;
- display project data in a variety of formats for M&E purposes;

and,

- export project data to other software applications for M&E purposes.

9.3.3 The National Water Resources Database (NWRD)

The NWRD Project is a parallel and highly relevant ongoing pro ject within WARPO to collect and store comprehensive data on the natural resources relevant to the water sector of Bangladesh. Tools developed to retrieve, manipulate and analyse natural resource data from the NWRD can be accessed through the 'Natural Environment Portal' of the MIS.

9.3.4 Map Viewing Facilities

During preparation of the NWMP many different maps were created. These include: working reference maps; maps produced the final Development Strategy Report (DSR) (WARPO 2001); as well as NWMP Programme maps and a series of maps specifically for use in the Investment Portfolio section of the NWMP report. Accessed via the 'Mapping Portal' within the MIS, various map viewing tools allow the user to browse, select and view any of these maps.

9.4 *Potential Future Functions*

The operational aspects of the MIS have been designed to be modular in nature and so the potential development of the MIS is endless. Specific future developments, for example could include creation of:

- a 'Costing Portal' – allowing the user access to relevant water sector historic and budget unit prices both for budgeting purposes as well as for monitoring and gradually improving the reliability of the budgeting process.

- A 'Reference Portal' – Allowing access to relevant documentation (technical reports, relevant internet WebPages, as well as online libraries).

- An 'ADP Portal' – allowing access to historic and current government budgeting details for water sector projects as contained in the official Annual Development Plans.

- Additional tools within the Natural Environment Portal to aid production of State of the Water Resources System (SWRS) reports.

Other important areas for future development might be: improved security; wider dissemination; delegation of data entry procedures to line agencies; improved data quality monitoring procedures; and even commercial versions of the MIS.

9.5 *Human Resources*

Just, as the vast potential of the MIS as a facilitator of sustainable water sector management should not be underestimated, so too the importance of appropriate, well motivated human resources to operate, maintain and constantly develop its potential is also stressed.

Ideally, a core team of three dedicated professionals will be needed to operate and expand the MIS; but from time to time, for instance when the MIS first operationalised, when annual NWMP reviews are in progress, five yearly reformulations are underway or bespoke research services are required, the core team will have to be temporarily expanded perhaps to five or more.

Job descriptions for the core team are suggested below in Table 9.1.

Table 9.1: Proposed Job Descriptions for the MIS Core Team

Job Title	Job Description
Senior MIS Specialist	Reporting directly to the relevant WARPO Director, the SMS will be responsible for overseeing continuous development of the WARPO MIS. He/She will provide encouragement, support and direction to the MIS team and will assist the M&E Director in disseminating and promoting the MIS both within and outside of WARPO's operational territory. In addition, the candidate will be responsible for directing other MIS staff and ensuring that the data-collection and data-entry processes operate smoothly. The SMS should possess proven management and communication skills as well as a sound understanding of MIS/GIS systems and their potential. He/she should be a service-oriented forward thinker, capable of anticipating future uses/development paths for the MIS, and must be prepared to keep abreast of information technology as it continues to develop.
MIS Specialist	Working under the direction of the SMS, the MS will be responsible for both spatial and non-spatial data storage and manipulation within the MIS. He/she will also ensure constant compatibility between the database and GIS systems used within the MIS, as well as their timely upgrading. Accordingly, he/she must be a highly competent operator of computer systems, specifically MS Visual Basic, MS Access, and ArcView GIS. Competency with other relevant software (e.g. additional programming languages and alternative database software) and experience in geo-referencing and polygon abstraction tools would also be desirable, though not essential. He/she must also be able to provide bespoke services to researchers and other "non-traditional" users of the MIS. The MIS Specialist will be often be working to tight deadlines and will be assisted by a Junior MIS Specialist. He/she should therefore have some project management experience.
Junior MIS Specialist	Working under the direction of the SMS and MS, the JMS will be responsible for assisting in the data-collection, data-entry, and (limited) software development processes. The candidate must be computer literate with experience of using MS Access and be capable of working unsupervised.

9.6 *Indicators*

Just as Objective EE2 serves as the objective for the MIS, so do its associated indicators:

data reliability
clarity of data
status of knowledge gaps

9.7 *Consolidated Costs*

There are no direct costs associated with the MIS. Its first generation software is already installed on WARPO's local area network, and it will be operated by members of the existing payroll. The costs of any expansion or enhancements will be subsumed within the budget for WARPO capacity building as described in Section 7.1.

10 Impacts and Benefits

Since the NWMP is intended to operationalise the NWPo and since the Development Objectives of the NWPo is the National Goals (Section 6.1 referred), it is meaningful to assess the impacts and benefits of the NWMP in terms of the National Goals as they apply to the physical environment; the human environment and the institutional environment. The results of these assessments are presented in the three sub-sections which follow. It will be seen from one of the tables involved that as well as benefits, there are also risks. These are addressed in Section 11. It will also be seen that some columns in each matrix are common to one or both of the other matrices (although not all the scores are necessarily the same for each of the three impact assessments due the different criteria applied). This is not an oversight, rather the commonalities of the issues at stake simply reinforces the validity of the NWPo's own demands for a "comprehensive, integrated and equitable" approach to water resources management in the country.

10.1 *Impact and Benefits to the Physical Environment*

The National Goals have an unequivocal environmental dimension; indeed the sixth sub-goal precisely concerns "Protection of the Natural Environment". The NWPo responds to this challenge by placing immediate emphasis on the health and sustainable exploitation of Bangladesh's extensive and highly complex river and groundwater systems. Even so, any plan which involves 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.

Table 10.1 identifies those environmental dimensions of the National Goals that have active or passive relations with the water sector while Table 10.2 comprises a graphic which allows a comparison of each with the NWMP cluster objectives.

It can be seen that with few exceptions, the NWMP is not merely benign, but actually proactively beneficial as regards the natural environment. Given the profound importance of the environmental question however, a more detailed assessment is provided as Annex E, where inter-alia the reader's attention is drawn to an assessment of the NWMP's environmentally relevant programmes' conformity with the NWPo.

10.2 *Impact and Benefits to the Human Environment*

The National Goals have an equally unequivocal social dimension. In fact four out of the six national goals are specifically applicable in this regard. Nonetheless as with the environment, it is possible to expand these before assessing the likely impacts and benefits of the NWMP with respect to them.

Table 10.3 identifies those social dimensions of the National Goals that have active or passive relations with the water sector while Table 10.4 comprises a graphic which allows a comparison of each with the NWMP cluster objectives.

10.3 *Impacts and Benefits for the Institutional Environment*

It is rather more difficult to relate the National Goals to any specific institutional issues directly. Yet the NWPo itself is 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.

Table 10.5 identifies those social dimensions of the National Goals that have active or passive relations with the water sector while Table 10.4 comprises a graphic which allows a comparison of each with the NWMP cluster objectives.

Table 10.1: Environmental Dimensions of the National Goals that Affect or are Affected by Water Management

Environmental Dimensions of the National Goals	Relevance to or Nexus with the NWMP
Water pollution reduction	Water pollution compromises environmental integrity, but can be reduced by means of an appropriate water management plan
Fish habitat improvement	Fish stocks, biodiversity and gene pools have been compromised by water sector development
Cross-cutting approaches	Cross cutting approaches are necessary in order to address the underlying causes, or macro-forces that result in negative environmental symptoms
Mainstreaming the environment	The environment's role and potential as a water sector stakeholder must be stressed, disseminated and understood by as wide a constituency as possible
Safeguarding the natural environment	As well as raising public awareness and inculcating a demand for environmental integrity, regulatory frameworks are necessary
Social equity and people's participation	Environmental sustainability is severely compromised when water resources are plundered or in the course of a spurious attempt to achieve socio-economic equity. And participation mobilises social capital and exclusion control rights that are essential for sustainability.
Human health and welfare	These cannot be assured or enhanced in the absence of regulations addressing the maintenance of water quality at adequate levels
Sustainable economic growth	There is a widely accepted and easily demonstrated relationship between poverty and environmental disregard, sustainable economic growth cannot be achieved without clean water and hydrological regimes that remain close to the natural baselines
Addressing long term issues	Any investment in environmental restoration should take a long view not only because the processes involved can be slow; but also because the parallel social engineering which is necessary is also a slow process, hence the long term nature of the NWMP
Institutional capacity building	Environmental benefits accruing to a water management initiative are difficult to achieve without a holistic, demand driven approach to institutional formulation, reformulation
Establishment of reliable and available data	Environmental standards cannot be monitored reliably and objectively without adequate data and data management resources
Mobilisation of comparative advantage	Traditional production systems do not always reflect comparative advantage, whereas changed perception of the value of water; the availability of demand driven support services and wise use concepts can mobilise comparative advantage to the betterment of environmental baselines.

Table 10.2: Impacts and Benefits of the NWMP on the Physical Environment

NWMP Cluster Objective	Contribution to Major Sectoral Environmental Objectives[2]											
	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
ID Institutional Development												
The national institutional framework for the water sector regulated, decentralised and devolved			+++	+++	++	++	+	+	++	+++	+++	
Capacities of the restructured water sector institutions strengthened in line with future demands					++	+	+	+	++		++	
EE Enabling Environment												
Rights, obligations and rules of business as they apply to all water sectors stakeholders promulgated via a coherent and comprehensive set of documents	++	++		++		++	+	+	++	+	+	
Development and management of water sector resources, institutions and infrastructure characterised by the use of reliable, well organised data and targeted adaptive research		++						+	++	++	+++	
User commitment to the sustainable and wise use of the country's water resources	+++	+++		++	+++	+++	++	++	+++			

NWMP Cluster Objective	Contribution to Major Sectoral Environmental Objectives[2]											
	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
Water sector costs shared between public, private and user entities according to comparative advantage						++		++	++			
MR Major Rivers												
Main and regional rivers comprehensively developed for multi-purpose use		+++	+	+	+	+	++	++	++			
TR Towns and Rural Areas												
Demand for safe and reliable drinking water supplies and services satisfied in towns and rural areas							+++					
Demand for sanitation facilities and services created and satisfied in towns and rural areas	+++						+++					
Large and small towns protected from flooding and stormwater run-off							+++	+++				

NWMP Cluster Objective	Contribution to Major Sectoral Environmental Objectives[2]											
	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
MC Major Cities												
Demand for safe and reliable drinking water supplies and services satisfied in the Statistical Metropolitan areas							+++					
Demand for sanitation facilities and services created and satisfied in the Statistical Metropolitan Areas							+++					
Statistical Metropolitan Areas protected from flooding and stormwater runoff							+++	+++				
DM Disaster Management												
Lives, livelihood and national infrastructure protected or mitigated against inundation damage by structural and non-structural means		–					+++	+++	+++			
AW Agriculture and Water Management												
Water-related constraints on agricultural production minimised		––					++	++				

NWMP Cluster Objective	Contribution to Major Sectoral Environmental Objectives[2]											
	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
EA Environment and Aquatic Resources												
Sufficient clean water for multi-purpose use	+ + +			+ +	+ + +		+ + +	+ +				
Adequate quality, connectivity and habitat water parameters for the preservation and improvement of aquatic and dependent terrestrial biomass and biodiversity		+ + +			+ + +		+ +	+ +				
Public committed to, and empowered to demand, environmental improvement and sustainable development of water-dependent resources	+ + +	+ + +	+ +	+ +	+ + +	+ + +	+ +					

Key to Impacts:

Major | Moderate | Minor | Positive + | Negative –

Notes

1 The actual impacts will depend on which programmes and components are implemented
2 Impacts may be reduced if appropriate mitigation measures can be implemented
3 Institutional strengthening, studies, research and public awareness-raising / empowerment will assist, but often only indirectly, all the key sectoral environmental objectives
4 Fish being taken as an indicator for aquatic species in general; this objective therefore includes ecologically-sensitive areas, such as wetlands

Table 10.3: Social Dimensions of the National Goals that Affect or are Affected by Water Management

Social Dimensions of the National Goals	Relevance to or Nexus with the NWMP
Water pollution reduction	Water pollution compromises human health, hygiene and productivity, but can be addressed in a suitable water management plan
Fish habitat improvement	Fish stocks and hence human sources of protein have been compromised by water sector development
Social equity and people's participation	It is not enough to involve people merely as participants, the achievement of social equity also requires consultation
Human health and safety	These are compromised by poor water quality, inadequate water quantities and catastrophes such as floods and droughts
Sustainable economic growth	Sustainable growth of a heavily water dependent economy is impossible without a holistic approach to water management
Institutional capacity building	Is necessary in order to make the best use of the new opportunities that decentralisation and devolution represent
Poverty alleviation	Decentralisation seldom works, if ever, without a concomitant enhancement of the socio-economic conditions characteristic of those to whom the entity is transferred
Food security	See above, but in addition, food security is a temporal as well as structural issue in a country where floods and droughts disrupt food supply and distribution
Choice, empowerment and self determinacy	Empowerment and self-determinacy (which are vital for sustainable decentralisation) are merely slogans unless achieved, at least in part, by the introduction of choice
Decent standard of living	Decentralisation seldom works, if ever, without a concomitant enhancement of the socio-economic conditions characteristic of those to whom the entity is transferred
Mobilisation of comparative advantage	Traditional production systems do not always reflect comparative advantage, whereas changed perception of the value of water; the availability of demand driven support services and wise use concepts can mobilise comparative advantage to the betterment of socio-economic baselines.

Table 10.4: Impacts and Benefits of the NWMP on the Human Environment

NWMP Cluster Objective	Contribution to Major Sectoral Social Objectives										
	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 determinancy	Decent standard of living	Mobilisation of comparative advantage
ID Institutional Development											
The national institutional framework for the water sector regulated, decentralised and devolved			+++		++	+++			+		+
Capacities of the restructured water sector institutions strengthened in line with future demands								++			
EE Enabling Environment											
Rights, obligations and rules of business as they apply to all water sectors stakeholders promulgated via a coherent and comprehensive set of documents	++	++	+++		+	++			+++		
Development and management of water sector resources, institutions and infrastructure characterised by the use of reliable, well organised data and targeted adaptive research	+	+						+			
User commitment to the sustainable and wise use of the country's water resources	++	++		++	++		+++	+		+++	+++

NWMP Cluster Objective	Contribution to Major Sectoral Social Objectives										
	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 determinancy	Decent standard of living	Mobilisation of comparative advantage
Water sector costs shared between public, private and user entities according to comparative advantage					++	+			+++		
MR Major Rivers											
Main and regional rivers comprehensively developed for multi-purpose use	++	+++			++		++	+		+	
TR Towns and Rural Areas											
Demand for safe and reliable drinking water supplies and services satisfied in towns and rural areas	+++			+++						++	
Demand for sanitation facilities and services created and satisfied in towns and rural areas	++			+++						++	
Large and small towns protected from flooding and stormwater run-off				++	+					+	

NWMP Cluster Objective	Contribution to Major Sectoral Social Objectives										
	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 determinancy	Decent standard of living	Mobilisation of comparative advantage
MC Major Cities											
Demand for safe and reliable drinking water supplies and services satisfied in the Statistical Metropolitan areas	+++			+++						++	
Demand for sanitation facilities and services created and satisfied in the Statistical Metropolitan Areas	++			+++						++	
Statistical Metropolitan Areas protected from flooding and stormwater runoff				++	+						
DM Disaster Management											
Lives, livelihood and national infrastructure protected or mitigated against inundation damage by structural and non-structural means				+++				++		+	
AW Agriculture and Water Management											
Water-related constraints on agricultural production minimised											

NWMP Cluster Objective	Contribution to Major Sectoral Social Objectives										
	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 determinancy	Decent standard of living	Mobilisation of comparative advantage
					++		++	++		++	
EA Environment and Aquatic Resources											
Sufficient clean water for multi-purpose use	+++	+++		++						++	
Adequate quality, connectivity and habitat water parameters for the preservation and improvement of aquatic and dependent terrestrial biomass and biodiversity		+++						++		++	
Public committed to, and empowered to demand, environmental improvement and sustainable development of water-dependent resources	++	++		++						++	

Key to Impacts:

Major Moderate Minor

Positive	+

Negative	–

Table 10.5: Institutional Dimensions of the National Goals that Affect or are Affected by Water Management

Institutional Dimensions of the National Goals	Relevance to or Nexus with the NWMP
Cross-cutting approaches	Cross cutting approaches are necessary in order to rectify systemic institutional inadequacies
Social equity and people's participation	Social equity requires clearly understood regulatory mechanisms to ensure equitability of resource availability; while participation has institutional ramifications in terms not only of models but also procedures
Institutional capacity building	If new or redefined demand scenarios result in new or restructured institutions, then capacity building is required in order that the resulting institutional landscape is adequately equipped (in terms of equipment, facilities and human resources) to meet those demands
Establishment of reliable and available data	Development, management and monitoring all depend on the availability of reliable, transparent and easily accessible data
Food security	When food security is potentially threatened by extreme hydrological events (floods and droughts), early warning requirements and disaster preparedness represent capacity building challenges for water sector institutions has an institutional dimension within the water sector
Regulation versus supply	Global experience confirms that sustainability is enhance when regulation is separated from supply, an issue that is recognised in the NWPo.
Rights and obligations	Decentralisation places new obligations on stakeholders; these are difficult to "sell" unless concomitant rights are transferred
Actors, powers and accountability	Successful decentralisation requires changes in actors power and accountability relationships
Choice, empowerment and self-determinacy	Choice of service provider inculcates competition which in turn empowers the user, while encouraging increased efficiency by the service providers
Legal and policy framework	New institutional paradigms require appropriate legal and policy frameworks not only for their establishment and mandates; but also to enhance their accountability
Cost recovery, user pays principles and alternative financing mechanisms	Since inadequate (or indeed impossible) funding of water sector investments services results in declining standards, the need for alternative funding modalities has to be addressed in a management plan
Private sector participation	Opportunities need to be created or enhanced to mobilise private sector interests as investors, managers and service providers
Mobilisation of comparative advantage	Subsidiarity, the defining ideal of water sector decentralisation is itself a manifestation of comparative advantage

Table 10.6: Impacts and Benefits of the NWMP on the Institutional Environment

NWMP Cluster Objective	Contribution to Major Sectoral Institutional Objectives												
	Cross-cutting approaches	Social Equity and People's Participation	Institutional Capacity Building	Establishment of reliable and available data	Food Security	Regulation vs. 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
ID Institutional Development													
The national institutional framework for the water sector regulated, decentralised and devolved	+++	+++	++			+++				+++		+++	
Capacities of the restructured water sector institutions strengthened in line with future demands			+++	++	++						++		
EE Enabling Environment													
Rights, obligations and rules of business as they apply to all water sectors stakeholders promulgated via a coherent and comprehensive set of documents		+++				++	+++	+++	+++	+++	+++	+++	
Development and management of water sector resources, institutions and infrastructure characterised by the use of reliable, well organised data and targeted adaptive research	+			+++	+								
User commitment to the sustainable and wise use of the country's water resources													

NWMP Cluster Objective	Contribution to Major Sectoral Institutional Objectives												
	Cross-cutting approaches	Social Equity and People's Participation	Institutional Capacity Building	Establishment of reliable and available data	Food Security	Regulation vs. 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
		+			+				++		+		
Water sector costs shared between public, private and user entities according to comparative advantage											+++		
MR Major Rivers													
Main and regional rivers comprehensively developed for multi-purpose use													
TR Towns and Rural Areas													
Demand for safe and reliable drinking water supplies and services satisfied in towns and rural areas													
Demand for sanitation facilities and services created and satisfied in towns and rural areas											+		
Large and small towns protected from flooding and stormwater run-off													

NWMP Cluster Objective	Contribution to Major Sectoral Institutional Objectives												
	Cross-cutting approaches	Social Equity and People's Participation	Institutional Capacity Building	Establishment of reliable and available data	Food Security	Regulation vs. 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
MC Major Cities													
Demand for safe and reliable drinking water supplies and services satisfied in the Statistical Metropolitan areas											+		
Demand for sanitation facilities and services created and satisfied in the Statistical Metropolitan Areas											+		
Statistical Metropolitan Areas protected from flooding and stormwater runoff													
DM Disaster Management													
Lives, livelihood and national infrastructure protected or mitigated against inundation damage by structural and non-structural means													
AW Agriculture and Water Management													

NWMP Cluster Objective	Contribution to Major Sectoral Institutional Objectives												
	Cross-cutting approaches	Social Equity and People's Participation	Institutional Capacity Building	Establishment of reliable and available data	Food Security	Regulation vs. 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
Water-related constraints on agricultural production minimised													
EA Environment and Aquatic Resources													
Sufficient clean water for multi-purpose use													
Adequate quality, connectivity and habitat water parameters for the preservation and improvement of aquatic and dependent terrestrial biomass and biodiversity													
Public committed to, and empowered to demand, environmental improvement and sustainable development of water-dependent resources													

Key to Impacts:

Major ■ Moderate ■ Minor ■ Positive + Negative –

11 Risks and Risk Management

The risks associated with each NWMP Programme are identified and discussed, along with mitigating assumptions, in the programme description profiles which comprise the Investment Portfolio (Volume 3). This section takes a broader view and assesses the risks that apply at Plan level.

