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REGIONAL TECHNICAL ASSISTANCE (RETA) SUPPORTING IWRM (BANGLADESH)

(ADB RETA PROJECT NO. 39199: PROCESS DEVELOPMENT FOR PREPARING AND IMPLEMENTING INTEGRATED WATER RESOURCES MANAGEMENT PLANS)

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WARPO
পানি সম্পদ পরিকল্পনা সংস্থা

ADB

ACRONYMS

ADB	Asian Development Bank
BADC	Bangladesh Agricultural Development Corporation
BBS	Bangladesh Bureau of Statistics
BDT	Bangladesh Taka
BIDS	Bangladesh Institute for Developmental Studies
BIWTA	Bangladesh Inland Water Transport Authority
BMDA	Barendra Multipurpose Development Authority
BWDB	Bangladesh Water Development Board
CBO	Community Based Organization
CEGIS	Center for Environmental and Geographic Information Services
CERP	Coastal Embankment Rehabilitation Project
CWASA	Chittagong Water and Sewerage Authority
CWRAS	Country Water Resources Assistance Strategy
DAE	Department of Agriculture Extension
DLIAPEC	District Level Inter-Agency Project Evaluation Committee
DMB	Disaster Management Bureau
DOF	Department of Forest
DPHE	Department of Public Health Engineering
DTW	Deep Tube Well
DWASA	Dhaka Water and Sewerage Authority
EMIN	Environmental Management Information Network
FAP	Flood Action Plan
FCDI	Flood Control, Drainage, and Irrigation
FPCO	Flood Plan Coordination Organization
GBM	Ganges-Brahmaputra-Meghna
GDA	Ganges Development Area
GEF	Global Environment Facility
GNP	Gross National Product
GOB	Government of Bangladesh
GPWM	Guidelines for Participatory Water Management
HTW	Hand Tube Well
HYV	High Yielding Variety
ICZM	Integrated Coastal Zone Management
IWM	Institute for Water Modeling
IWRM	Integrated Water Resource Management
JMREMP	Jamuna Meghna River Erosion Management Project
LGED	Local Government Engineering Department
LLP	Low Lift Pump
MEF	Ministry of Environment and Forests
MPO	Master Plan Organization
MWR	Ministry of Water Resources
NWMP	National Water Management Plan
NWPo	National Water Policy

NSAPR	National Strategy for Accelerated Poverty Reduction
NWRC	National Water Resource Council
O&M	Operation and Maintenance
STW	Shallow Tube Well
WARPO	Water Resources Planning Organization

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I. INTRODUCTION

A. Background

1. Water is essential for sustainable growth of a community. Inadequate water and sanitation services have a particularly adverse affect on the health of the poor and their ability to contribute to economic development. The Millennium Development Goals (MDGs) focus on reducing poverty, hunger, child and maternal mortality, and major diseases, and on promoting primary education and environmental sustainability. The MDGs and the Poverty Reduction Strategy Paper (PRSP) of the Government of Bangladesh recognize that increased access to safe water and sanitation is vital for overall development of the community and should be addressed through Integrated Water Resources Management (IWRM).

B. Objectives

2. The overall objective of the sector is to ensure safe water supply in adequate quantity and quality for both rural and urban communities, for the purpose of domestic consumption including drinking, bathing, sanitation and other household use.

3. Specific objectives include:

- Strengthen the national agency (DPHE) to take the lead role in facilitating institutional reform to achieve sustainability in service delivery;
- Support capacity building in Local Government Institutions (Union Parishad, UZ, City corporations and Municipalities) in Operation and Maintenance and in tariff management;
- Ensure water quality surveillance, and support research initiatives for alternative resource development, arsenic mitigation, and affordable water and waste treatment technology;
- promoting increased private sector participation.

II. DOMESTIC WATER SUPPLY

A. Use of Ground Water

4. Groundwater has been considered a reliable source of safe drinking water for many years. During recent decades progress has been made in providing drinking water to rural areas through installation of hand-pump tube-well systems. The following hydro-geological zones are recognized:

- Shallow aquifer areas served with suction mode hand pumps
- Low water-table areas served with deep-set pumps
- Coastal belts are served with a deep aquifer but alternative technical options to utilize surface and rain water need to be developed including Pond Sand Filters (PSF), Rain-water Harvesting, Iron-removal Plants (IRP) and protected Dug wells.