11.1 *Political and Institutional Risks*

Political and institutional risks are related and likely to be both conceptual and operational; and furthermore, in the case of institutions will include the prevailing institutional culture as well as formulations. And there are cause and effect relationships between several, of the identified risks.

Beginning therefore with the conceptual risks as they apply to the institutions. These begin with an acknowledgement of the vested interests of the line agencies in maintaining the status quo. This has resulted in a culture of secrecy and rivalry leading in turn to a lack of coordination, cooperation and accountability (especially downwards accountability which is so necessary for successful decentralisation). The effects of vested interests and resistance to change also permeate at the technical level where prescriptive, supply driven, project based approaches prevail over more responsive, demand driven or systems approaches. This is reflected in an enduring preference for expensive capital solutions instead of cheaper and potentially quicker, more sustainable institutional solutions. Part of this begins with an unwillingness to recognise the potential that the grass roots represents as an engine of change; and hence as a definer of demand. Equally, the resulting lack of choice and self-determinacy at the grass roots introduces the risk that continuing inefficiencies will not be improved as a result of demand from a grass roots empowered by choice.

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 reformulations required by policy take, then GoB wins by definition. If the institutional reformulations are 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 (another issue that will require significant political will) and demand driven institutions should eventually be reflected in sustainable remuneration packages for their employees, making them also winners.

Operational risks begin with the continuing delays in the establishment of the Local Government Institutions that will have a crucial role to play in decentralised water management; and with delays in engaging the processes necessary to achieve consensus between stakeholder institutions of Bangladesh's water sector (without which the vested interests mentioned are likely to persist). Furthermore, there seems to be an inherent difficulty in adopting the long view without which the lacking commitment to operation, maintenance and other sustainability issues will remain elusive.

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

11.2 *Social Risks*

Social risks fall into five categories, two of which have a clear nexus with certain of the political and institutional risks. A prolonged 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 hence sensitisation campaigns that are meaningless and badly focussed. This, and low political will, may dilute messages that need to be robust and highly focussed: examples would concern cost recovery, the wise and regulated use of natural resources and maximised community responsibility for operation and maintenance of their schemes. Equally, similar dynamics 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 however and mitigates them, as does the NWPo, by the emphasis it places 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. Furthermore by addressing public awareness at programme level; in terms of both water sector reform and the broader environmental imperatives, the NWMP has highlighted sensitisation not only as a adjunct to other activities; but also as a cause worthy of addressing for its own sake thereby introducing the chance of mobilising expertise which may currently lie outside the remit of the traditional water sector. Pragmatism also suggests that where the support of the donors and development banks is required, their own policies will demand that sufficient regard will be paid to social issues such as consultation, sensitisation and participation.

However, even with the most expertly delivered and successful sensitisation campaigns, it may be that there will be some initiatives that are 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 programmes targeted at the preparation of appropriate regulatory mechanisms. However, where the lack of demand concerns interventions that are directed at perceived needs, then there would seem to be no reason for proceeding. This is acknowledged by the NWMP's emphasis on a demand driven approach to development.

The other social risks are more difficult to mitigate simply by means of a water management plan because they have causes beyond the confines of the water sector. These all concern the poor and the only real way to solve the problem of poverty is to alleviate it. People are poor not because there is no water management plan, but because of exploitation; distortions in the economy; unequal opportunities and possible lack of social capital (at least in the cities). As far as the NWMP is

concerned there are risks that the poor will become displaced as a result of ongoing water sector development or excluded from the schemes that result (although this type of exclusion should not be confused with the exclusion control rights that represent valid regulatory processes at the level of user organisations). There are also risks of increased marginalisation of the poor, especially in respect of environmental programmes and erosion control of the charlands which may become attractive to more powerful interests once stabilised unless land tenure rights are conferred in parallel programmes beyond the scope of a water management plan.

But given that the best way to solve poverty related problems is to alleviate poverty, the NWMP has many programmes with potential poverty alleviation benefits. 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. It should be noted however, that natural resource benefits such as these will do little to enhance the socio-economic status of rural women, female headed households and the poorest sections of the community unless fair and impartial access to the resources in question can be guaranteed and maintained for them.

11.3 *Environmental Risks*

Without adequate sensitisation, environmental strategies are often viewed as counterproductive limitations on human survival and economic activity. Furthermore, adequate sensitisation takes time. Given the delicate state of Bangladesh's aquatic resources, there is consequently 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 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 may result in untreated waste products being discharged into the river system.

Risks of this nature are mitigated however, by the NWMP's holistic view which includes the environment itself as an important water sector stakeholder, to the extent that an entire cluster of programmes is dedicated to the sustainable health and hygiene of the environment and aquatic resources. Furthermore, the programme 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, very much as components of the Plan's foundation as it were.

Finally, the risk of water table unacceptable draw-down is acknowledged, although monitoring records considered during the development strategy studies suggest that this risk is not extreme, especially as the NWMP will facilitate conjunctive use opportunities wherever practical, as per policy.

11.4 *Financial Risks*

It will be no surprise that financial risks concern both capital and recurring costs. As far as capital costs are concerned, it will be seen in section 13 "Funding the NWMP" that much of the Plan can be funded by traditional sources. We will get to those aspects of the Plan which require alternative funding momentarily; first however, it is necessary to make it clear that "traditional financing modalities" assume significant participation of the donor communities (which, in this context, are taken to include development banks), with the remainder affordable when compared with historic direct Government support to the sector. The issue at hand is therefore less concerned with the availability of funds; but rather the willingness of those holding them to release them. This will depend on the extent to which donor interest can be maintained and their conditions satisfied; but before taking a closer look at the potential represented by the Donor community, it is necessary to make the implications of funding shortfalls clear to the reader.

The assumptions that drive section 13 (and set out therein) concern forecasts of the growth in GDP. These forecasts were estimated during the Development Strategy Studies, and justify the assumption that GDP will continue to grow at around 5.5% to 6% per year. If in reality however, GDP fails to grow at these rates, then either higher percentages will have to be allocated to the water sector than those recommended in section 13, or implementation of the Plan will have to be attenuated or trimmed. While The Plan embodies sufficient scope for either of these options (attenuated or delayed water resources programmes such as the barrage and/or erosion control ones for instance, would have an immediate and beneficial effect on NWMP funding requirements, without being as demand sensitive as the capital intensive water service programmes). If such decisions become needful however, they will be made largely on the basis of political criteria and as such are beyond the remit of those responsible for preparing the Plan, except as far as the need for flexibility is concerned (hence the framework approach adopted). Nonetheless, the political philosophy inherent in those decisions and the will that forces them through will be of significant interest to the donors who will be looking constantly for signs of the enabling environment.

Donor consultations carried out during its preparation confirmed very significant interest in the Plan. In fact several high profile donors are specifically waiting for the Plan to be published in order that it might inform their preparation for fresh rounds of water sector support (see also Section16.1, "Using the Plan").

Conditionality is a more difficult issue not only because of the conceptual challenges it sometimes represents; but also (and this point cannot be over emphasised) because there can be incompatibilities between the policies of different donors, and furthermore in some cases, a donor's monitoring criteria are sometimes incompatible with their own policies. This can cause enormous difficulties for even the most compliant of beneficiary governments. The Plan mitigates these risks because it reflects both conventional wisdom and proven best practice; just as donor policies do.

The alternative funding sources represent a different kind of risk as by definition they are very much an unknown quantity. This theme will be developed fully in section 13. At this stage it is necessary merely to make it clear that alternative funding will be severely constrained, to the detriment of the Plan's success, in the absence of an enabling environment. Furthermore, reality suggests that the pace of response to an increasingly enabling environment is likely to lag behind the pace of its establishment for many years into the Plan's implementation. This leaves Government of Bangladesh with no alternative but to be ready at least, and quickly, to commit significantly increased GDP allocations to the water sector – particularly water services in the towns and cities if a socio-economic calamity of gargantuan proportions is to be averted. To this end the Plan has an entire cluster targeted at the establishment of the necessary conditions, and programmes within it concern not only ways to mobilise alternative sources of finance; but also ways by which to regulate their use and to protect both investors and users alike from exploitation, monopolistic tendencies and sharp practice.

Recurring costs represent an altogether different and more serious risk. Much of the decline of existing facilities has resulted from grossly inadequate recurring cost recovery, and furthermore, convincing restoration scenarios will inevitably be among donor's pre-financing conditions. The Plan provides for 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 without which any hopes of optimal cost recovery would be groundless. But this theme is also development in section 13.

11.5 *Technical Risks*

It is possible to suggest a wide range of technical risks and between them, they concern both the implementation and operation of water sector schemes, as indicated in Table 11.1.

Table 11.1: Technical Risks Associated with the NWMP

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

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

Part C: Implementation Arrangements

12 Implementation Plan

Wherever they are encountered, historic water management plans have often focussed on end products in the form of capital investments. As such they have tended to be rigid, prescriptive and comprise little more than shopping lists. By comparison a modern, rolling framework plan such as this is neither static nor prescriptive. In fact, by stressing the importance of responsive, decentralised and participatory decision making, and by providing instead of a shopping list, a framework within which such decisions can be guided by policy, demand and best practice, the Plan is equally concerned with process as with product – an essential distinction in the context of long-term sustainability. Put another way, the NWMP lays a foundation for the comprehensive and integrated management of the sector as a whole, including the supply and demand side institutions that serve or depend upon it. The success of the Plan should consequently be measured not only in terms of the physical management of the resource (the product) but also the extent by which all the stakeholders work together to achieve the Plan's objectives (the process).

But this is unlikely to be achieved without expert coordination and encouragement, which in turn demands that a suitable agency is mandated and equipped for the task, ready to run with it as soon as possible after the Plan's official adoption by Government. Furthermore, for the purpose of implementing the Plan, the coordinating agency's objectives should be the same as those of the Plan itself. Equally such an agency's allegiance should be perceived as responsive to the sector at large as opposed to being aligned with particular interests within the sector.

Institutional responsibilities for coordinating the Plan and implementing its Programmes are suggested in this section. First however, it is useful to consider the overall implementation schedule.

12.1 *NWMP Implementation Schedule*

Figure 12.1 comprises an implementation schedule for the NWMP as currently formulated[8]. Ideally and inevitable, many of the programmes will be linked operationally or conceptually, serially or in parallel. Such linkages are explored in Section 14.

[8] The use of the term "as currently formulated" acknowledges the likelihood of revision during the five yearly reviews and reformulation of the Plan.

Figure 12.1: NWMP Implementation Schedule

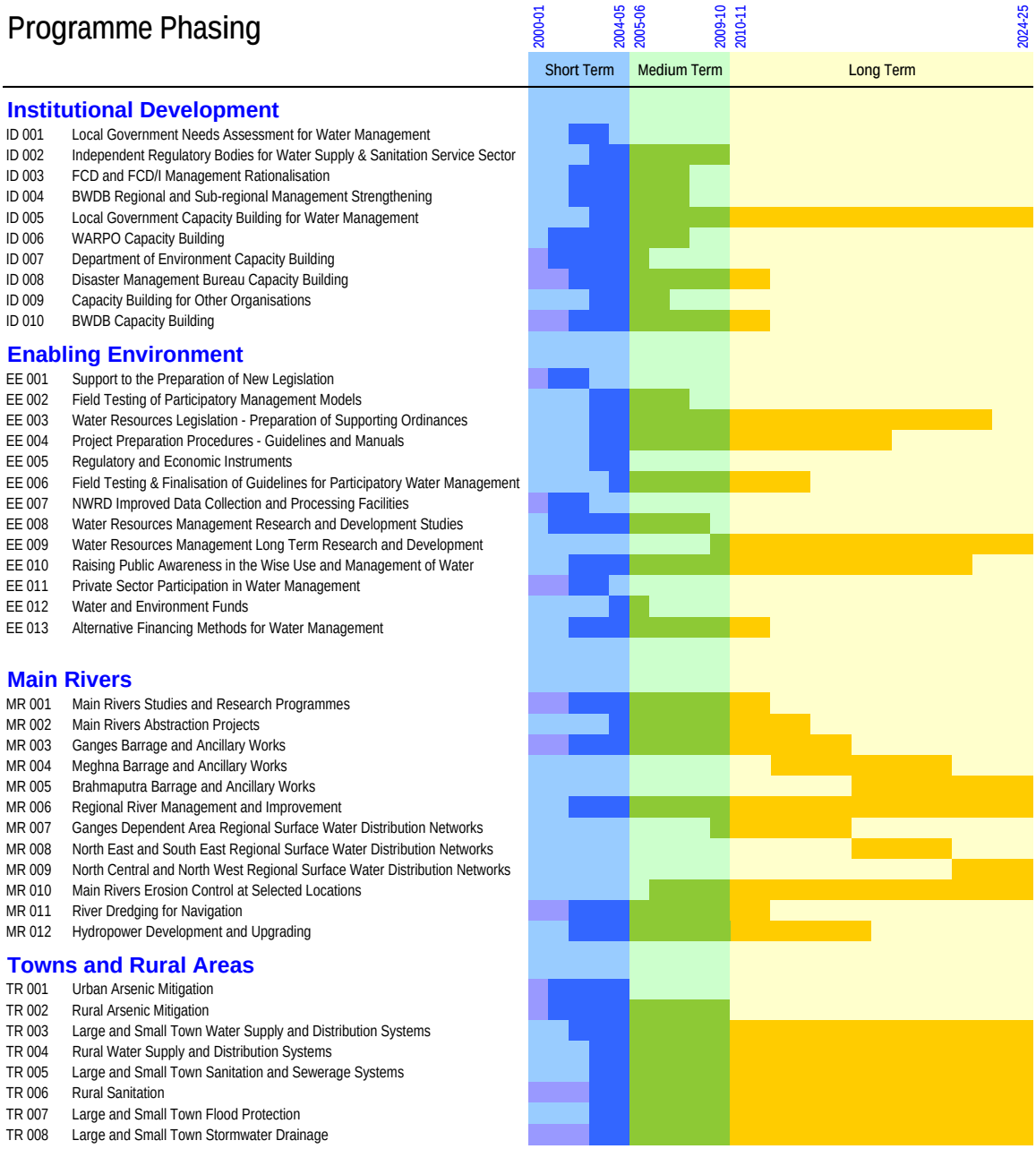
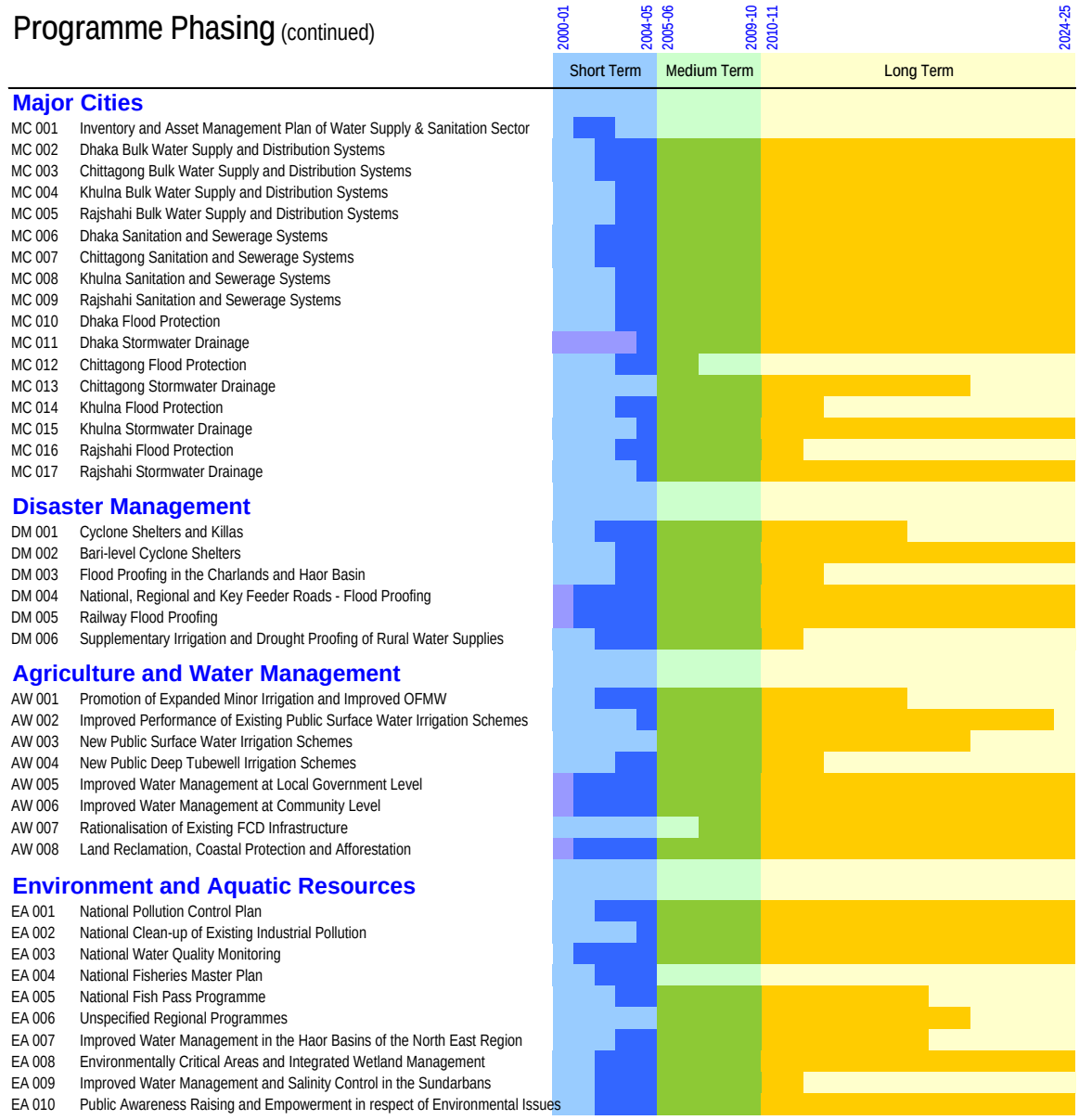


Figure 12.1 NWMP Implementation Schedule Cont'd



12.2 *Responsibilities*

The Investment Portfolio (Volume 3) assigns primary responsibility for each programme to a specific agency. Each of these agencies will be responsible for identifying and designing, perhaps in cooperation with their development partners where appropriate, the specific projects that will make up the programmes designated to them. As well as having to be consistent with the NWMP framework, they will also have to be consistent with policies, rules and guidelines set out by Government from time to time. With this caveat, the Plan allows the line agencies to prepare their own plans and initiate them through the normal administrative channels (see also sub-section 12.4 below).

The Investment Portfolio also sets out which agencies are expected to play a secondary or support role within a particular programme. Many of these roles are strategic in terms of sustainability or institutional advantage. Line agencies will therefore need to take these potentially advantageous, but nonetheless subordinate relationships fully into account whilst preparing their work plans. The programmes database within the MIS (section 9 referred) can be used to identify primary and secondary responsibilities for each agency, while Figure 12.2 presents a summary of the information.

12.3 *Coordination and Monitoring*

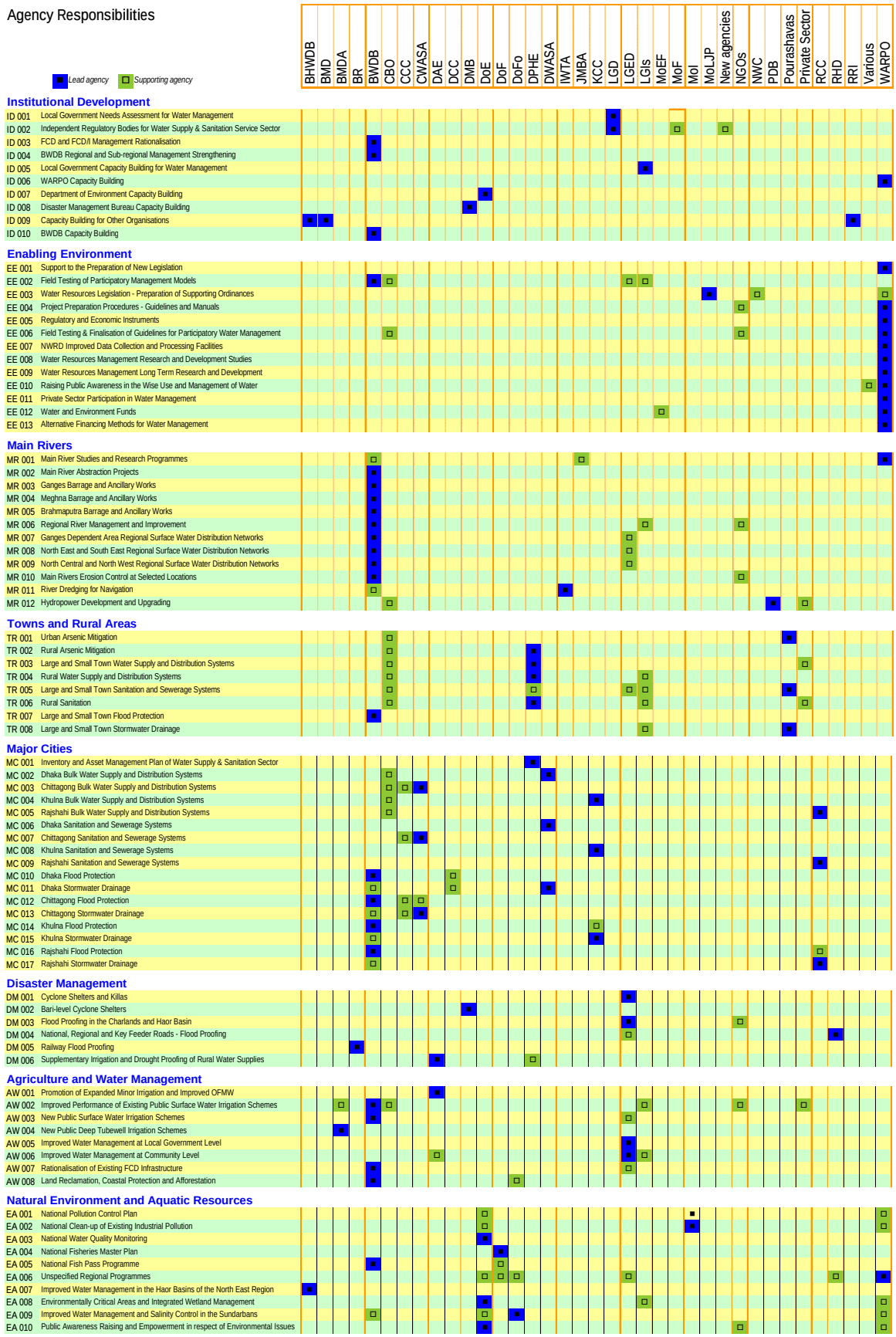
According to the NWPo, the NWMP will be implemented by different agencies, under the overall monitoring, coordination and advice of WARPO.

NWPo §4.2.b refers:

> "WARPO will prepare, and periodically update, a National Water Management Plan (NWMP) addressing the overall resource management issues in each region and the whole of Bangladesh, and providing directions for the short, intermediate, and long runs. The plan will be executed by different agencies as determined by the Government from time to time."

Institutional responsibilities for NWMP implementation were therefore assigned in Figure 12.2. What this means in terms of next steps for the institutions involved is discussed in Chapter 16. Even so, it can be seen that the institutional landscape reflects the changes required by the NWPo, most of which will actually be effected by the NWMP itself. Accordingly, any institutional implications have either been discussed elsewhere in this document, or in the detailed programme descriptions contained in Volume 3 "The Investment Portfolio". However, inter-alia the figure clearly shows that in addition to its policy defined roles, WARPO will also have sole responsibility for seven programmes; primary responsibility for seven and secondary responsibility for six. Furthermore, as the agency responsible for monitoring the Plan, WARPO will inevitably be closely linked with annual reviews and quinquennial updates.

Figure 12.2: Institutional Responsibilities for the NWMP Programmes



Finally in this regard, WARPO will be the agency to operate under the aegis of the Plan. For these reasons it is worthwhile taking a closer look at the implications for WARPO, and to do so in the context of its current five year work plan (Five Year Work Plan for WARPO 2001-2005, June 2001): Table 12.1 refers.

Table 12.1: WARPO's Work Plan Compared with the NWMP

WARPO Function	Main Activity	Relationship to the NWMP
Planning & Research	Periodic updates of the NWMP	Proactive: WARPO is directly responsible
	Regional & inter-regional development studies	Proactive: WARPO has primary or secondary responsibility for deliverables under Plan
	Assistance & advice to other organisations on planning	Reactive: application and facilitation of the NWMP to its participants
	Water resources & demand estimates	Reactive: demand driven service to other NWMP participants
	Delineation of planning & regulatory zones	Proactive: WARPO has primary or secondary responsibility for deliverables under Plan
	Research & development	
Monitoring & Evaluation	State of the Water Resources System Report	Reactive: input to WARPO's monitoring role
	NWMP Progress & Impact Monitoring Report	Proactive: WARPO has overall responsibility
	Monitoring of regulatory & economic instruments	Proactive: These are NWMP outputs
Portfolio Management	Clearing house function	Proactive: WARPO is directly responsible
Information & IT Support	MIS & NWRD operation & maintenance	Proactive: Primary management responsibility under the NWMP
	Quality control & standardisation	Proactive: WARPO has primary or secondary responsibility for deliverables under Plan
	Data management policies	
	WARPO internal support & network assistance	No direct relevance
	Technical database development	
Institutional & Legal Issues	Support for legal & regulatory drafting	Proactive: WARPO has primary or secondary responsibility for deliverables under Plan
	Guidelines & manuals	
	Institutional Arrangements for IWRM	
	Sector funding	Proactive: Part of the clearing house function
General Management, Administration and accounts	Internal planning & organisational development	Proactive: these will all be outputs of programme ID 006 "WARPO Capacity Building" which WARPO itself will be responsible for commissioning and facilitating.
	Human resources development for WARPO	
	Human resources development for others	
	External relations	
	Administration	
	Accounts	

It shows that of the 25 main activities anticipated for WARPO during the period, only two have no direct relevance to the NWMP, while of the others 20 out of 23 are proactive as regards implementation of the Plan. This has two implications.

First, WARPO's current capacity will have to be strengthened both technically and operationally. In particular, it will need a dedicated roster of staff hired directly by WARPO rather than seconded temporarily from other agencies, and this will require an innovative approach to its financing. But these and other relevant issues will be addressed by Programme ID 006 "WARPO Capacity Building". Second, conceptually more important, and so far not considered, is the matter of WARPO's place in the institutional landscape.

In line with conventional wisdom, executive responsibility for the management of Bangladesh's water sector rests with an apex body convened of members drawn from a wide range of institutional stakeholders, namely the National Water Resources Council and its Executive Committee. The principle advantage of such an arrangement is that agencies having mutually irreconcilable interests in the sector, temporary or otherwise, can have their difference adjudicated at the highest operational level. This is particularly advantageous when the apex body in question is served by a technically competent secretariat, which WARPO is now responsible for providing. However, it is debatable whether such a secretariat should be part of one of the stakeholder agencies, as is WARPO since it is part of the Ministry of Water Resources. Options to re-position WARPO, to be considered under ID 006, could entail its re-establishment away from a line agency to a neutral location elsewhere within the country's civil administration, perhaps the Prime Minister's Office.[9]

12.4 *NWMP and the National Planning Process*

If the process oriented facets of the NWMP are to contribute to the long term sustainability of water sector management in Bangladesh it is essential that it complements and informs the normal planning and budgeting activities of Government rather than replaces them. To this end, as the apex body and with WARPO's assistance, the NWRC will have to work closely with the Ministry of Planning to harmonise Five Year Plans and Annual Development Programmes with the NWMP and its updates.

12.5 *Parallel Actions*

Although the NWMP addresses actions required within the water sector, many of the agencies concerned, have responsibilities that extend beyond the Plan's remit. Examples of this would be the broader efforts of the Ministry of Agriculture and its agencies to promote improvements in crop husbandry, seed management and fertiliser usage; or the Department of Environment's regulatory mandate which goes beyond issues solely concerned with water. Yet many of these parallel actions will ultimately have bearing on water sector demands, and therefore need to be kept in view. Four areas in particular have special implications on the water sector.

[9] Equally, as suggested at the end of Section 6, an interim step might be to rotate the ECNWRC chair around the stakeholder agencies.

- **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 LGI's and reinforce the 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:** Bangladesh has no integrated transport policy. Planning of navigation oriented investments would be greatly enhanced by consideration of alternative transport modes and development plans for these.

13 Funding the NWMP

13.1 *Disbursement Schedule*

Figure 6.4 presented the consolidated capital costs of each cluster over the NWMP short, medium and long terms, along with the residual costs of programmes commenced, but not completed during the Plan's 25 year horizon. The same costs were presented at programme level in Sections 7 and 8; but still in terms of the short, medium and long term, plus residual phases. It should be noted however, that residual costs as defined, are not the only costs that the NWMP will incur beyond 2025. First there will be the costs of routine ongoing activities initiated or strengthened by the Plan such as research, erosion control and pollution monitoring or control etc. Since these are effectively annual, rather than investment costs the NWMP budget makes no provision for them beyond 2025. Secondly however, in order to maintain installed water service capacity ahead of demand it will be necessary to make investments within the lifetime of the plan against increasing demand beyond 2025 (Figure 8.5 referred). Wherever relevant, such costs are clearly identified on the cost estimates provided within the Investment Portfolio programme descriptions. Equally, they are included in the NWMP capital budget that is broken down by Cluster and year in Table 13.1 which also includes the recurring costs.

Figure 13.1 presents the same information in graphical form.

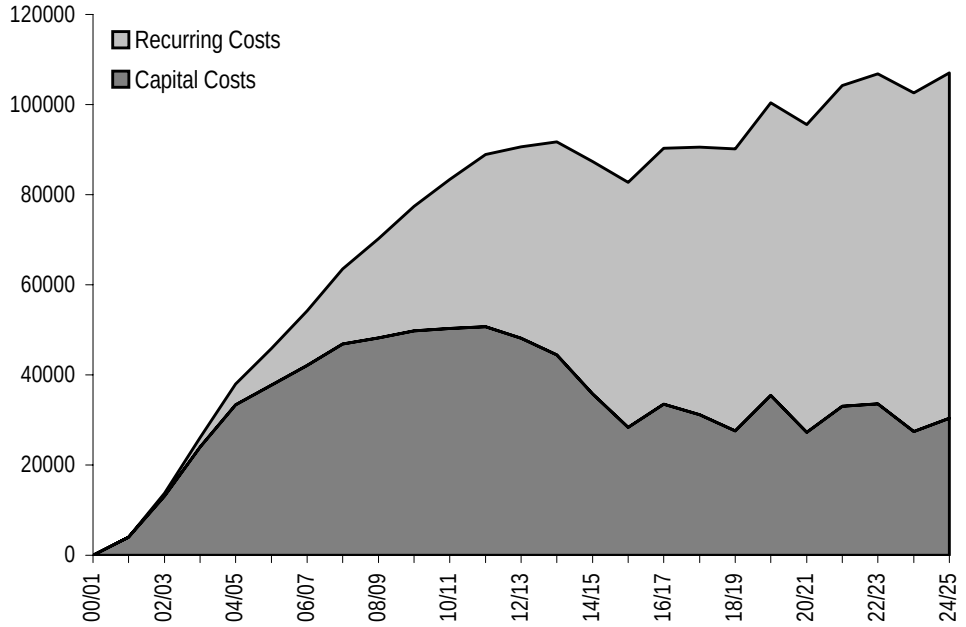


Figure 13.1: NWMP Disbursement Schedule

Table 13.1: Disbursement Schedule for the NWMP

CLUSTER	COST TYPE	00/01	01/02	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14	14/15	15/16	16/17	17/18	18/19	19/20	20/21	21/22	22/23	23/24	24/25
ID	Capital	0	123	588	1475	1595	1761	1433	1358	1085	1085	845	845	484	484	484	484	484	484	484	484	484	484	484	484	484
	Recurring	0	0	0	0	32	64	96	129	183	244	276	309	341	555	587	619	651	683	715	748	780	812	844	876	908
EE	Capital	0	116	180	250	296	207	193	193	173	173	173	173	124	124	117	117	117	117	106	106	106	106	106	100	100
	Recurring	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
MR	Capital	0	0	2494	2594	3349	1950	2810	2810	2810	3923	7265	13811	10122	10122	9674	9674	13826	5804	5804	5804	5804	14371	14371	14371	14371
	Recurring	0	0	0	0	157	314	539	681	867	1053	1239	1429	1703	2141	2495	2849	3136	3423	3961	4066	4171	4277	4758	4880	5002
TR	Capital	0	2776	4276	10481	11981	13309	15309	19218	19968	20468	17214	11464	13301	13301	4801	10801	6301	10801	6301	8535	8856	6173	3745	4801	7301
	Recurring	0	0	0	602	1444	3078	4966	7057	9510	12588	15800	18889	21503	23096	25226	27356	27959	29671	30628	32402	33359	34610	35933	36810	37263
MC	Capital	0	8	3454	6095	12520	16595	18495	19472	19667	19717	20417	20017	19182	16083	16616	3216	8716	10566	11766	17416	9383	9283	12267	5000	5633
	Recurring	0	0	0	0	352	971	2151	3754	5549	7465	9430	11400	13450	15414	17294	18956	20675	20999	21894	23031	24217	26002	27022	27921	29208
DM	Capital	0	475	1326	1590	1590	1590	1553	1530	1593	1545	1545	1545	1505	1199	1199	1199	1199	540	540	540	540	540	540	540	540
	Recurring	0	0	19	61	105	149	193	236	280	326	372	417	463	509	683	727	771	816	837	858	878	899	920	941	962
AW	Capital	0	241	271	491	655	1063	1250	1256	1836	1836	1836	1836	2371	2151	2151	2151	2151	2135	2135	2135	1727	1727	1727	1727	1563
	Recurring	0	0	4	4	9	51	97	164	240	317	421	525	629	733	867	965	1062	1159	1256	1353	1450	1547	1623	1700	1776
EA	Capital	0	214	519	994	1365	1281	1101	1011	1040	1040	1040	1040	1003	1003	703	703	703	703	430	430	384	384	384	384	384
	Recurring	0	0	2	2	3	12	61	71	80	90	99	109	118	128	137	147	156	162	168	174	174	175	176	176	177
TOTAL	Capital	0	3953	13107	23969	33349	37756	42144	46848	48171	49787	50334	50730	48093	44468	35747	28347	33498	31151	27567	35451	27284	33067	33623	27406	30376
	Recurring	0	0	25	670	2102	4639	8103	12092	16710	22083	27636	33078	38208	42575	47289	51619	54411	56913	59459	62631	65030	68322	71276	73305	75297

Both Table and Figure are consistent with the agreed Development Strategy which requires that investment in water supply and sanitation will be sufficient to allow the back-log of investment to catch up with demand by the end of the Plan's medium term (2010). Inevitably, this has significant funding implications, especially with respect to investment.