5. The detection in 1993 of arsenic pollution in groundwater threatened its use as a safe water source. It is estimated that about 25 percent of existing hand-pump tube-wells, mostly in the shallow aquifer zone, are no longer safe due to arsenic contamination, putting about 35 million people at risk of arsenic poisoning. The biggest achievements of the special arsenic initiative were to screen water from all hand pumps and to obtain a better understanding of the problem. The problem still persists but arsenic mitigation has now been incorporated into the regular water supply program.

6. The Bangladesh Water Supply Program, a successor to the World Bank-assisted Bangladesh Arsenic Mitigation Water Supply Project (BAMWSP), emphasizes community-based mini-piped systems in urban and rural areas. Many other organizations including NGOs and Social Development Funds (SDF) have been piloting mini-piped schemes in selected areas with partial cost-sharing of capital investment and O&M by private investors and NGOs. The Bogra Academy for Rural Development and the Barind Multi-Purpose Development Authority (BMDA) have also experimented with conjunctive use of water for irrigation and domestic water supply. These experiments are too recent to permit valid conclusions for the future, but the arsenic pollution problem has to some extent shifted the thinking from household-based to community-based water supply that originates from arsenic free water sources. Other recent developments, referred to later in this report, reinforce this concept of community-based solutions.

B. Technological Challenges

7. Excessive withdrawal of groundwater for irrigation has lowered the water table in many areas below the effective reach of suction hand pumps. Furthermore, although not of serious concern now, future adverse effects of agricultural chemicals and manganese in shallow aquifers cannot be ruled out. In the coastal areas, the shallow aquifer is increasingly becoming saline to a depth of 300m[1].

8. To address the declining water table, the government and donors worked together to devise and field test a deep-set hand pump. The result was two versions of a community hand pump, the 'Tara' and the 'Super-Tara or Tara II', capable of abstracting water from depths of 15 and 25 meters respectively. The Tara hand pump was acclaimed as the "Birth of a Star" that

[1] NWMP, Development Strategy, Volume No. 2, Main Report, August 2000, p. 126

would revolutionize rural water supply with its Village Level Operation and Maintenance (VLOM) characteristics. Unfortunately even after a decade of promotion it is difficult, if not impossible, to buy a Tara hand pump in the open market. “Cylinder’, ‘Moon’ and ‘Disco’ pumps, ingenious local contraptions at comparable prices, sell better.

9. Arsenic pollution; declining water tables; leaching of agro-chemicals, manganese etc. into the shallow aquifer; and increasing salinity intrusion in coastal areas, all point to community-based solutions for rural water supply. More effort and resources should go into exploring alternative sources and evolving technical and social options. Rural water supply may effectively shift from the current household-based to community-based systems.

C. Use of Surface Water

10. In the past, surface water has not been encouraged as a first option for domestic water supply because of operational constraints and comparatively high cost, except in large cities. However, its use may become necessary in the near future and may become cost-effective with bulk treatment. Integrated Water Resource Management (IWRM) should take into account the availability of surface water sources for domestic use and to arrest salinity intrusion in the coastal belt.

D. Service Coverage

11. While average service coverage figures indicate substantial progress over the last few decades, service provisions have not been equitable, with disadvantaged social groups suffering the poorest service. Even in generally well-served areas there are still pockets of un-served and underserved areas where people can access safe water only with considerable difficulty - especially urban slum-dwellers and squatters. Over the last two decades the absolute number of urban residents without water and sanitation services has increased, because the improvement in urban service coverage has not kept pace with the rapid growth in population.

12. Most investments in the urban water and sanitation sector have been in large and medium urban centers, whereas smaller centers have lost out in the competition for resources. The larger centers have better service coverage than the smaller ones. Of the 309 or more municipalities or pourashavas, only 100 have piped water systems, primarily serving the core. People in the fringe rely on hand pumps, and urban services have eluded the “poor and hardcore poor”. Of slum-dwellers and squatters, only 30% have access to piped water supply and only 20% to sanitary latrines. Research suggests that some slum dwellers are paying up to 25 times the unit water rate paid by upper- and middle-class people with formal connections. Half the people in slum areas spend more than 30 minutes collecting water, while 7% spend 2 hours or more[2]. In rural areas service coverage in domestic water supply is much better and most rural people can access safe water within 150 meters of the homestead. But arsenic contamination has lowered the previous 90 percent rural coverage by from 10 to 30 percent. Rural investment is mostly directed to arsenic-prone areas and to difficult parts of less well-served districts.