13.2 *Financing Investments*

Before considering ways to finance the capital costs of the NWMP it is helpful to separate traditional water resources activities, which in Bangladesh largely means flood control, drainage and irrigation and appurtenant activities from non-traditional water service activities comprising water supply and sanitation. Such a split is interesting for two reasons:

1 water resource interventions are defined by geography whereas water services are defined by demographics;

and,

2 as a consequence water resources interventions are generally bound and finite; whereas water services are unbound and not finite while demographics change.

Capital costs of water resources activities are consequently separated from water services in figure 13.2 which clearly highlights the rapid build up of water service investments necessary to meet demand by 2010 - a scenario which, it is repeated, is consistent with the Development Strategy. However, a second scenario is presented in Figure 13.3 which assumes that capacity will not overtake demand until 2025, thereby moving the peak investment rates significantly into the longer term where they are preceded by a more gentle and easily accommodated funding stream.

In both scenarios, minimum levels of Government investment are set at that which is sufficient to cover all traditional water resources investment, net of beneficiary contributions (the blue line on the figures). Beneficiary contributions are expected to increase progressively over the Plan duration as the impacts of institutional reform and decentralisation take effect such that Government funding, along with the beneficiary contribution will be sufficient to cover the costs of traditional water sector activities by 2025. This requires the beneficiaries to contribute something like 6-7% of total investment costs by that time - a not unreasonable target.

Even so, as shown in Figure 13.4, GoB will still have to allocate almost 0.8% of GDP during much of the Plan's Medium Term in order to cover traditional water resource investments.

Figure 13.2: Capital Funding for the NWMP – Scenario 1

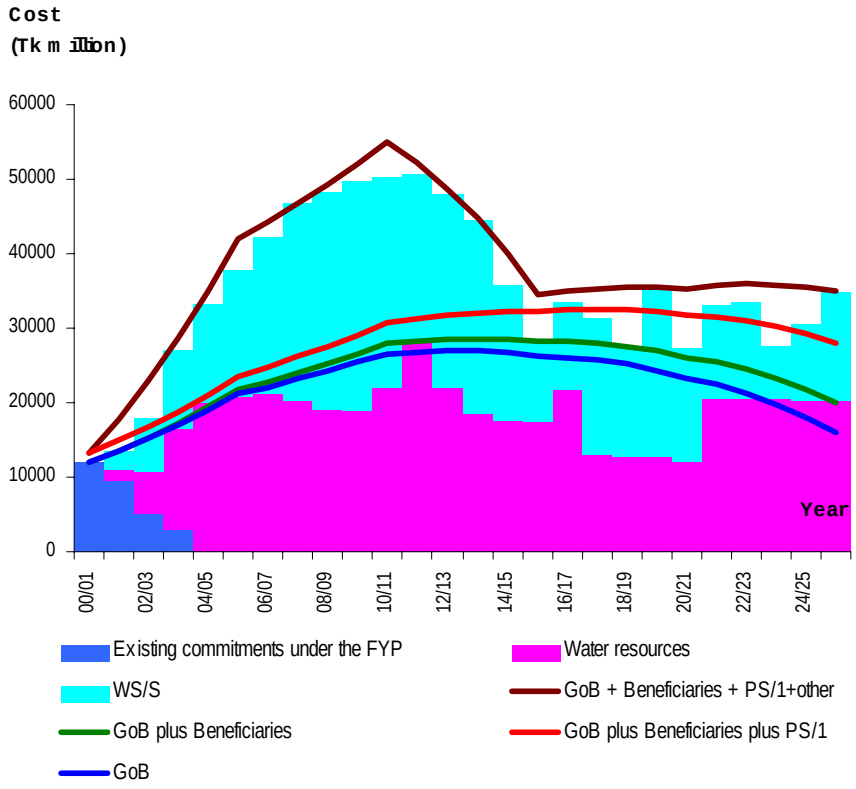


Figure 13.3: Capital Funding for the NWMP – Scenario 2

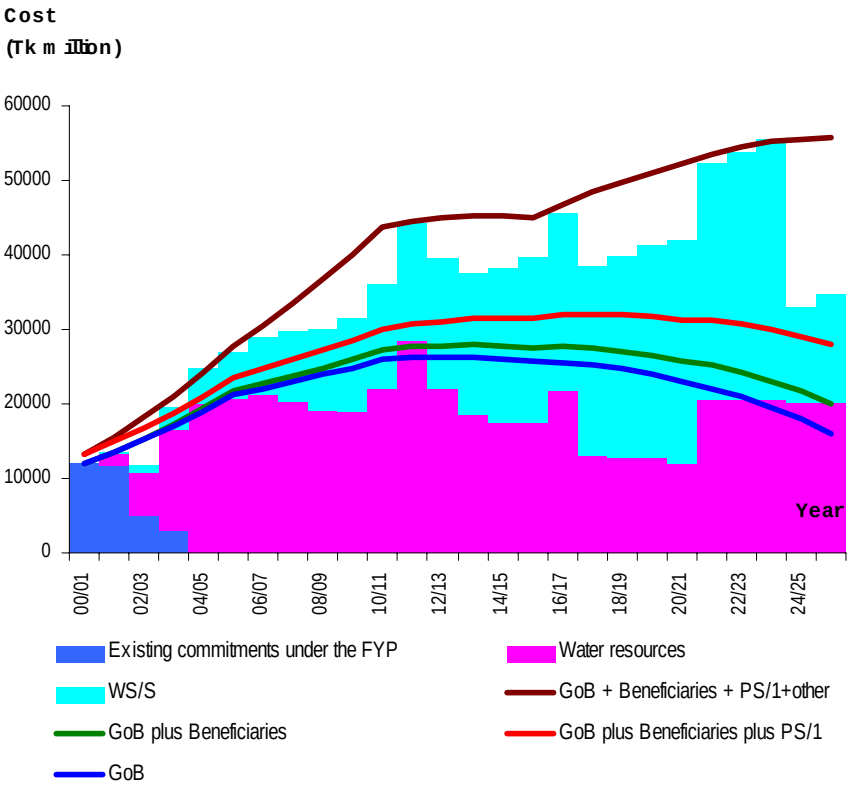
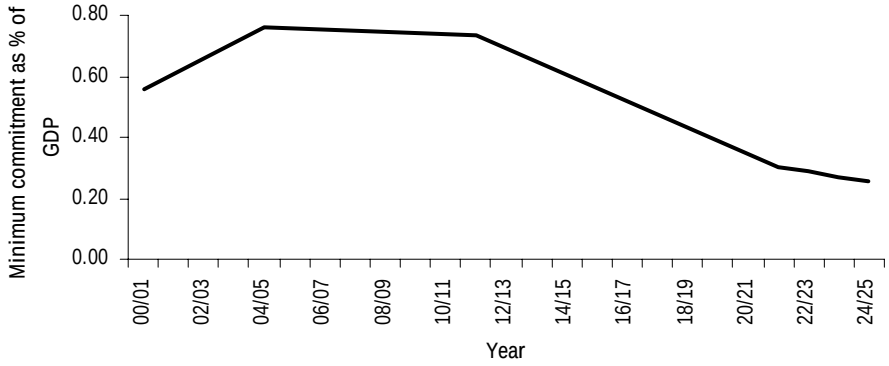


Figure 13.4: Minimum GoB Commitment Necessary to Cover Water Resources Investments



Although under the current FYP which ends in 2002, the GoB allocation is only 0.59% of GDP, the higher allocations necessary to cover traditional water sector activities by no means inconsistent with historic trends which saw GDP allocations as high as 0.9% in the mid-nineties; but even if restored to these levels they would remain significantly inadequate against the urgently needed investments in water services. For this, alternative sources of funding will have to be identified and mobilised. One option for this would of course simply be for the Government to increase its water sector GDP provision. At the medium GDP growth rate of 5-6% assumed for the Plan, GoB's allocation would have to increase to an average rate of some 1.34% throughout the medium term for Scenario 1 and 0.84% for Scenario 2 - table 13.2 refers.

Table 13.2: Percent of Projected GDP (Medium Trend)

		NWMP TERM		
Investment Requirements	Current	Short	Medium	Long
Water resources		0.589%	0.643%	0.336%
Water supply and Sanitation - 1		0.283%	0.802%	0.309%
Water supply and Sanitation - 2		0.076%	0.302%	0.428%
Total investment - 1		0.873%	1.445%	0.645%
Total investment - 2		0.665%	0.946%	0.764%
Funding Options				
Current private sector	0.600%	0.066%	0.076%	0.091%
Beneficiary contributions	0.000%	0.012%	0.032%	0.045%
GoB minimum requirements	0.590%	0.511%	0.535%	0.200%
Funding gap - 1		0.283%	0.802%	0.309%
Funding gap - 2		0.076%	0.302%	0.428%
GoB maximum funding - 1		0.795%	1.337%	0.509%
GoB maximum funding - 2		0.587%	0.838%	0.628%

This may be considered too much, in which case alternative sources of funding will be necessary if indeed, installed water service capacity is ever to be established an maintained ahead of demand. Fortunately the need for alternative financing is clearly acknowledged by the NWPo which calls for the mobilisation of all financing options. In fact, NWMP Programme EE 013 "Alternative Financing Methods for Water Management" is a direct response to Policy in this regard. Several options are appropriate.

The first is the ongoing participation of the existing domestic private sector that results largely from the demand for equipment and services from mainly small businesses throughout the country. Measurable trends over the last decade justify the assumption that domestic private sector activities will increase during the NWMP as it makes further inroads into the water supply and sanitation sector. The effect of this is shown by the red line on figures 13.2 and 13.3, where the existing domestic private sector is identified as PS/1. However, given the small-scale activities that typify the existing domestic private sector, it is highly unlikely, and indeed inappropriate, that its activities will ever be sufficient to bridge the funding gap that still remains.

Secondly therefore, there is the potential to attract larger scale private sector interests, both in terms of service contracts or the provision of infrastructure, especially bulk water supplies. To this end much talk has been given to the possibilities of attracting international utility companies to the Bangladeshi water sector. However, a variety of commentators have correctly pointed out that it may be many years before Bangladesh will be an attractive target for international investors in public utilities to the extent that the Government can formulate meaningful funding strategies dependent on their participation. Even so, based on discussions with the Infrastructure Investment Facilitation Programme (World Bank, DFID and CIDA), there would seem to be potential Bangladeshi investors with meaningful levels of funds available. Furthermore the same sources confirmed that potential investors such as these are already looking at water sector opportunities, pursuant however to the successful operation of convincing pilot schemes. For now, Government's challenge is to change the investment climate in Bangladesh by means of a rigorous process of institutional development (hence the ID Cluster) and the facilitation of an environment perceived as enabling, not frustrating, by the potential investor – local or foreign (hence the EE Cluster).

The same caveat applies to the remaining funding options which are increased donor support, public bond issues along with water and environment funds.

For instance, if the funding is to be sourced from revenue driven environment funds, it is essential that the user pays principles inherent in the NWPo be effectively enforced. These and the associated issues of decentralisation and participation will be closely scrutinised and evaluated by the donor community. Even though such issues are central to the enabling environment, they will not be achieved without breakthroughs on the parallel issues of user satisfaction with the services provided and with the accountability of the service provider. Equally, issuing bonds will achieve nothing if the potential buyer does not trust the seller. However, as has been

successfully demonstrated in China, major water related activities can be financed from share issues in which even the lowest paid workers can participate. Finally, entrepreneurial investment will not happen in the absence of profitable business plans; and profitable business plans depend, once again on reliable revenues; but to be reliable revenues must be fair and reasonable, and this requires supply side regulations – another crucial feature of a truly enabling environment.

Unfortunately experience shows that steps towards the enabling environment should not be rushed. Yet in the meantime, population increases, urbanisation and rising expectations will compound the demand for water sector services, to the extent that the costs of getting ahead of demand will escalate to levels that could never be met without public spending commitments that would be draconian at best and impossible at worse.

Consequently, Government's challenge is both clear and unavoidable. First, sufficient political will must be generated in order to force the enabling environment through the inevitable resistance caused by vested interest, turf wars, old paradigms and general reluctance to change. Secondly, until the results are actually perceived as enabling by potential participants (be they donors, investor or simply fee paying users), Government will has little alternative but to finance the funding gap itself. And if this is to be done consistently with the county's own development strategy, it will have to be started quickly.

13.3 *Financing Recurring Costs*

The importance of user pays principles in the context of water sector investments was stressed in the preceding section; but they are also crucial for sustainability. Lack of adequate recurring funding has been rightly blamed for many of the ills that characterise the Bangladeshi water sector. In fact its importance, as the pivotal constraint on sustainability, cannot be overstated. Even so, the funding of the Plan's recurring costs is an altogether different matter to that of its capital costs, which as we have seen is intended to comprise both state funds and new sources including the private sector. This difference is especially relevant in the case of infrastructure installed and services provided by private sector investors, because they are only concerned with recurring profits, recurring costs simply comprise the ongoing investments in operation, maintenance and repair necessary to secure the revenues and hence the profits. Consequently, to them cost is a meaningless concept except within the context of cash flow management. Dependable and adequate Revenues are the key to sustainability.

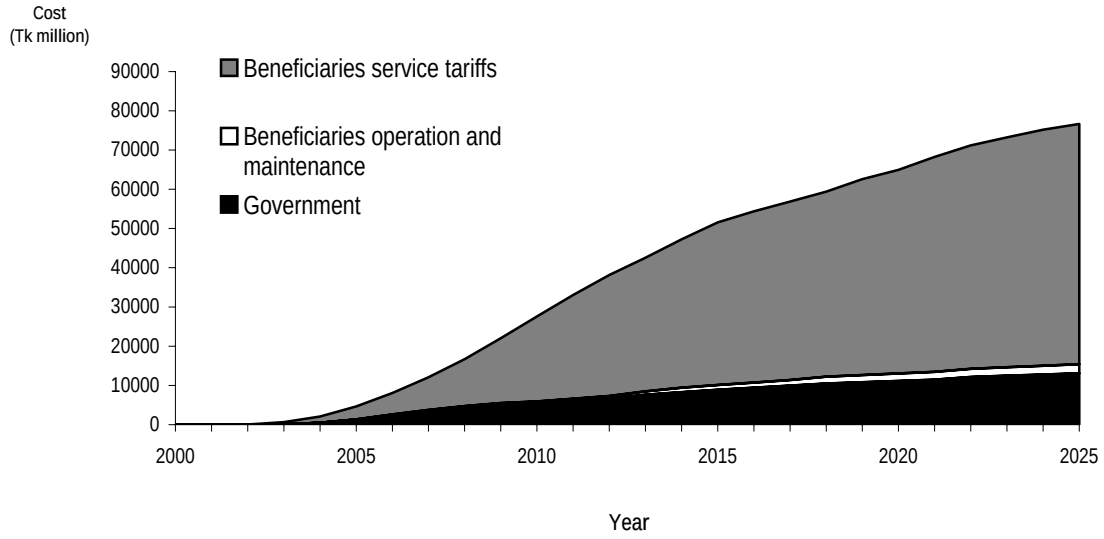
Furthermore, this principle is applicable not only to private sector funded concerns which would demand full cost recovery but also to all state funded ones that involve services. Such services might concern the delivery of a commodity – water in this case – or maintenance contracts for dykes and the like. This applies both to schemes for which full cost recovery is required and to schemes that might be considered as sunk costs, although in these cases, sustainability requires that service revenues include some sort of sinking fund provision against future costs of repairing the effects of damage or deterioration. Equally, both the NWPo and this Plan anticipate

schemes that will be maintained directly by the user group's members. This, and the broader operation of the user group, will also depend on the availability of adequate recurring funds, labour or other provision in kind via user fees, and the assessment of user group fees must allow for sinking fund provisions. Recurring costs should therefore be covered by user pays modalities to the greatest extent possible, leaving GoB to cover whatever balance remains.

This is why the NWPo places great emphasis on cost recovery in the sense not only of annual costs, but also of capital costs recovered either retrospectively by tariffs (in the case of privately funded infrastructure, such as water supply systems) or by means of sinking funds for the future rehabilitation and upgrading of communal infrastructure such as a surface irrigation scheme (whether exploited by title or usufruct).

As with every other facet of the enabling environment however, such concepts should be introduced slowly, and on the back of thorough sensitisation/consultation cycles. Of course, cost recovery against services delivered will grow as rapidly as the available services (so long as the services are satisfactory); but community operation and maintenance funding will only grow as rapidly as community understanding increases. Figure 13.5 provides an indication of how incremental recurring costs are expected to build up during the lifetime of the Plan, as well as recommendations as to how they will be met.

Figure 13.5: Recurring Cost Allocations for the NWMP



It can be seen that the greater part of the anticipated recurring costs will comprise service tariffs, which by definition must be paid if the service is not to be denied; the remaining burden is neither excessive for the beneficiaries or government; but before ending this important consideration it is necessary to consider briefly the helpful transitional role that a sensible subsidies programme can play towards the establishment of sustainable water management.

Subsidies of course are no substitute for full, sustainable cost recovery, and furthermore when delivered via service providers, they simply paper over the cracks of inefficiency, thereby perpetuating rather than solving the problems. However, when subsidies are paid via the service user, not only is the user empowered thereby, but also the service provider has to smarten its act, if it is to survive on fee income alone. This approach means that the subsidies actually catalyse rather than constrain institutional reform and is even more effective if there is competition, in which case user empowerment is increased further. This may indicate a transitional role for subsidies in Bangladesh until the cost recovery as per NWPo Guidelines is in place.

Subsidies may also have a role to play in pollution clean up, especially in the case of important, but nonetheless marginally profitable artisanal industries such as tanning. In such examples there may be a case for subsidised effluent scrubbing equipment for instance.

14 Linkages

There are two kinds of linkages between the programmes as described. The first are those which may be described as **technical**, the second relate to programme **phasing**.

14.1 *Technical linkages*

The technical linkages are clearly highlighted in each Programme Description Profile within the Investment Portfolio. They reflect the necessary integration of effort that is needed throughout the Plan, both in terms of achieving overall goals, and also in terms of necessary parallel actions. Figure 14.1 summarises where these linkages occur. Part of WARPO's responsibility in monitoring implementation of the Plan will be to ensure that these linkages are being adequately reflected during the course of programme implementation and particularly in the design of specific projects within the programmes.

14.2 *Phasing Linkages*

It is recognised that many activities set in the medium term will be influenced by actions taken in the short term. In this regard, the importance of addressing programmes within the Institutional Development (ID) and Enabling Environment (EE) clusters in the short-term cannot be over-emphasised. These programmes address fundamental issues such as capacity building, establishment and updating of guidelines and standards, legal and regulatory reform and development of alternative funding mechanisms. Without the input from these programmes, many later programmes are at grave risk of under-achieving.

This accepted, there are few strong phasing linkages between programmes beyond that which is common sense. Those that are of importance have been highlighted in Figure 14.1, and are briefly described below.

Preparation of supporting ordinances (EE 003) should not commence until at least there is common agreement on the overall shape of the Water Resources Act (EE 001).

Long-term research and development into water resources management (EE 009) will follow the priority programmes set for the short- to medium-term (EE 008). The nature of activities in EE 009 will be in part contingent upon the success and achievements of EE 008, but will also be determined as new problems surface out of other short-term programme activities.

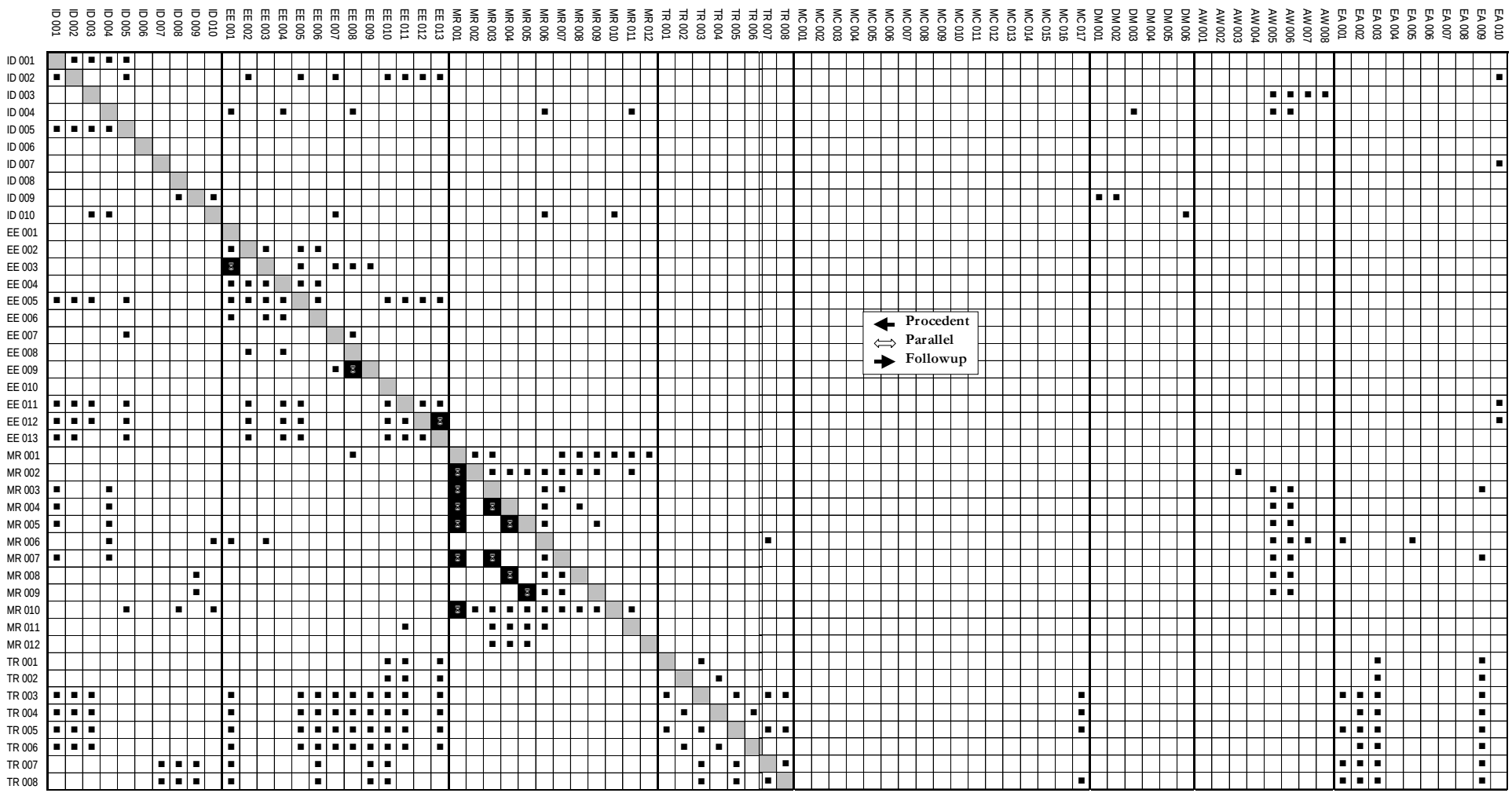
Future development of the Main rivers will be influenced greatly by the studies taken up in the short term under MR 001. This study programme will set the framework for subsequent investment decisions. Development of surface water distribution networks (MR 007, 008, 009) are linked to the timing of barrage developments (MR 003, 004 and 005). It is also assumed that no more than one barrage could be

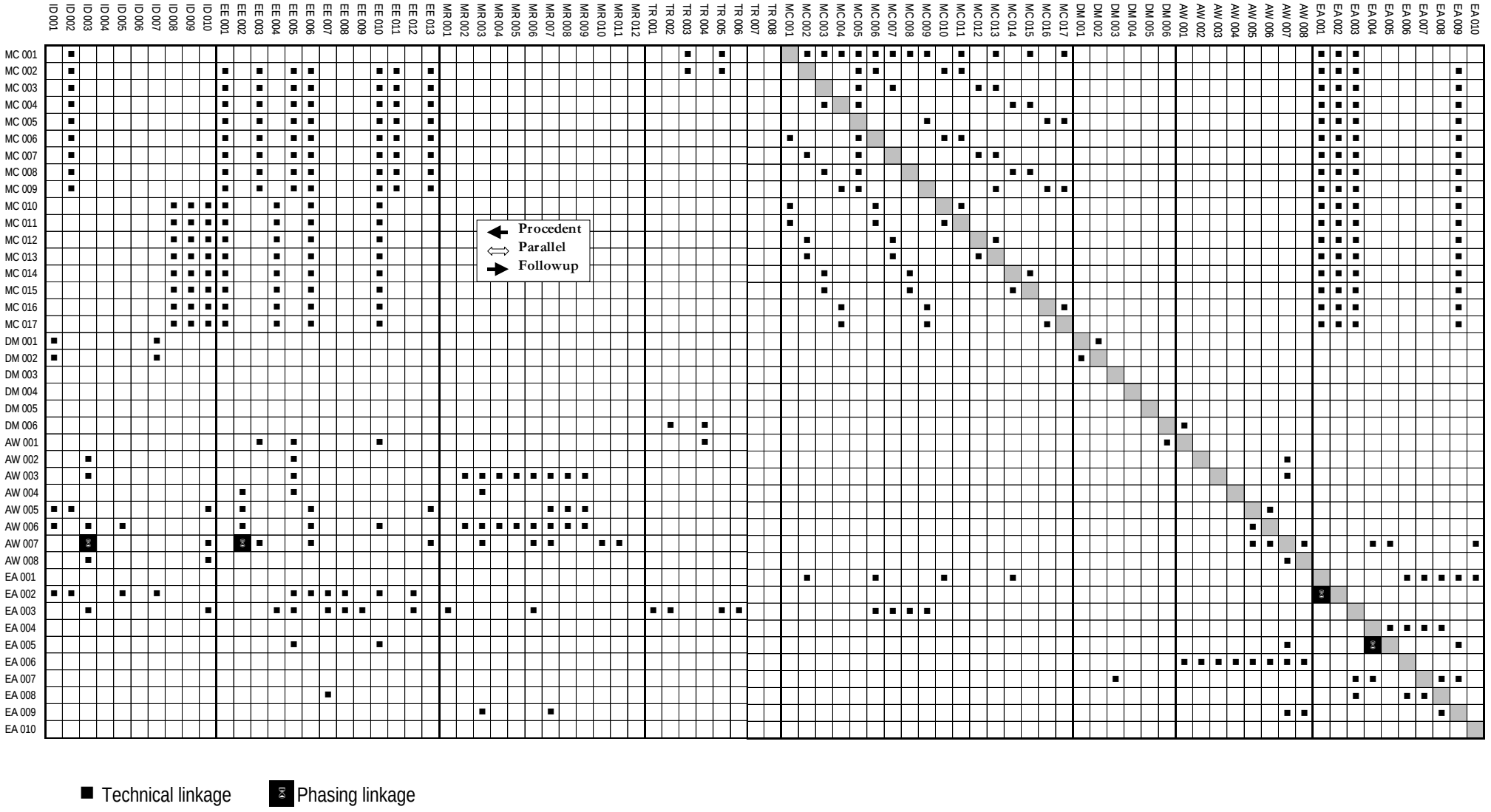
built at a time (assuming also that these investments prove justified), and that therefore if MR 003, 004 and 005 proceed, this should be done sequentially.

Programme AW 007, Rationalisation of Existing Inland and Coastal FCD Infrastructure, should not proceed until pilot testing under Programme ID 003 and Participatory Models under EE 002 have been completed.

The National Fishpass Programme (EA 005) similarly should not be taken up until the Fisheries Master Plan (EE 004) has been prepared.

Figure 14.1: Linkages between Programmes




ID 001
ID 002
ID 003
ID 004
ID 005
ID 006
ID 007
ID 008
ID 009
ID 010
EE 001
EE 002
EE 003
EE 004
EE 005
EE 006
EE 007
EE 008
EE 009
EE 010
EE 011
EE 012
EE 013
MR 001
MR 002
MR 003
MR 004
MR 005
MR 006
MR 007
MR 008
MR 009
MR 010
MR 011
MR 012
TR 001
TR 002
TR 003
TR 004
TR 005
TR 006
TR 007
TR 008
MC 001
MC 002
MC 003
MC 004
MC 005
MC 006
MC 007
MC 008
MC 009
MC 010
MC 011
MC 012
MC 013
MC 014
MC 015
MC 016
MC 017
DM 001
DM 002
DM 003
DM 004
DM 005
DM 006
AW 001
AW 002
AW 003
AW 004
AW 005
AW 006
AW 007
AW 008
EA 001
EA 002
EA 003
EA 004
EA 005
EA 006
EA 007
EA 008
EA 009
EA 010
Procedent
Parallel
Followup
Technical linkage
Phasing linkage

15 Monitoring, Evaluating and Updating the NWMP

Objective monitoring normally involves the regular comparison of activities and impacts against pre-determined objectives, using criteria represented by indicators which themselves usually require verification. Normally two types of objective are used when establishing a monitoring framework of the kind represented by the NWMP:

Development Objectives: which are objectives that a given intervention (a plan, a cluster, a programme or a project) cannot achieve by itself. Achievement of the National Goals is the Development objective of the NWMP, but its achievement clearly requires other plans and strategies

Immediate Objectives: which are objectives that a given intervention can achieve by itself.

It follows therefore that an immediate objective at one level, say Cluster level in the case of the NWMP, is the development objective for the next level down, in this case Programme level.

With this in mind, a nested structure of objectives is proposed for the Clusters and Programmes introduced in Sections 6, 7 and 8. It is set out in Figure 15.1 where it can be seen that all of the objectives converge at the National Goals (the achievement of which, the reader is reminded, will require a pan-sectoral approach). The nested structure itself, does not stop at Cluster level, the Programmes also have immediate objectives, as indicated by Figure 15.2 which comprises a representative portion of the nested structure from programme level upwards[10].

For NWMP monitoring purposes however, Programmes need two kinds of Immediate Objective as well as a Development Objective. Table 15.1 lists the Objectives (and indeed the indicators, but these will be discussed shortly) suggested for Programme EE 003. It can be seen that the Programme has two objectives with a suffix beginning with "I", plus one with the suffix "K". These are all immediate objectives that can be used to monitor the progress and impact and impact of the programme: that identified with the "K" suffix is a special or Key objective that can be used also to monitor progress and impact of the Cluster and indeed the Plan as a whole. The final indicators, which has the suffix "D" is the Development indicator of the programme, which by definition it shares with other programmes (as per figure 15.2).

[10] The figure also suggests the way by which the structure replicates itself at project level and below)

Table 15.1: Objectives and Indicators for Programme EE 003

Objective	Suffix	Indicators/Means of Verification	Due
• Water quality monitoring capacity strengthened technically and geographically	I1	• Number of accredited institutions participating	2003
• Quality assured water quality data available to all stakeholder	I2	• Number of stakeholders requesting data	2005
• Reduction of gross/persistent pollution	K	• Number of pollution sources cleaned up • Spot checks	2025
• Sufficient clean water for multi-purpose use	D	• Quality of water • Quantity of water	2025

So much for the Objectives and their vertical and horizontal linkages within the NWMP, it is now necessary to consider the indicators.

As with Objectives there can be several kinds of indicators. The Operations Evaluation Department of the World Bank suggests four layers of them. Between them they cover the gamut of processes from intangible sectoral aims to specific measurable activities at project level or below. The NWMP is concerned with both intangible sectoral aims and quantifiable impacts. As such so called *Impact and outcome/effect* indicators would be appropriate since they refer to long or medium term development changes, and can be both quantitative and qualitative. No attempt has been made in this case to use so-called SMART indicators since, as explained in Section 6, the Plan is supposed to be a flexible and responsive framework, rather than a prescriptive list of fixed interventions. It is nonetheless necessary to highlight the difference between *impact* and *activity* indicators. Simply stated:

- activity indicators measure the progress of implementation, an example would be: "x" many household connections, by 2010;

whereas,

- impact indicators measure the extent to which an activity (project/ programme/cluster or plan) has worked: i.e. cases of gastro-enteric infections reduced by 75%, by end 2010.

Indicators for the NWMP include both activity and impact indicators.

Having now defined the nature and inter-relationships of the NWMP's objectives and indicators it remains to suggest how they might be used for the monitoring the NWMP. The 84 programme descriptions that comprise the investment portfolio (one for each programme) each has its own version of Table 15.1. The objectives and indicators that these tables hold are included in each programme's records within the Management Information system described in Section 9 (and carried through to the summary sheets which begin each programme's description in the Investment Portfolio document. Thus progress at programme level is monitored by tracking each of the indicators, while progress at Plan level is monitored by tracking in particular the key indicator or each programme (which were also identified in the programme table of sections 7 and 8).

Figure 15.1: Nested Objectives of the NWMP

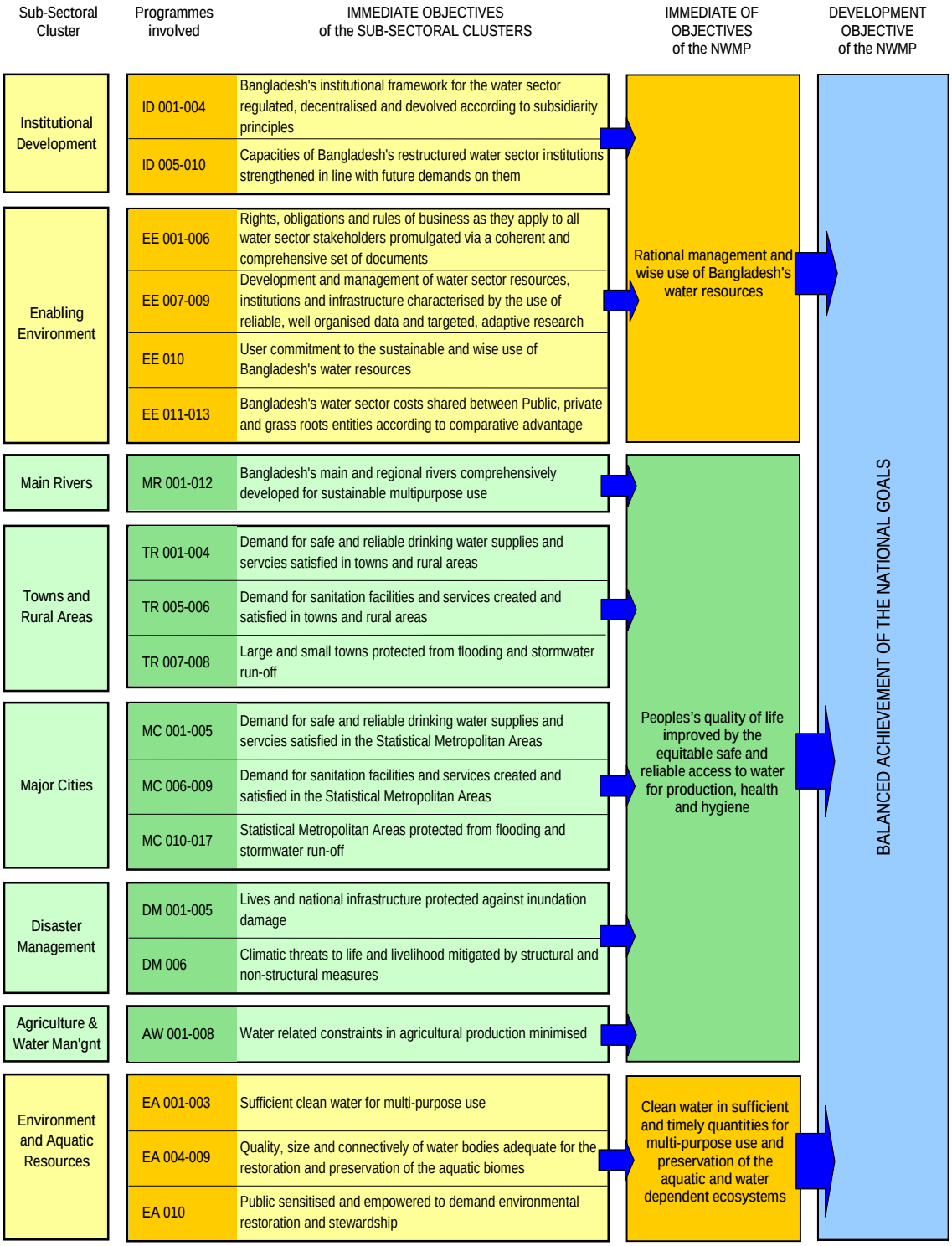
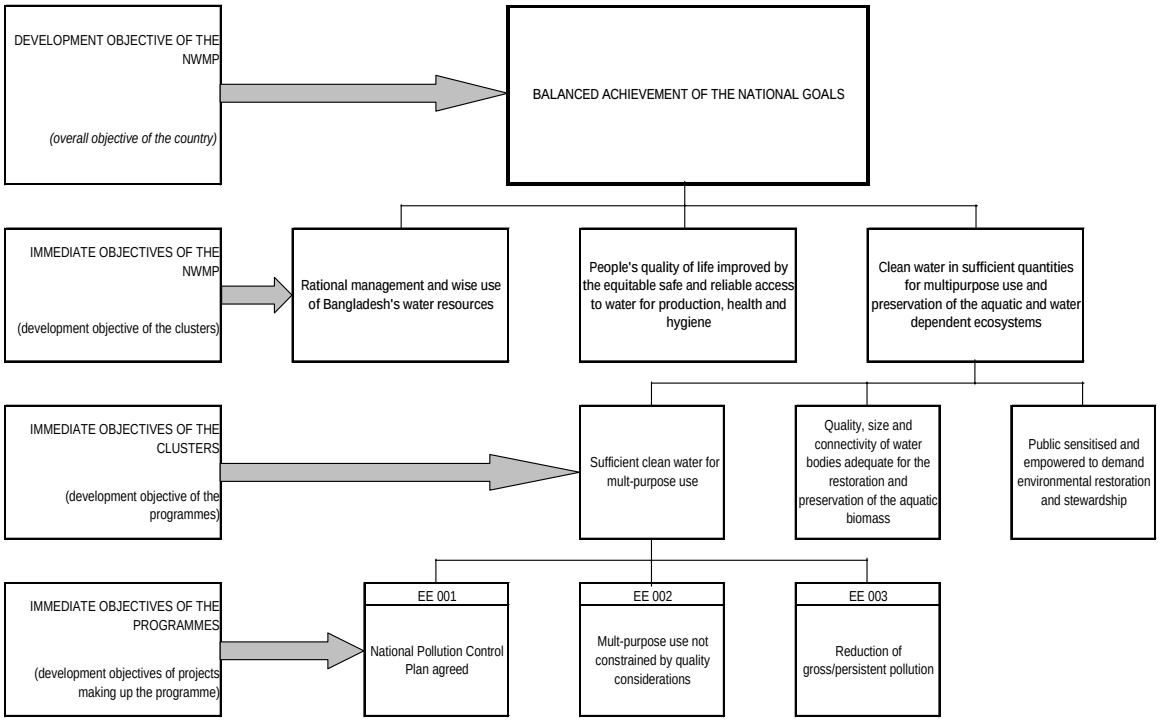