13. The total population by year 2025 is projected to be 181 million, of which about 73 million or 40% would live in urban areas. Practically all the population increase between now and 2025 will be in urban areas. Currently approximately half the urban population is ‘poor’, with an additional 7 million ‘hard-core’ poor living in slums or squatting at the lowest level of

[2] The Dancing Horizon – Development Prospects in Bangladesh, UN Agencies, 1997

poverty[3]. The population growth rate in some informal urban settlements is as high as 9 percent per annum, so that in all likelihood the population of slum-dwellers and squatters will increase substantially. Projections for 2010 put the number of poor urban slum-dwellers and squatters at 25 million. Most of the additional people will have few or no skills, and will be employed in marginal occupations at low wages. They will contribute little to municipal revenues but will nonetheless need services, thereby burdening the already inadequate systems.

14. The projected increases in urban populations in Bangladesh have profound implications for social development and poverty reduction. Provision of water and sanitation services for urban centers will need to be a public health and development priority and will require large investments. Whereas current water delivery systems provide about 10,000 million liters per day, the future (2050) demand is expected to be around 35,000 million liters per day.

E. Drainage and Pollution Abatement

15. Waterlogging following heavy rainfall is common in most urban centers. Rapid urbanization in recent years has further worsened the drainage problem. Inadequate provisions for drainage maintenance coupled with improper disposal of solid wastes lead to frequent drain blockages and water logging even after moderate showers.

16. Traditionally, SWM and drainage are seen as municipal functions with no community involvement. Lack of general awareness among people regarding the benefits of clean drains and proper disposal of solid wastes have resulted in a general absence of community initiatives for development of these services.

17. More attention than at present must be given to drainage, pollution abatement and solid waste management. It is unrealistic to expect all urban centers, large and small, to develop drainage master plans and SWM systems, but they have to become aware of future projections and take a long-term view.

18. Absence of control or treatment of effluent discharges from industry and agriculture has a major impact on the contamination of surface and ground water. Pollution of rivers around major cities is increasing at an alarming rate, with serious implications for their future water needs. Large sections of the rivers that flow through the cities are biologically dead. Increasing domestic sewage and industrial effluents pollute the Buriganga, Lakhya, Balu and Turag in Dhaka District, Karnafuly in Chittagong District, and the Passur and Bhairab in Khulna Districts. In addition to major waterways, these cities have numerous open drainage channels, lakes and tanks none of which meet national water quality standards even for recreational use (BOD less than 2 ppm and DO more than 6 ppm).

19. Small towns with low industrial growth and population densities do not yet face serious risks of surface water pollution. The lone exception is Rangamati where lakeside urban development is an increasing threat to water quality of the lake, which is a source of water supply for the town.

20. Water quality in the river Lakya deteriorated very fast between the initial feasibility for Saidabad treatment plant in the early 1990s and the commissioning of the plant. A Study at the Institute of Water Modeling (IWM) shows that reliance on groundwater alone for water supply in

[3] Islam, 1998: According to a World Bank definition as those who earn less than Tk 2600 (£40) per month for an average family of six. 'Hard-core poor' are those similarly earning less than Tk 1,742 (£27) per month. The latter would be enough to keep the family on the borderline of starvation and pay only minimal amounts towards other basic needs.

Dhaka city is not sustainable. In the central area of Dhaka the groundwater table is declining at an average rate of 2.0 meters per year. This is expected to worsen in future. The Asian Development Bank report on Urban Sector Strategy draws the same conclusion[4]. There is a proposal for bringing in water from the River Meghna to serve future needs.

21. The World Bank has recently sponsored a study to assess surface water pollution in and around Dhaka. The study is presently in draft form and has not yet been published. It is expected to lead to a World Bank financed project on pollution abatement and environmental improvement in Dhaka.

22. Barring a few exceptions, drains in urban areas are constructed in bits and pieces without reference to a plan or the natural drainage system. Indiscriminate dumping of solid wastes into drains, poor solid waste management, and the destruction of natural drainage through physical development are more the rule than the exception.