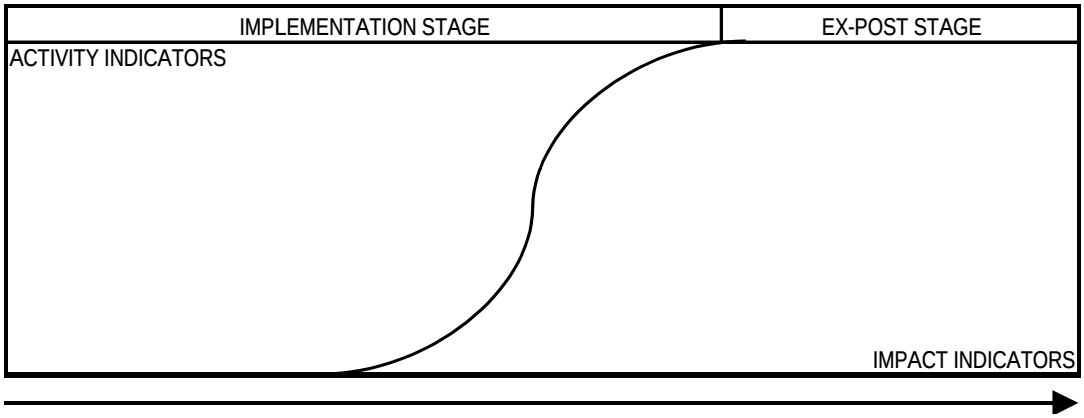
Figure 15.2: Relationship of Programme Objectives to the achievement of the National Goals



Furthermore, the MIS also allows a similar monitoring process to be carried out at project level, although apart from the establishment of the project portal and associated search engines for the MIS, project level analysis is beyond the scope of the NWMP. It is necessary to point out however, that the MIS can only handle a maximum of four objectives and indicators simultaneously for monitoring purposes (whether of Programme or Project).

This is because for monitoring purposes, especially at apex or sectoral level, too many indicators frustrates the process by discouraging the responsible party; increasing the risk of data unavailability; increasing the risk of unreliable data and, by introducing too many variables, reducing objectivity. Notwithstanding this, it is valid to propose as many objectives and indictors as is needed to "model" the programme or project involved. But when this is the case, for monitoring purposes it is necessary only to select those indicators that are most applicable at the time of monitoring. Objectives and indicators within the MIS can therefore be updated as the objective profile of the intervention changes, and will be particularly useful as such when the indicator profile changes from activities to impact, Figure 15.3 refers.

Figure 15.3: Changing Relationship Between Activity and Impact Indicators



It will be recalled from section 6 that the NWMP terms of reference require it to be a *" rolling plan to be reviewed and updated every five years"* and therefore *"capable of continuous evolution"*. The monitoring capabilities provided by the Objectives, Indicators and MIS will provide much of the key information required by those responsible for evaluating and updating the Plan. But such information is insufficient by itself, since although monitoring of the kind proposed will identify strengths and weaknesses or successes and failures, it will not necessarily identify the causes of such weaknesses or failures. Equally, the demand scenarios may change, as might some of the Plan's initial assumptions. Any monitoring outputs needs to be assessed in the light of such changes, many of which will be inevitable. Equally, it may be necessary from time to time to question the conceptual basis of some programmes, especially since water sector reform paradigms themselves continue to change globally as experience moulds conventional wisdom.

Monitoring has therefore to be complemented by regular, detailed evaluations at Plan, Cluster, Programme and indeed Regional levels. To this end it is strongly recommended that each programme is subjected to an ex-post and at least one mid-term evaluation. This will almost certainly be a condition on any external funding; but programmes funded entirely from GoB sources should be subjected to thorough evaluations of the same kind. Furthermore, these evaluations should be carried out by third parties to both WARPO (see below) and the programmes themselves. The resulting evaluation reports should be used, along with the monitoring outputs of the MIS, as the basis of the major reviews which the terms of reference suggest should be at five yearly intervals. Ideally, such five yearly reviews will be major, substantive events likely to include redefinition of objectives, refinancing of the Plan or rescheduling of disbursements. Even so, optimal performance of the Plan will also require more modest adjustments on a more regular basis, at least annually.

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

16 Action Plan

16.1 *Using the NWMP*

In accordance with the Terms of Reference and current planning approaches, the NWMP set out in the preceding text is not a list of investment requests. Instead it consolidates the challenges, goals and opportunities represented by Bangladesh's water sector within a framework bound by policy, best practice and conventional wisdom. As such it identifies those areas requiring attention; estimates the associated budgetary requirements and suggests funding modalities which are consistent with user pays principles and decentralised sectoral management.

Furthermore, by identifying conceptual and operational links between the programmes and by addressing holistic objectives that are linked vertically and horizontally, it has been prepared in a "*comprehensive and integrated manner, with regard for the interests of all water-related sectors*". (NWPo §4.2.c). It therefore reflects the need for a "*comprehensive and integrated analysis of relevant hydrological, topographical, social, political, economic, environmental and institutional factors across all related water-using sectors*". (Preamble to NWPo §4.2) while acknowledging Government's intention that "*all necessary means and measures will be taken to manage the water resources of the country in a comprehensive, integrated and equitable manner.*" NWPo (§2).

However, if the Plan is to facilitate these aims, it has to be used. To this end it can be used in four ways, two of which are linked.

First, the Plan sets out clear priorities, in other words it identifies those issues that simply must be addressed either in response to pressing demand or as a precursor or catalyst of others. In particular the high priority programmes include:

- All the institutional development programmes, especially ID 006 "WARPO Capacity Building"
- All the enabling environment programmes
- The Technical Inventory and Asset Management Study (MC 001), closely followed by all programmes targeted at water services.
- Programmes addressing FCD/I rationalisation.

and,

- Programmes addressing pollution control and clean up.

Secondly, the Plan provides a forum within which Government and its Development Partners can together agree investment strategies at programme or project level. The Plan along with its MIS system, will provide Government and its donor collaborators with a quick and easy way to identify opportunities of mutual interest. For instance, if during consultations a particular donor indicates an interest in say, supporting BWDB in NW region, the MIS will identify all programmes matching the two along with budget estimates; the Investment Portfolio will provide descriptions of the programmes along with linkages, other information sources and the risks and assumptions involved. Armed with the resulting "prospectus" the Government and Donor can then enter into detailed discussions and project preparation activities, knowing that the resulting initiative will be consistent with the framework criteria

defined in this section's opening paragraph. Furthermore, key background issues and concepts can also be studied either by means of this document, or the many analytical documents that support it (Annex D refers).

Thirdly, the Plan makes a similar service available to local stakeholders, in that it can compile their own interests and agendas institutionally or regionally, thereby providing a similar foundation for detailed programming activities.

Finally the Plan can be used for monitoring purposes, but this was described in the preceding section.

16.2 *Next Steps*

Although complex and wide ranging, the Plan and its objectives are also practical and achievable; but successful implementation will depend on a prompt start. As stressed in Section 12, implementation will be very much the responsibility of the line agencies concerned. On the pivotal assumption that Government will reinforce WARPO's mandate and fund adequately its ongoing development and operational costs in a timely fashion, the Plan requires that each line agency, under WARPO's overall advice and coordination, takes responsibility for identifying and preparing the projects[11] that will make up the programmes and contribute to the achievement of their objectives. Once such projects have been prepared (or during preparation if appropriate), potential financiers of the projects and programmes - be they Government, donors, private sector or beneficiaries - will use Plan conformity as one of the pre-financing appraisal criteria.

The final tables which follow, are intended to alert all responsible agencies to each of the programmes that they will be responsible for in the NWMP short term. In most cases, preparation should begin immediately if the Plan is to be achieved. Full descriptions are available within the investment portfolio while guiding principals have been provided by the NWPo and elaborated by this Plan and the Development Strategies, which preceded it.

---

[11] It should be noted that projects can:

- be sub-sets of a Programme, as in the case for instance of erosion control at a specific location;
- comprise an entire Programme, such as the WARPO capacity building programme (ID 006); or,
- contribute to several Programmes, as in the case of the proposed Small Scale Water Resource Development Sector Project.

Table 16.1: Programmes for Agencies having only one Programme in the NWMP Short Term

Lead Agency Responsible	MIS Ref	Programme Name	Description	Start
BHWDB	EA 007	Improved Water Management in the Haor Basins of the North East Region	The Haor Basin contains the last major remaining semi-natural and large-scale freshwater wetlands of the country and includes important mother-fish sites. The Basin is under threat from encroachment of agriculture and capture fisheries. The purpose of the programme is to safeguard the water resources and to preserve the semi-natural characteristics of the whole Basin with special attention being paid to the ecologically important sites. This will be achieved by the development and implementation of a staged, environmentally responsible water management plan for the area.	2003
BMD, BHWDB, RRI	ID 009	Capacity Building for Other Organisations	The NWPo §4.02(o) requires the GoB or its responsible agencies to undertake comprehensive and integrated analysis of relevant hydrological factors across all related water-using sectors for the purpose of managing the river systems and providing early warning systems of natural disasters like flood and drought. NWPo §4.13 also requires water bodies like haors„ baors and beels are preserved for maintaining the aquatic environment and facilitating drainage. This programme provides for capacity building of three key agencies involved in these activities, namely: Bangladesh Meteorological Department, River Research Institute and Bangladesh Haor and Wetland Development Board.	2003
BMDA	AW 004	New Public Deep Tubewell Irrigation Schemes	It is the policy of the Government that "support of private development of groundwater irrigation for promoting agricultural growth will continue" (NWPo §4.7). GoB policy is that TW irrigation should be a private rather than a public sector activity. However, subsidised DTW irrigation development in socially-deprived areas where irrigation is otherwise unaffordable may be justified on social and economic grounds; where drilling is difficult or costly and where surface water is limited. This programme will deal with the installation of an estimated 2000 new deep tube wells to meet these needs.	2003
BR	DM 005	Railway Flood Proofing	In line with Policy's call for coping with floods in relation to vital infrastructure (NWPo §4.2.p.ii), this programme targets at the flood proofing needs of key portions of Bangladesh's railway network. The Railway Department will be responsible for implementation of this programme. The programme has collateral benefits since the raised embankments comprise safe havens while facilitating the movement of relief goods during flood emergencies. This is a long term programme with coverage in six hydrological regions and work is expected to proceed as part of the network upgrading programmes. However, a significant risk to this programme is that the disruption to services that is inevitable when line raising is in progress, may well persuade the railway operators that it is cheaper to lose income for a few hours or days each year than to incur expenditure raising lines while simultaneously losing revenues for that period.	2001

Lead Agency Responsible	MIS Ref	Programme Name	Description	Start
IWTA	MR 011	River Dredging for Navigation	This Programme seeks to restore the IWT waterways in a cost-effective manner, with a structured approach recognising both the technical and management issues that have to be overcome. A comprehensive national dredging management plan would be prepared covering short to long-term dredging requirements, as well as dredger operations and the role of the private sector. The programme also makes provision for both capital dredging of the major rivers, much of it being deferred maintenance, and maintenance dredging thereafter. Dredging of other waterways is included in MR 006.	2002
LGD	ID 001	Local Government Needs Assessment for Water Management	The NWPo creates new roles for and places new responsibilities on Local Government Institutions. In particular NWPo §4.2.e requires LGI's to implement FCD/I projects having a command area less than or equal to 1000ha, while NWPo §4.2.f calls upon LGI's to coordinate stakeholder participation at all stages of water sector project cycles. Furthermore, as a result of NWPo §4.4.d LGI's will become progressively responsible for the management of all FCD schemes up to 5000ha, as well as for the raising of operation and maintenance tariffs through local resources. This programme assesses the implications of these challenges in terms of the institutional framework and human resource requirements and presents them in the form of a institutional capacity building and human resource development programme document.	2002
LGIs	ID 005	Local Government Capacity Building for Water Management	The NWPo creates new roles for and places new responsibilities on Local Government Institutions. In particular NWPo §4.2.e requires LGI's to implement FCD/I projects having a command area less than or equal to 1000ha, while NWPo §4.2.f calls upon LGI's to coordinate stakeholder participation at all stages of water sector project cycles. Furthermore, as a result of NWPo §4.4.d LGI's will become progressively responsible for the management of all FCD schemes up to 5000ha, as well as for the raising of operation and maintenance tariffs through local resources. This programme is intended to deliver the necessary capacity building and human resource development in response to the needs assessments carried out under Programme ID 001 (Local Government Needs Assessment for Water Management). The programme will begin with the establishment of a Central Training Unit and thereafter comprise a long and sustained effort beginning in the short term of the NWMP and continuing throughout the remainder of its 25 years. The programme will include training for both LGED and DPHE to strengthen their abilities to provide technical support for LGIs.	2003
MoI	EA 001	National Pollution Control Plan	NWPo states that "pollution of both surface and groundwater around various industrial centres of the country by untreated effluent discharge into water bodies is a critical water management issue." This programme is intended to result quickly in a widely-agreed and politically-endorsed Pollution Control Plan, with clear, time-bound deliverables based on progressive compliance with anti-pollution regulations, notably the national Water Quality Standards (WQS.)For the short term, the anticipated Plan is expected to concentrate on 'fast-track' pilot clean-up projects for major pollution hot-spots and the establishment of suitable non-regulatory and regulatory instruments to assist the general clean-up process. It will set priority	2002

Lead Agency Responsible	MIS Ref	Programme Name	Description	Start
			water quality indicators, notably pollutant parameters, for 'clean' and dirty water. The Action Plan and its dependent activities will be reviewed and modified as necessary as an integral part of the five-yearly reformulations of the NWMP and implemented over the medium and long term accordingly.	
MoLJP	EE 003	Water Resources Legislation - Preparation of Supporting Ordinances	Programme EE 001is intended to result in a new Water Resources Act; this complementary programme is intended to address the need for legal commentary, under-laws and precedents to the new Act that will shape and arbitrate its enforcement. Inter-alia these will incorporate or address experiences gained while field testing institutional structures and modalities under Programme EE 002	2003
PDB	MR 012	Hydropower Development and Upgrading	The purpose of this programme is to review in detail the potential for further investment in HEP, identify suitable modalities of development and provide for the necessary downstream investment. The study would focus on: expansion of Kaptai generation capacity; integrated development of the Sangu and Matamuhuri rivers for hydropower generation and other uses; power generation at barrages; and micro-HEP schemes. Micro-HEP appears particularly worthy of pursuit, especially in more remote areas, such as in the CHT, where early exploitation of local resources of power generation could bring high social benefit.	2002
RHD	DM 004	National, Regional and Key Feeder Roads - Flood Proofing	In line with Policy's call for coping with floods in relation to vital infrastructure (NWPo §4.2.p.ii), this programme targets the flood proofing needs of key portions of Bangladesh's highway network. As with current practice, the National Highways, Regional Roads and Type A Feeder Roads will be raised by the central Roads and Highways Department (RHD). Type B Feeder Roads and Rural Roads will be raised by the Local Government Engineering Departments (LGEDs). The programme also has collateral benefits since the raised embankments comprise safe havens while facilitating the movement of relief goods during flood emergencies. This is a long term programme with national coverage, however it has been assumed that embankment raising will be carried out when a particular road is due for major maintenance or re-surfacing, with priority given to high risk areas in the case of national and regional roads.	2001

Table 16.2: BWDB's NWMP Short Term Programmes

MIS Ref	Programme Name	Description	Start
ID 003	FCD and FCD/I Management Rationalisation	This programme is intended to facilitate the transfer of FCD/I scheme management as per policy. Three steps will be involved. In the short term BWDB will receive capacity building with respect to environmental and social issues, while in consultation with the stakeholders a range of transfer options will be identified and prepared. Finally these options will be pilot tested at selected locations during the short and medium term.	2002
ID 004	BWDB Regional and Sub-regional Management Strengthening	According to its Act, BWDB is responsibile for controlling the flow of water in all rivers and aquifers. To this end it is the strategy of GoB to prepare integrated river improvement initiatives which give due importance to all stakeholders. This programme is intended to provide the necessary support to BWDB to enable it to prepare such initiatives at regional and sub-regional levels consistent with the GoB strategy.	2002
ID 010	BWDB Capacity Building	This programme is intended to strengthen BWDB in several ways: improved flood forecasting and warning; strengthened surface and groundwater monitoring and dissemination; support for erosion and accretion forecasting; support for drought forecasting; re-orientation programmes especially with regard to the social and environmental dimensions of water resources management, MIS, HRD and other related fields of BWDB; a new central office and upgraded regional centres	2002
EE 002	Field Testing of Participatory Management Models	The NWPo calls for the decentralisation and/or devolution of the water sector. Various models have already been proposed, most of which are prescribed by the size of scheme involved. The programme is intended to test the efficacy of the models proposed to date as well as other potential options to be identified on the basis of comprehensive stakeholder consultation.	2003
MR 002	Main Rivers Abstraction Projects	This Programme provides for investments in augmenting dry season surface water availability for multi-purpose use through abstraction from the main rivers by means other than barrages (barrages are covered in MR 003 to MR 005). The programme is conditional upon the outcome of the studies conducted under Programme MR 001. The principal options that this programme may take up are main river pump stations and dredging and associated works at distributary offtakes (works on the Gorai are considered under MR 003 however).	2004
MR 003	Ganges Barrage and Ancillary Works	This Programme comprises the investment portion the diversion works associated with the integrated development of the water resource system in the GDA in Bangladesh. Other aspects of the GDA development in Bangladesh are covered in other programmes under MR, AW, EA and ID. It has three main construction elements: (i) dredging and training works at the Gorai offtake to provide immediate additional flows for environmental purposes; (ii) a barrage across the Ganges to control dry season Ganges flows and provide substantially greater flows for multi-purpose use; and (iii) a Gorai headworks structure to control wet and dry season flows entering the GDA in Bangladesh, enabling planned and manageable development to take place.	2002

MIS Ref	Programme Name	Description	Start
MR 006	Regional River Management and Improvement	The aim of the programme is to ensure that river management plans are prepared and implemented in a comprehensive and cost-effective manner. It represents the upper tier of three levels of river system management, the other two being the responsibilities of Local Government and community groups. It provides the resources to plan, develop and maintain the regional river systems in an integrated manner, interfacing with these other institutions and responsive to stakeholder needs. The programme acknowledges that a fully replicable approach will take a number of years to establish and incorporates both technical support and investment capital on a long-term basis. It has many linkages with other programmes.	2002
TR 007	Large and Small Town Flood Protection	NWPo §4.2.9.i of the NWPo states that "..critical areas such as district and Upazila towns, important commercial centres, and places of historical importance will be gradually provided reasonable degree of protection against flood". The low areas of many of the towns in Bangladesh are vulnerable to flooding during monsoon. Significant damage was caused during the 1988 and 1998 floods due either to absence of embankments, embankment failure or the inability of protected areas to drain during times of heavy rainfall because of high water levels outside. This programme will undertake measures such as: raising of exsiting embankment crest levels; repair of damaged embankments; and, provision of erosion protection works where necessary. New flood protection works will also be involved consisting mainly of constructing embankments on riverbanks with integral drainage sluices.	2003
MC 010	Dhaka Flood Protection	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i) After Dhaka was severely affected by the 1988 flood, the western flood embankment was constructed. During the 1998 flood it afforded some relief to parts of the city but the eastern embankment was extensively inundated. There are significant areas of existing development in Dhaka where reconstruction and the associated opportunity to raise land will not occur for many years. This programme will provide flood control infrastructures along right bank of the Balu River, which will include construction of a flood embankment, flood wall and drainage sluices.	2003
MC 012	Chittagong Flood Protection	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i). The low areas of Chittagong city are vulnerable to flooding during cyclones and spring tides. Local flooding is also caused by heavy rainfall and poor internal drainage. This programme is to provide an embankment or flood wall on the Karnaphuli River banks, proper maintenance of the existing sea dyke along with construction of new wave protection works, drainage sluices etc. In addition, this programme provides for the installation of pumps for selected areas and maintenance of internal drains. The short to medium term beneficiaries of the programme will comprise some 3.1 million estimated to be at risk of the cyclone threat once every forty years or less.	2003
MC 014	Khulna Flood Protection	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i). Some of the lower, southern parts of Khulna are vulnerable to flooding during spring tides and a flood protection embankment with tidal sluices has been constructed to provide protection. However, the protected area is vulnerable to waterlogging when the drainage sluices cannot be operated due to high external water levels. In other parts of the city, local flooding is caused by heavy rainfall due to inadequate storm drainage. This programme contains measures to address these problems.	2003

MIS Ref	Programme Name	Description	Start
MC 015	Khulna Stormwater Drainage	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i) . The progressive expansion and urbanization of Khulna City increases the need for storm drainage as the increase in paved surfaces hastens runoff rates and reduces infiltration thereby causing urban flooding. This programme will mitigate Khulnas' stormwater drainage problem by ensuring a properly planned, comprehensive drainage system ranging from collection of water at local street level to disposal of accumulated drainage water at pump stations.	2004
MC 016	Rajshahi Flood Protection	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i). Rajshahi already has a flood embankment system; but this needs protection against erosion damage. This programme will deliver suitable remedial measures necessary to ensure the flood embankment groynes remain effective as flood protection for the city of Rajshahi.	2003
MC 017	Rajshahi Stormwater Drainage	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i). The progressive expansion and urbanization of Rajshahi City increases the need for storm drainage as the increase in paved surfaces hastens runoff rates and reduces infiltration thereby causing urban flooding. This programme will mitigate Rajshahis' stormwater drainage problem by ensuring a properly planned, comprehensive drainage system ranging from collection of water at local street level to disposal of accumulated drainage water at pump stations.	2004
AW 002	Improved Performance of Existing Public Surface Water Irrigation Schemes	It is the policy of the government to "encourage future groundwater development for irrigation by both the public and private sectors" (NWPo §4.7.b). Even so experience confirms that current performance of existing public irrigation schemes is not satisfactory. This programme is intended to address both challenges by means of the following approaches: full participation of beneficiaries; command area development; conjunctive use of surface and groundwater; rehabilitation; improved O&M and appropriate beneficiary contributions to both capital and recurring costs.	2004
AW 008	Land Reclamation, Coastal Protection and Afforestation	NWPo Article 4.2(r) states that the Government will "*Plan and implement schemes for reclamation of land from the sea and rivers*". In line with this Article, studies will be undertaken for reclamation of land from estuary region and sea. The NWPo also recognises the importance of coastal embankments/polders with the statement that it is the policy of the government to "Investigate thoroughly, important flood control and management issues, such as the efficacy of coastal polders, for guiding future policy on structural interventions." (NWPo §4.15.c). Another purpose of this programme is to embank and where necessary provide arborial protection to accreted land thereby protecting life/property/livelihoods from tides, or scend.	2001
EA 005	National Fish Pass Programme	The NWPo requires that "Fisheries and wildlife will receive due emphasis in water resource planning in areas where their social impact is high" (NWPo §4.9.a); "Measures will be taken to minimise disruption to the natural aquatic environment in streams and water channels." (NWPo §4.9.b), and; "Water development plans will not interrupt fish movement and will make adequate provisions in control structures for allowing fish migration and breeding." (NWPo §4.9.e). Yet there has been a reduction in fish production in recent years due, at least in part, to structures that inhibit fish migration routes. As a response, this programme will screen all major existing FCD/I projects (>5000ha) and will prepare and implement a plan for mitigation works. Emphasis will be given to 'fish-friendly' structures rather than separate dedicated fish-pass structures.	2003

Table 16.3: CWASA's NWMP Short Term Programmes

MIS Ref	Programme Name	Description	Start
MC 003	Chittagong Bulk Water Supply and Distribution Systems	Water allocation for domestic and municipal use is the first priority under the NWPo. This programme, which responds to both the NWPo and the National Policy for Safe Water Supply and Sanitation (NPSWSS), aims to address the need for "…safe and affordable drinking water supplies through various means..." for all inhabitants, especially the urban poor (NWPo §4.6.a) population of Chittagong is expected to more than double over the next 25 years, from 2.5 million in 2000 to 6 million in 2025. At present, only 55% of the population is served by the main public water supply system, the rest being dependant on unreliable and increasingly polluted local sources. This programme deals with the massive task of rehabilitation, improvement and extension of the city's water supply systems in order to raise coverage levels to 95% by 2010, and then to sustain it at 100% beyond that date. It will be accomplished through the development of new water sources, improvement and expansion of the existing DTW-fed system, and the	2002
MC 007	Chittagong Sanitation and Sewerage Systems	The NWPo "mandates relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health." (NWPo §4.6.c). The population of Chittagong is expected to more than double over the next 25 years, from 2.5 million in 2000 to 6.1 million in 2025. At present, about 52% of the population is adequately served by sanitation facilities, mainly by pit latrines with/without septic tanks. Only one part of the city is served by a smallbore sewerage system which is in poor condition. There is no conventional waterborne sewerage system. In the slums and other disadvantaged areas, more than 95% are dependant on 'hanging latrines' and open defecation which exacerbates pollution and public health problems and increases the likelihood of epidemic outbreaks of waterborne and water-related diseases. This programme aims to raise and sustain appropriate service coverage.	2002

Table 16.4: DAE's NWMP Short Term Programmes

MIS Ref	Programme Name	Description	Start
DM 006	Supplementary Irrigation and Drought Proofing of Rural Water Supplies	This programme aims to promote supplementary irrigation during the drought-prone aman season, as well as including efforts to drought-proof rural water supplies.	2002
AW 001	Promotion of Expanded Minor Irrigation and Improved On-farm Water Management	It is the policy of the Government to "Encourage and promote continued development of minor irrigation" (NWPo §4.7.a) and to "Encourage future groundwater development for irrigation by both the public and the private sectors" (NWPo §4.7.b). With the ultimate goal of increased agricultural productivity, this programme involves the improvement of irrigation pumping efficiency, promotion of lower cost force-mode tubewell pumps, and a farmer education/training component to improve on-farm water management and the wise use of water	2002

Table 16.5: DMB's NWMP Short Term Programmes

MIS Ref	Programme Name	Description	Start
ID 008	Disaster Management Bureau Capacity Building	This programme will provide the resources necessary to continue ongoing capacity building activities throughout the short and medium terms in order that the DMB can address its mandate in an increasingly effective fashion.	2002
DM 002	Bari-level Cyclone Shelters	This programme is for the cyclone risk areas and is relevant to the NWPo as it provides "flood proofing systems to manage natural disasters: (NWPo §4.2.o) and takes special account the particular needs of women and children (NWPo §3.b) while motivating the people themselves to develop different flood proofing measures. Over three million people live or subsist in areas exposed to significant risk of destruction and loss of life due to cyclone strike. This programme is intended to provide safe havens in the form of $12m^2$ concrete framed buildings on raised $72m^2$ earth platforms, one in each bari in the coastal areas. A total of 43,768 bari-level-cyclone-shelters will be raised over 15 years, benefiting some 1.72 million people in the short/medium term.	2003
DM 003	Flood Proofing in the Charlands and Haor Basin	NWPo §4.2.o of the NWPo requires the Government, through it's responsible agencies, to develop flood proofing systems to manage natural disasters, and clause p of the same section requires that appropriate measures are provided, in designated flood risk zones, to protect life, property and vital infrastructure etc. This programme is concerned with providing proven cost effective technologies for flood proofing such as encouraging raised dwellings and the construction of communal flood shelters.	2003

Table 16.6: DOE's NWMP Short Term Programmes

MIS Ref	Programme Name	Description	Start
ID 002	Independent Regulatory Bodies for Water Supply and Sanitation Service Sector	Initially, this programme will begin by studying options for the establishment of a regulatory framework for water supply and sanitation as well as the institutional demands thereof. This preliminary stage will be followed by the establishment and mandating of the institutions themselves. It is anticipated that existing institutions will be able to accept some of the responsibility; even so a clear need for new, specialist agencies is foreseen.	2003
ID 007	Department of Environment Capacity Building	As far as aquatic resources are concerned, DoE is mandated to protect water quality and ensure efficiency of use and in particular to monitor (and establish standards of) effluent disposal to prevent water pollution. This programme allows for institutional capacity building of DoE including the establishment of representational offices down to District level.	2001
EA 002	National Clean-up of Existing Industrial Pollution	NWPo states that "pollution of both surface and groundwater around various industrial centres of the country by untreated effluent discharge into water bodies is a critical water management issue." Furthermore, "Industrial polluters will be required under law to pay for the cleanup of water-body polluted by them." (NWPo §4.8.d). Based on the National Pollution Control Plan (Programme EA 001), this programme will address directly the clean-up of existing pollution black spots and the enforcement of the polluter-pays principle.	2004
EA 003	National Water Quality Monitoring	This programme is intended to spread the water quality monitoring effort away from known pollution black-spots towards prevention of pollution of clean and relatively clean water. This approach is justified because time and resources are better spent providing an early warning of pollution problems at vulnerable sites where remedial action is possible before ecological damage becomes irreversible. Prime targets for this water quality monitoring will be water sources with potential for supplying large scale potable water supply and ecologically sensitive areas.	2001

Table 16.7: DoFish's NWMP Short Term Programmes

MIS Ref	Programme Name	Description	Start
EA 004	National Fisheries Master Plan	The country's inland fisheries, which provide employment for some 2M full-time and 12M part-time fishermen, account for 3% of total GDP and 60% of the animal protein intake. Following the 1999 National Fisheries Policy, a national fisheries strategy and sector development programme are urgently required to address the threats to the fisheries industry including such problems as fragmentation and reduced water availability for natural water bodies, disrupted hydraulic connections between them and physical structures that constrain fish movements. The purpose of this programme is to develop a fisheries development plan which will include provisions for protection of fish stocks, and of other important aquatic species, and for prevention or mitigation of the above negative impacts.	2002

MIS Ref	Programme Name	Description	Start
EA 008	Environmentally Critical Areas and Integrated Wetland Management	The country's aquatic habitat is rapidly shrinking as a result of abstractions (especially for irrigation); flood control and agricultural encroachment. And deteriorating water quality exacerbates the problems. Supported by other measures, safeguarding the water resources of the nation's water bodies is necessary to arrest the trend and provide for both the human and the natural environments (eg health, nutrition, livelihoods, fish and broader biodiversity). This programme is intended to provide the necessary protection and sustainable use measures in the water sector as part of a wider integrated wetlands management (IWM) programme.	2002

Table 16.8: DPHE's NWMP Short Term Programmes

MIS Ref	Programme Name	Description	Start
TR 002	Rural Arsenic Mitigation	Arsenic contamination of groundwater water supplies has become a serious health hazard in Bangladesh affecting some 76 million people. This is recognised by NWPo §4.06a of the NWPo which requires the Government to "facilitate availability of safe….drinking water through various means". This programme will provide short term and medium term arsenic mitigation measures for water supplies (such as arsenic filters and household removal facilities in all rural. More permanent measures will be introduced in the long term (See Programme TR 004) .	2001
TR 003	Large and Small Town Water Supply and Distribution Systems	The preamble to §4.6 of the NWPo highlights the water supply problems facing Bangladesh's urban areas (large and small). Water tables are receding due to heavy groundwater abstraction. Furthermore, saline intrusion in coastal aquifers and contamination elsewhere further compromises the drinking water supplies for urban inhabitants. In accordance with the Government's policy to to "Facilitate availability of safe and affordable drinking water supplies." (NWPo §4.6.a), this programme is intended to provide resources for the implementation of piped water supply schemes fed from DTW or surface water sources in order to serve 90% of the population (of each town) with piped drinking water supplies.	2002
TR 004	Rural Water Supply and Distribution Systems	The preamble to §4.6 of the NWPo recognises that "The rural areas of Bangladesh suffer from a lack of quality drinking water". This situation is worsening due to heavy withdrawals of groundwater (the principle source for most of the rural areas) for irrigation a trend which is exacerbated by agro-chemical and saline pollution of groundwater. Although the rural population is expected to increase relatively slowly over the next 25 years, from 102 million in 2000 to 107.7 million in 2025, it is nonetheless the GoB's intention to "facilitate the availability of safe and affordable drinking water supplies through various means" (NWPo §4.6.a). It is estimated that 92% of the rural population normally have access to potable water, mainly through shallow HTWs. The thrust of this programme is therefore to improve the quality of water supply services (reliability and access) in areas already served as well as extending the coverage to 100% by 2005.	2001

MIS Ref	Programme Name	Description	Start
TR 006	Rural Sanitation	§4.6.c of the NWPo "mandates relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health." The population of rural areas is expected to increase slightly over the next 25 years, from 102 million in 2000 to 108 million in 2025. At present, only 40% of the population has access to pit latrine facilities, the other 60% relying on 'hanging latrines' and open defecation which exacerbates pollution and public health problems and increases the likelihood of epidemic outbreaks of waterborne and water-related diseases. This programme aims to provide appropriate sanitation facilities for the whole rural population and raise and sustain service coverage at 100% by 2010.	2001
MC 001	Inventory and Asset Management Plan of the Water Supply and Sanitation Sector	Much of the water supply and sanitation infrastructure in Bangladesh is either poorly maintained due to lack of investment in operation and maintenance or reaching the end of its useful life. However, without a detailed and clear understanding of the existing situation there is little point in carrying out major investment. Before any new investment is made on these rapidly deteriorating systems it is essential to obtain a better understanding of the condition and performance of the existing underground and above ground assets. Such an exercise is commonly referred to as an asset management plan (AMP) and is the intention of this programme.	2001