23. Drainage and solid waste management in most cities and towns remain neglected. Apart from some areas of Dhaka and Chittagong, the overall condition of urban drainage and SWM is generally poor. Untreated sewage flows into open water courses, rivers, canals and ditches. Only Dhaka has a sewage treatment plant with a capacity to handle about 30% of the city's sewage. A national NGO, Prism Bangladesh, is testing decentralized waste water treatment with duckweed in Khulna. The result has been encouraging but the land requirement for the system precludes its large scale adoption in major urban centers where land prices are very high. However, this may be a solution in small urban centers.

24. The Environment Policy 1992 seeks to associate as closely as possible with all international environmental initiatives and agreements whilst also maintaining the ecological balance, protecting the country against natural disasters, regulating polluting industries and ensuring sustainable use of the country's natural resources.

25. The Policy components are numerous and specific, relating to agriculture; industry; health and sanitation; energy and fuel; water development, flood control and irrigation; land; forest, wildlife and biodiversity; fisheries and livestock; food; coastal and marine environment; transport and communication; housing and urbanization; and population. Notwithstanding these provisions, there is little evidence of implementation of the policy principles. Perhaps it is relevant to review and revise the environment policy to make it more realistic, implementable and effective.

F. Natural Disasters

26. Bangladesh is no stranger to natural disasters. Floods, cyclones and tidal surges destroy water and sanitation facilities every year. Washing away of latrines and inundation of hand tube wells are common phenomena. Yet development partners and individuals are establishing thousands of water and sanitation facilities every year without any consideration of Disaster Risk Reduction (DRR). Some international and national NGOs have initiated studies and research to address the problem. Research and Development are necessary to evolve technical and social solutions that provide people access to safe water and sanitation services during and after natural disasters.

[4] Freeman, John C, et al: Urban Sector Strategy, Final Report, MLGRD&C and ADB, Dhaka, August 2000

III. INSTITUTIONAL FRAMEWORK FOR WATER SUPPLY AND SANITATION

A. National Policy Support

27. Recognizing the need for sector reform and coordination, the GOB adopted the National Policy for Safe Water and Sanitation (1998) and the Arsenic Mitigation Policy. The salient features of these policies include the following:

- Demand-driven approach to development instead of present supply-driven one;
- Recognizing and encouraging private sector participation;
- Gradual reduction in subsidies on water supply and sanitation services, but with safety net for the poor;
- Emphasis on user-participation through increased involvement of local government bodies and Community organizations;
- Capacity building of at all levels from the service provider level to user level ;
- Emphasize on behavioral change through social mobilization for optimum use of water facilities, hygiene practices and environmental sanitation;
- Increased involvement of women in water and sanitation services; and
- Adoption of technological options to suit socio-economic conditions, including support to for research initiatives.

28. The National Water Policy (1998) recognizes Bangladesh as a lower riparian country with little control over rivers entering its borders. Upstream diversions and abstractions affect water availability and quality during critical dry months. Reduced water availability in the Ganges-dependent area affects the southeast region of Bangladesh in number of ways, including salinity intrusion that further reduces the availability of potable groundwater, environmental degradation, and destruction of livelihood patterns.

29. Professional and civil groups have identified the need for IWRM to resolve conflict between competing interests in use of ground and surface water resources. A mechanism for effective cooperation and collaboration among different stakeholders would be necessary to make this possible.

30. The National Water Policy includes the following agenda:

- Facilitate availability of safe and affordable drinking water supply through a variety of means, including rainwater harvesting and water conservation;
- Preserve natural depressions and water bodies in major urban areas for recharge of underground aquifers and rainwater management;
- Mandate 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;
- Empower, and hold responsible, municipalities and urban water and sewerage institutions to regulate the use of water for preventing wastage and pollution by human action; and
- Mandate local governments to create awareness among the people in checking water pollution and wastage.

31. WARPO is an apex central institution for promoting Integrated Water Resource Management (IWRM). WARPO and DPHE need to improve their coordination and dialogue if planning in resource management and mutual sharing of information on water resource parameters is to be improved. Very recently, an initiative was taken to prepare a Memorandum of Understanding to this affect with RETA-Support. Continuous follow-up for management information and regulatory intervention to sustain drinking water supplies should be maintained by WARPO and DPHE.

B. Institutional Framework

1. Statutory Responsibility, Delegation, and Linkages

32. The statutory responsibility for water supply and sanitation (WSS) lies with the Ministry of Local Government, Rural Development and Co-operatives (MLGRD&C). The ministry delegates the functional responsibility to the Department of Public Health Engineering (DPHE), the Local Government Engineering Department (LGED), the city corporations (CCs), the municipalities and in Dhaka and Chittagong, to the Water Supply and Sewerage Authorities (WASAs). DPHE is responsible for planning, designing and implementing water supply and sanitation services in rural and urban areas except the cities of Dhaka and Chittagong. LGED is responsible for urban and rural infrastructure development but its activities in drainage, solid waste management and rehabilitation of water supply overlap with the responsibilities vested in DPHE.

33. The MLGRD&C also establishes linkages with the Ministries of Health, Forest and Environment, Education, Water Resources and other relevant line Ministries for coordination. The Ministry of Environment provides the guidelines for water supply and pollution control of the surface water. However, much remains to be desired in implementation of guidelines at the field level. The inter-ministerial and inter-agency coordination is, to say the least, weak and needs much work and effort to make it operate effectively.

2. Urban areas

34. These vary in their institutional capacities and responsibilities. Dhaka WASA is responsible for water supply, subsurface drainage and sewerage, whereas Chittagong WASA deals only with water supply. Dhaka City Corporation (CC) is responsible for solid waste management (SWM) and on-site sanitation, whereas Chittagong CC is responsible for drainage as well. Rajshahi, Khulna, Sylhet and Barisal CCs are responsible for drainage, SWM and maintenance of water supply facilities installed by DPHE or LGED. The municipalities are responsible for SWM and maintaining a sanitary environment within their boundaries. Provision, operation and maintenance of water supply are statutory responsibilities of municipalities, but these have limited technical competence and rely on DPHE (or LGED) for design and construction.

35. Despite their assigned responsibilities the WASAs and the municipalities lack sufficient autonomy to take important decisions on planning, implementation, tariff, staffing and other aspects of water supply and sanitation service. Tariffs have to be approved by central government and do not reflect the cost of water production. The government has introduced some reforms to improve situation in Dhaka WASA: these involve reconstituting the Board with members drawn from both the public and private sectors, redefining the Board's role on policy matters relating to corporate planning, tariff setting, appointment of staff and remuneration, and

making management accountable for meeting operational and financial targets. Despite these changes the central government still maintains a firm grip on the affairs of DWASA.

3. Rural Areas

36. DPHE is the dominant agency for water and sanitation in rural areas. The Union Parishads are beginning to play an important role in hygiene education and community mobilization as well as in the formation of Union Water and Sanitation Committees. There is a trend of allocating a minimum number of female representatives in the various parishads and other committees. This is meant to strengthen women's involvement in the sector, but the social status of women and the fact that sector agencies are almost exclusively a male preserve are likely to inhibit their involvement.

37. Provision of rural water services is channeled through the Union Water Supply and Sanitation Committee. New tube wells are allocated according to a set of selection criteria. DPHE contractors install the tube wells. Communities participate in site selection and make cash contributions depending on the type of water point installed. Operation and maintenance of water points are the responsibility of the users: caretakers undertake minor repairs but major repairs are done by DPHE or private-sector mechanics. The government's service delivery mechanism has been successful in achieving physical targets, but sustainability is jeopardized by the highly subsidized service provision and the continued public involvement in local level service planning and implementation.

4. Municipalities

38. At the municipal level DPHE plans and implements water and sanitation schemes. Despite the presence of local DPHE offices, the centralized administrative structure of DPHE coupled with the weak managerial, financial, technical and communication skills of the pourashava has often resulted in inadequate consultation between DPHE, municipalities and local communities. Under these circumstances, municipalities do not identify strongly with the schemes and subsequently provide poor maintenance and consumer service.

39. As per municipal ordinance, municipalities are responsible for water supply and sanitation, but lack sufficient autonomy to take decisions. LGD approves all important municipal decisions on planning, implementation, staffing and tariff. Municipalities' capacities in management, technical matters and finance are too limited to operate water systems efficiently or to undertake community development and social mobilization. Government agencies advance this as an argument to exclude local authorities from planning, design and implementation of water supply systems, but not when turning facilities over to municipalities for O&M and management.

40. DPHE installs urban water supply systems and turns them over for O&M to municipalities or maintains them jointly. Municipal involvement consists of being kept informed rather than taking decisions jointly. Consequently the municipalities do not have a sense of ownership, have little interest in O&M and are either unwilling to or incapable of running the systems efficiently. The pervasive inefficiency and dearth of resources result in huge water losses, low service levels and poor sanitation in most urban areas of the country.