Table 16.9: DWASA's NWMP Short Term Programmes

MIS Ref	Programme Name	Description	Start
MC 002	Dhaka Bulk Water Supply and Distribution Systems	Water allocation for domestic and municipal use is the first priority under the NWPo. This programme, which responds to both the NWPo and the National Policy for Safe Water Supply and Sanitation (NPSWSS), aims to address the need for "…safe and affordable drinking water supplies through various means..." for all inhabitants, especially the urban poor (NWPo §4.6.a). The population of Dhaka is expected to treble over the next 25 years, from 9 million in 2000 to 27 million in 2025. At present, only 51% of the population is served by the main public water supply system, the rest being dependant on unreliable and increasingly polluted local sources. This programme deals with the massive task of rehabilitation, improvement and extension of the city's water supply systems in order to raise and sustain coverage levels at 100% by 2010. It will be accomplished through the development of new water sources, improvement and expansion of the existing DTW-fed system, and the introduction of safe hand-pumps fed by small DTW	2002
MC 006	Dhaka Sanitation and Sewerage Systems	The NWPo "mandates relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health." (NWPo §4.6.c). The population of Dhaka is expected to treble over the next 25 years, from 9 million in 2000 to 27 million in 2025. At present, about 68% of the population is adequately served by sanitation facilities. The main public sewerage system is in poor condition and is inadequately maintained, and as such is likely to exacerbate pollution and public health problems and increase the likelihood of epidemic outbreaks of waterborne and water-related diseases. This programme aims to ensure that by 2010, there are appropriate sanitation facilities for 98% of the city's population.	2002

MIS Ref	Programme Name	Description	Start
MC 011	Dhaka Stormwater Drainage	NWPo states that "Regions of economic importance such as metropolitan areas,…will be fully protected against floods as a matter of first priority" (NWPo §4.2.p.i). The progressive expansion and urbanization of Dhaka increases the need for storm drainage as the increase in paved surfaces hastens runoff rates and reduces infiltration thereby causing urban flooding. Each heavy rainstorm causes inconvenience and sometimes major damage and disruption as a result of ineffective or inadequate drainage. This 38500TkM programme will mitigate Dhakas' drainage problem by providing a properly planned, comprehensive drainage system ranging from collection of water at local street level to disposal of accumulated drainage water at pump stations.	2004

Table 16.10: KCC's NWMP Short Term Programmes

MIS Ref	Programme Name	Description	Start
MC 004	Khulna Bulk Water Supply and Distribution Systems	Water allocation for domestic and municipal use is the first priority under the NWPo. This programme, which responds to both the NWPo and the National Policy for Safe Water Supply and Sanitation (NPSWSS), aims to address the need for "…safe and affordable drinking water supplies through various means..." for all inhabitants, especially the urban poor (NWPo §4.6.a). The population of Khulna is expected to double over the next 25 years, from 1.1 million in 2000 to 2.4 million in 2025. At present, only 51% of the population is served by the main public water supply system, the rest being dependant on unreliable and increasingly polluted local sources. This programme deals with the massive task of rehabilitation, improvement and extension of the city's water supply systems in order to raise and sustain coverage levels at 100% by 2010. It will be accomplished through the development of new water sources, improvement and expansion of the existing DTW-fed system, and the introduction of safe hand-pumps fed by small	2003
MC 008	Khulna Sanitation and Sewerage Systems	The NWPo "mandates relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health." (NWPo §4.6.c). The population of Khulna is expected to double over the next 25 years, from 1.1 million in 2000 to 2.4 million in 2025. At present, about 51% of the population is adequately served by sanitation facilities, mainly by pit latrines with/without septic tanks. In one part of the city there is a smallbore sewerage system which is now defunct. There is no conventional waterborne sewerage system. In the slums and other disadvantaged areas, people are dependant on 'hanging latrines' and open defecation which exacerbates pollution and public health problems and increases the likelihood of epidemic outbreaks of waterborne and water-related diseases. This programme aims to raise and sustain appropriate service coverage to 100% by 2010.	2003

Table 16.11: LGED's NWMP Short Term Programmes

MIS Ref	Programme Name	Description	Start
DM 001	Cyclone Shelters and Killas	This programme is for the cyclone risk areas and is relevant to the NWPo as it provides "flood proofing systems to manage natural disasters: (NWPo §4.2.o) and takes special account the particular needs of women and children (NWPo §3.b) while motivating the people themselves to develop different flood proofing measures. The programme will provide safe havens in the form of proven infrastructure comprising raised and covered cyclone shelters and killas (raised mounds) where both humans and livestock can take refuge. Short to medium term beneficiaries of the programme will comprise some 1.72 million people estimated to be at a risk of serious cyclone threat at least once every 30 years or less. In the long term the programme will be extended to cover lower risk areas corresponding to a maximum return periods of 1:100 years and will be closely linked with programme DM 002 "Bari-level Cyclone Shelter".	2002
AW 005	Improved Water Management at Local Government Level	Implementation of the NWPo will result in a four tiered civil-administrative hierarchy for the water sector: central, regional, local and community. The BWDB will remain responsible for water management issues as they affect or occur in the main and regional rivers. Equally, management of certain schemes below 5000ha will become the responsibility of community based organisations. Water courses, whether natural or man-made, that will be the management responsibility of neither BWDB nor community organisations will become the responsibility of LGI's. Furthermore, actual ownership of all schemes except municipal water schemes will be transferred to the LGI's. This programme is intended to rehabilitate, upgrade and restore as appropriate, the water courses involved as well as to provide the LGI's with the necessary appurtenant equipment and facilities.	2001
AW 006	Improved Water Management at Community Level	Implementation of the NWPo will result in a four tiered civil-administrative hierarchy for the water sector: central, regional, local and community. The BWDB will remain responsible for water management issues as they affect or occur in the main and regional rivers. Local rivers and scheme delivery systems will become the management (and in some cases property) of LGI's while management of certain schemes below 5000ha will become the responsibility of community based organisations. This programme is intended to rehabilitate, upgrade and restore as appropriate, the water courses and field distribution/collection systems involved as well as to assist in providing with the necessary appurtenant equipment and facilities.	2001

Table 16.12: Paurashava's NWMP Short Term Programmes

MIS Ref	Programme Name	Description	Start
TR 001	Urban Arsenic Mitigation	Arsenic contamination of groundwater water supplies has become a serious health hazard in Bangladesh affecting some 76 million people. This is recognised by NWPo §4.06a of the NWPo which requires the Government to "facilitate availability of safe….drinking water through various means". This programme will provide short term arsenic mitigation measures for water supplies (such as arsenic filters and household removal facilities in all urban areas except those comprising the Statistical Metropolitan Areas (See the Major City cluster). More permanent measures will be introduced in the medium and long terms (see Programme TR 003).	2001
TR 005	Large and Small Town Sanitation and Sewerage Systems	§4.6.c of the NWPo "mandates relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health." The population of large (>50,000ppl) and small towns is expected to more than double over the next 25 years, from 14 million in 2000 to 36 million in 2025. At present, between 55% (small towns) and 65% (large towns) of the population is adequately served by sanitation facilities, mainly by pit latrines with/without septic tanks. In the poor areas and fringe communities, people are dependant on 'hanging latrines' and open defecation which exacerbates pollution and public health problems and increases the likelihood of epidemic outbreaks of waterborne and water-related diseases. This programme aims to provide appropriate sanitation facilities and raise and sustain service coverage at 100% by 2010.	2002
TR 008	Large and Small Town Stormwater Drainage	NWPo §4.6 says that "Lack of proper sanitation and drainage facilities, …. are the primary causes of diseases in the urban areas". Storm water drainage is an increasing problem in urban areas, as the construction of buildings and paved areas has progressively increased run-off. At the same time, pressures on land has caused natural drainage channels to be filled in and built upon. Encroachment on watercourses and water bodies has progressively reduced natural drainage. No urban areas have adequate storm drainage at present. This programme provides resources for a nationwide installation/upgrading and maintenance of stormwater drainage facilities in large and small towns. These will most probably be gravity systems which although cost-effective, will require regular adequate maintenance.	2003

Table 16.13: RCC's NWMP Short Term Programmes

MIS Ref	Programme Name	Description	Start
MC 005	Rajshahi Bulk Water Supply and Distribution Systems	Water allocation for domestic and municipal use is the first priority under the NWPo. This programme, which responds to both the NWPo and the National Policy for Safe Water Supply and Sanitation (NPSWSS), aims to address the need for "…safe and affordable drinking water supplies through various means..." for all inhabitants, especially the urban poor (NWPo §4.6.a). The population of Rajshahi is expected to tripple over the next 25 years, from 0.7 million in 2000 to 2.3 million in 2025. At present, only 40% of the population is served by the main public water supply system, the rest being dependant on unreliable and increasingly polluted local sources. This programme deals with the massive task of rehabilitation, improvement and extension of the city's water supply systems in order to raise and sustain coverage levels at 100% by 2010. It will be accomplished through the development of new wellfields, improvement and expansion of the existing DTW-fed system, and the introduction of safe hand-pumps fed by small	2003
MC 009	Rajshahi Sanitation and Sewerage Systems	The NWPo "mandates relevant public water and sewerage institutions to provide necessary drainage and sanitation, including treatment of domestic wastewater and sewage and replacement of open drains and construction of sewers, in the interest of public health." (NWPo §4.6c). The population of Rajshahi is expected to triple over the next 25 years, from 0.7 million in 2000 to 2.3 million in 2025. At present, about 70% of the population is adequately served by sanitation facilities, mainly by pit latrines with/without septic tanks. There is no conventional waterborne sewerage system. In the slums and other disadvantaged areas, people are dependant on 'hanging latrines' and open defecation which exacerbates pollution and public health problems and increases the likelihood of epidemic outbreaks of waterborne and water-related diseases. This programme aims to raise and sustain appropriate service coverage to 100% by 2010.	2003

Table 16.14: WARPO's NWMP Short Term Programmes

MIS Ref	Programme Name	Description	Start
ID 006	WARPO Capacity Building	WARPO has suffered considerably in the past from a lack of permanence, with adequate funding support being provided only during national plan preparations and little in-between. Furthermore, prevailing employment conditions then, make the appointment and retention of suitable staff difficult. This programme intends to render WARPO sustainable while building its capacity such that it becomes a centre of excellence characterized by committed high calibre staff. This will be achieved by revision of WARPO's legal establishment, restructuring of WARPO staffing, relocation to a permanent suitable office and various capacity building programmes.	2001
EE 001	Support to the Preparation of New Legislation	As acknowledged by the NWPo and other sources, the existing legal framework does not reflect the decentralized participatory characteristics intended for the water sector. As such it needs revision and supplementation in a number of key areas. This programme is intended to provide support in the form of technical assistance and study that will i) assist in identifying where and how legislation needs to be revised or augmented; ii) facilitate the preparation of a Water Resources Act and iii) result in an appropriate registration process for the community based organisations.	2001

MIS Ref	Programme Name	Description	Start
EE 004	Project Preparation Procedures - Guidelines and Manuals	This programme is intended to prepare enforceable guidelines and advisory manuals covering the processes and procedures considered necessary during the preparation of water sector initiatives.	2003
EE 005	Regulatory and Economic Instruments	This programme is intended to prepare enforceable guidelines and advisory manuals concerning standards, regulation and economic instruments for the water sector.	2003
EE 006	Field Testing and Finalisation of the Guidelines for Participatory Water Management	A set of Guidelines For Participatory Water Management was issued in February 2001. While the document represents an excellent point of departure, it needs more work if it is to be made consistent with conventional wisdom and international best practice. This programme is intended to finalise the Guidelines via a process of pilot testing and evaluation complemented by further research, international technical assistance and study tours.	2004
EE 007	NWRD Improved Data Collection and Processing Facilities	Given that water resource planning and management requires a very wide range of information drawn from myriad institutional sources, this programme is intended to familiarize the many stakeholder institutions with the potential benefits that well organized, accessible data represents and to facilitate the realization of that potential. Beginning with a process of consultations with all stakeholder institutions, principles of common standards; access protocols and data pricing options will be agreed and a proposal written. Other objectives include the establishment of one-stop data retrieval and the availability of all reports in digital format. This programme is relevant to the NWPo as it provides improved, better organised management of information, and is in keeping with the NWPo call for a systematic, comprehensive overhaul of the sector's data systems.	2001
EE 008	Water Resources Management Research and Development Studies	§4.15 of the NWPo recognizes the important contribution that well focused and coordinated research can play in facilitating the wise and sustainable use of water resources. In particular, the Policy calls for strengthened research capacity at water resource and agricultural institutions. It also prescribes focused research into important flood control and management; water resources management; sociological and institutional issues. This programme comprises ten specific research programmes that are not contained within any other programmes, and that are not already ongoing.	2001
EE 010	Raising Public Awareness in the Wise Use and Management of Water	Public awareness campaigns by all relevant agencies in the water sector are to be seen as an important vehicle for the active promotion of all the key components in the NWPo and the NWMP, fostering increased consultation and participation, and increased awareness of all water sector issues at local, regional and national levels. This programme will consider, assess and implement various publicity campaigns around the country to this end, such as radio broadcasts, newspaper articles, cinema advertising, promotional videos, rural trade fairs, extension services, etc.	2002
EE 011	Private Sector Participation in Water Management	One of the main objectives of the NWPo is to "…improve the investment climate for the private sector in water development and management" (NWPo §3.01e) To this end, the ongoing Infrastructure Development Company Ltd. (IDCOL) has already been established and provides 'top-up' funds to private led projects. This programme continues in the same vein by promoting the creation of a legal and regulatory framework to aid investor/provider confidence, and also in improving access of the rural and urban poor to adequate credit facilities. Special tax/duty privileges to attract foreign investment to the water sector, and establishment and public awareness raising of consumer rights in relation to private water supply schemes will also be undertaken.	2002

MIS Ref	Programme Name	Description	Start
EE 012	Water and Environment Funds	Regulatory and economic instruments are an important part of demand management in a modern decentralized water sector. This programme is intended to broaden the scope and increase the utility and effectiveness of such instruments in Bangladesh particularly those pertaining to the abstraction of both surface and groundwater; arsenic mitigation, effluent scrubbing and cost recovery across the board.	2004
EE 013	Alternative Financing Methods for Water Management	The availability of and access to adequate financial resources for operations and maintenance; emergency work; rehabilitation; replacement and new development is a major sustainability issue in Bangladesh's water sector. The current trend to decentralise management responsibility is expected to take the pressure off central finances. This programme will study needs and opportunities for alternative financing (such as an independent regulatory framework), and then promote various local and international sources of finance (thirteen different sources have been identified at this stage). The NWPo recognises the importance of promoting alternative financing in such clauses as: ".. improve the investment climate for the private sector in water development and management" (NWPo §3.01e), and; "the formulation of options for investment and management" (NWPo §4.051).	2002
MR 001	Main Rivers Studies and Research Programmes	This Programme comprises a series of studies to establish a cost-effective approach to long-term development of the river systems for multi-purpose use. The studies will each contribute to the understanding of individual river development prospects as well as to an overall integrated development plan, set within the context of the international water-sharing issues. Topics covered include a regional development plan for the Meghna and Brahmaputra rivers, master planning of major river training and hydro-power development, Brahmaputra Barrage study, and feasibility studies of development of the Ganges Dependent Area.	2002
EA 009	Improved Water Management and Salinity Control in the Sundarbans	Whilst action will be taken under Programme MR 003 to remedy the shortages of upland flows, and under MR 007 to ensure effective rejuvenation of the river systems within the Ganges Dependent Area, insufficient is known about the Sundarbans inter-acts with the water regime in this complex tidal area. The purpose of this programme is to improve knowledge of the inter-actions between the ecological health of the forest reserve and the aquatic environment within which it is situated. An extensive scoping exercise will precede data collection and assessment. Provision is also made for long-term monitoring of selected parameters.	2002
EA 010	Public Awareness Raising and Empowerment in respect of Environmental Issues	The NWPo states that "Protection and preservation of the natural environment is essential for sustainable development." (NWPo §4.12). However, despite the existing support of environmentally concerned organisations, NGO's and individuals within Bangladesh, any actions are unlikely to be successful without considerably increased public awareness of the environmental issues and how the affect on their own lives. This programme will therefore involve both government and NGO's and will include wide-ranging dissemination of information and strengthening of environmental NGOs. Means to ensure access of people to effective remedies (eg. Environmental law and effective courts) will also be established.	2002

Acknowledgements

This plan has been prepared by the Water Resources Planning Organisation, Ministry of Water Resources, Government of the People's Republic of Bangladesh over a period of three and a half years. Throughout, WARPO have enjoyed the support and co-operation of many organisations and individuals, who have given unstintingly of their time and unfailingly in their valuable and constructive contributions to this Plan. WARPO gratefully acknowledges their assistance.

Stewardship: The National Water Resources Council under the Chairmanship of the Hon'ble Prime Minister, the Executive Committee of the NWRC under the Chairmanship of the Hon'ble Minister for Water Resources, and the Ministry of Water Resources.

The NWMP Project Consultants: Halcrow Group Ltd together with Mott Macdonald Ltd., Danish Hydraulic Institute, Natural Resources Consulting Engineers Inc., Bangladesh Engineering & Technological Services Ltd., Engineering & Planning Consultants Ltd., House of Consultants Ltd, Engineering Consultants and Associates Ltd., Proshika Manobik Unnayan Kendra, and Assistance for Social Organisation and Development with assistance and support from Surface Water Modelling Centre, Environment & Geographic Informatipn System Project and Bangladesh Institute of Development Studies.

The Independent Panel of Experts: Prof Haroun-er-Rashid (Chairman), Dr QK Ahmad, Prof Md Anisuzzaman, Dr HR Khan, Ms Kushi Kabir, Dr Asit K Biswas, Ms Gulsar Corat, Mr Jetze Heun, and Prof William Easter.

The Water Policy Advisory Group: Dr Yusuf A Choudhry (Chairman), Dr Eugene Stakhiv, Saeed Rana, MH Siddiqi BU, Dr KM Rahaman and Prof H Arefeen

NGOs supporting the consultation programmes: ADAB, BNPS, Caritas, CDA, CDS, CRIS, HEED, PROSHIKA, RDRS, SPS, TMSS, Uddipan, UST and UTTARAN

The Contact Group of Government agencies: BADC, BARI, BHDB, BIWTA, BWDB, DAE, DoE, DoF, DoFo, DPHE, DWASA, JRC, LGED, RAJUK, RHD, RRI, SPARRSO and SRDI

The Development Partners: The World Bank, Asian Development Bank and other members of the Local Consultative Group (Water) under the chairmanship of the Royal Netherlands Embassy.

Lastly, and most importantly, WARPO gratefully acknowledges the many individuals, numbering in excess of 1O,OOO, who have given up their time to attend the conferences, seminars, workshops and meetings held throughout the country as part of the consultation programmes.