41. Of the 100 urban water systems in operation, DPHE and municipalities jointly maintain 39 and municipalities maintain 22. The remaining 39 systems are still maintained under the DPHE projects that installed them.

42. DPHE often focuses on technical installation without much attention to maintenance and management. This approach achieves distribution goals but with little or no impact on use or quality of the services. Agencies prefer to meet physical targets rather than to improve local capacity and competence for operation and management of services.

5. Water Quality Monitoring and Surveillance

43. Inadequate regulation is a constraint on sustainable use of groundwater resources for domestic purposes in the near future. Except in large cities, sinking of wells for water supply does not need prior approval of authorities. In the not too distant future, over-use of agro-chemicals may seriously pollute the shallow water table. Water quality monitoring and surveillance is the responsibility of DPHE, which also abstracts and supplies water. This is analogous to combining the duties of an accountant and auditor in the same position. DPHE, as implied in the National Policy on Safe Water and Sanitation 1998, should gradually shift from its role as a provider of services to that of a facilitator regulating services and helping local government institutions to implement their mandate.

C. Analysis of Sector Institutions

1. Department of Public Health Engineering

44. The institutional arrangement of the WSS sector is highly centralized, being mostly dependent on annual development plans and available resources. The sector is mostly supply driven and does not respond well to user needs. Government Agencies within the Ministries have many overlapping functions with very little coordination among them. Lack of ownership by the end users tends to hinder sustainable operation of the systems. Nevertheless, in rural areas DPHE with assistance from UNICEF has successfully transferred to users the responsibility for operation and maintenance (O&M) of about 10 million hand pumps. Also, rural sanitation service, delivered in partnership with the union parishads, has gradually improved, and community participation has proven effective in moving towards universal sanitation coverage by 2015.

45. However, for a long time DPHE has been unable to recruit professional staff at the entry level. It has been managing implementation on an ad hoc basis measures with temporary staff. The lack of a sense of ownership and of an incentive for career advancement results in a frustrating situation in the organization. DPHE finds it difficult to make structural adjustments to facilitate policy shifts towards empowering local governments, decentralization, and demand-driven planning. DPHE is a strong technical organization, and engineers who dominate it cannot be expected to excel in the social domain as well, so there is a need for a multi-disciplinary mix in project planning and implementation. While it is not necessary for an organization to be equally adept in all aspects of development, it is essential to recognize the mix of skills necessary and to create appropriate partnerships for planning, implementation and management.

2. City Corporations

46. Most of the City Corporations do not have the capacity to deal with technical aspects of planning, designing and inspecting of improved water supply and waste water infrastructures. Resource allocation is highly politicized and ad hoc, with inadequate consideration for long term planning, institutional development, environmental issues, feasibility analysis, cost sharing and

improved service delivery. Absence of master plans for water resource development and for environmental sanitation in urban centers may lead to serious environmental degradation and loss of livelihood.

3. Water and Sewerage Authorities

47. Dhaka WASA is facing a serious problem of water availability. Use of groundwater has reached critical levels and is no longer viable without serious environmental consequences. Surface water in rivers is heavily polluted from industrial and domestic wastes. However, several projects to improve water availability are being studied.

48. Over the past decade DWASA has made good advances in revenue management and loss reduction. Nonetheless, further institutional reform and capacity building is imperative to improve decision-making, technical management, transparency and accountability. Annual floods pose an additional burden on DWASA. There is a need to work with stakeholders to prevent unauthorized land grabbing, closure of natural channels and retention basins, and improper solid waste disposal. Flood control measures with assistance from BWDB may provide scope for an IWRM initiative, which demands mutually agreed long- and mid-term action plans. The World Bank is working to formulate a project for pollution abatement and environmental improvement in Dhaka city.

49. The Chittagong WASA has similar institutional problems in addressing landslides that destroy natural drainage channels in the city's hills. Unaccounted-for water, around 35% of total use needs to be reduced through better management and tariff collection.

4. Local Government Institutions in Municipal Towns

50. Water supply in municipal towns depends mostly on groundwater. Intermittent piped water supply is available but water pressure is low, placing a burden on consumers who have to pump water into overhead tanks. In most towns people in the fringe use hand pumps. Service coverage through house connection and street taps is estimated at around 65% of the total requirement. Only 100 of the 309 municipal towns have piped water supply, which in smaller towns is limited to the core while people in outlying areas depend on hand tube wells. Institutional capacity to manage the system needs to be improved through technical service and tariff reforms.

IV. ON-GOING SECTOR REFORM INITIATIVES

A. Introduction

51. The National Policy for Safe Water and Sanitation was adopted in 1999. Despite attempts to implement the policy, progress has been slow. Conditions in the sector have changed since adoption of the policy. Arsenic pollution, for instance, was on the periphery in 1998, the Millennium Development Goals (MDGs) or the 'Sanitation for All by 2010' goal had not been adopted, and the Poverty Reduction Strategy paper had not been issued. It is therefore time to reassess and update the policy.

B. Reform Agenda

52. The following reform agenda items, including a number of agreed principles and action plans, have been identified through stakeholders' workshops.

1. Sector Coordination through Sector Development Framework and Sector Development Program

53. As per provisions of the National Policy on Safe Water and Sanitation 1998, the Local Government Division (LGD) of the MLGRD&C constituted a Forum for Water and Sanitation to coordinate sector development. The Secretary, LGD chairs the Forum, which has representatives from relevant ministries, government agencies and donors.

54. With Danish assistance the government set up the Unit for Policy Implementation (UPI), later re-named Policy Support Unit (PSU), to assist the sector in implementation of the National Policy. To assist the UPI, a Policy and Arsenic Support Unit under a senior assistant secretary was also established in the Planning Cell of the LGD. The UPI formulated a Sector Development Framework (SDF) and later undertook preparation of the Sector Development Program (SDP). The SDF was the first step in Policy implementation and provides an institutional mechanism and framework for coordination.

55. The Sector Development Program (SDP) has assessed investment, human resource and training needs to meet the targets of the Program. The SDP was seen a precursor to a Sector Wide Approach (SWA) to development which in the future would gradually evolve into a basket-funding mode. However, both the SDF and SDP lack broad-based ownership. Some development partners, not without justification, see it as a single donor-driven initiative. There has been no real cooperation of development partners in its formulation, except for a few workshops and seminars,. This is a serious constraint for a program that relies largely on donor funding.

56. The SDP was prepared and adopted in 2005, but to this day the portfolio of investments in the sector does not match its provisions - there has been no action to put the required man-power in place or bring about institutional reforms. The Program does not adequately consider the provisions in the National Water Management Plan (NWMP). A process is underway to revisit and revise the SDP. The process of hiring a consultant is on-going but is a repeat of past arrangements – it is being sponsored again by a single donor agency that in the past has had difficulty in bringing other development partners on board!

2. Devolution of responsibility and enhanced authority to LGI

57. Planning and decision making in DPHE and LGED are centralized, with LGIs having little or no role in decision-making. Empowerment of LGIs through channeling development funds and building in-house capacity, with the central agencies in the role of facilitators, would improve WSS service delivery. This is being done on a limited scale. The past government started disbursing small development funds directly to the Union Parishads, and a few donor-assisted projects are disbursing development funds through the same channel. These are welcome initiatives whose success would potentially change local development administration. It remains to be seen whether these changes will remain project-based exceptions or will be mainstreamed.

3. Greater Autonomy to WASA, City Corporations and Pourashava

58. To provide the WASAs, City Corporations and Pourashavas with greater autonomy and authority, specific amendments to the relevant Ordinances and Acts have to be brought about. Capacity building and autonomy are pre-requisites to devolution of enhanced authority for improved management of WSS services.

4. Emphasis on user participation involving local community organization

59. User communities have had very little input to planning or implementation of public WSS projects. Empowering communities through support of community institutions and building of capacity and awareness in CBOs would contribute to a sense of ownership, sustainability and better operation of facilities.

5. Promotion of Women and Inclusion of Poor in the community organization (CBO) and support for behavioral changes in personal hygiene and sanitation

60. Gender equity and participation of poor in decision-making will facilitate priority setting as the users perceive the benefits of improved health and hygiene practices, with proper use of water and sanitary disposal of wastes.

6. Economic Pricing of Water

61. Efficient management and maintenance of water supply and sanitation services have a cost. Revenue from most urban piped water supplies in Pourashava do not meet even the O&M cost due to poor governance and political reluctance on the part of the people's representatives to raise tariffs. The LGI should be motivated and empowered through community consultations to collect revenues sufficient at least to meet O&M costs. The institutional set-up has to be made cost-effective and efficient through capacity building, reduction of system losses, and transparency in financial management.

7. Operation and maintenance of Hand Pump based Rural Water Supply

62. Historically DPHE maintained rural hand pump tube wells with no cost recovery from users. From 1990 the operation and maintenance of the hand pumps has been the responsibility of a caretaker family selected by users, and trained and equipped by DPHE. During natural calamities and for Tara tube-well maintenance, DPHE mechanics at UZ level are available on call. NGO programs follow similar procedures for O&M of rural hand pumps.

8. Gradual Reduction of Subsidy with safety net for poor

63. Presently rural water supply facilities are operated on partial cost recovery, and community hand pumps are subsidized. Generally all people in the community share the user contribution, but in some places affluent households pay a major share and influence the well-site selections. The reform initiative suggests promotion of a change in attitude from subsidy to cost-sharing, and of micro-credit for water supply and sanitation services.

9. Encourage participation of Private Sector in urban piped water supply

64. Development Partners and the Government are encouraging the private sector to build and operate urban water supply systems. The World Bank assisted Social Development Foundation, a government owned company, has been piloting and fine-tuning the terms and conditions to attract private investment and participation. The World Bank with DPHE now supports a Bangladesh Water Supply Program involving private sector participation. These initiatives are still at a formative stage and a sound regulatory mechanism is yet to be framed to safeguard the interests of consumers, particularly the poor.

65. The financial institutions of the country should come forward to promote increased participation of the private sector, with policy support for investment incentives. Tax relaxation or low interest rate for WATSAN service providers is deemed to be a necessary fiscal incentive for private investment.

10. Complimentary Partnership with NGOs/ CBOs

66. A protocol for Government–NGO partnership needs to be formulated for all public water supply projects, in order to mobilize the communities to build Community Based Organizations to take charge of operations and sustain the systems.

11. Adoption of range of technological options for water supply and sanitation

67. The Arsenic Policy has recommended a range of options for arsenic-safe water supply to communities. It recommends improvement of existing technology through research and development. Piped water supply for smaller communities, with water treatment at source, is encouraged where feasible, with full cost recovery for operation. Development of arsenic treatment at household level has been initiated, and further research for acceptability and affordability is underway.

12. Encourage behavioral change in sanitation and use of safe water

68. Awareness building and social mobilization for sanitation and safe water is pre-condition for achieving health and personal hygiene. Local government agencies and NGOs should adopt a strategy for this. Most current DPHE projects include such a strategy.

13. Demand-driven approach to development

69. Demand-driven planning determines the service level and the willingness to pay for the services, through a consultative process with stakeholders and user communities. Top-down planning does not do this, resulting in lack of ownership that affects sustainability. Institutional

reform to empower communities in decision-making is a prerequisite for sustainable operation and accountability.

14. Ongoing National Water Supply and Sanitation Project of DPHE

70. Of 18 ongoing DPHE projects, seven are in urban and the rest in rural areas. The GOB alone finances 13 projects; GOB-Danida finances two; GOB-ADB supports one urban water supply project; IDA the Bangladesh Water Supply Program and DFID the UNICEF-GOB project and the Char Development Project. Total investment outlay is Taka 4290.9 million with a total project aid of Taka 2048.2 million.

C. Selected Institutional reforms within DPHE

71. The DPHE reform program includes the following:

- Rural water supply had been traditionally maintained by DPHE since before independence, but since year 2000, DPHE has handed over operation and maintenance to communities through training of caretakers during implementation. However, during natural calamities DPHE mobilizes its mechanics at upazilas to restore disrupted systems as required;
- In urban water supply, municipalities have full responsibility for operation as per mandate, with DPHE providing technical assistance and capacity building;
- Over the last 5 years DPHE has strengthened water quality surveillance through 10 zonal water laboratories and one central laboratory in Dhaka;
- Program implementation has increasingly adopted awareness programs and community participation;
- More NGOs than ever before have been involved in water supply and sanitation;
- DPHE has gradually been changing from implementer to facilitator of services in most ongoing projects, and has enhanced its role in training and monitoring.
- Very recently local government at union level has been involved in planning and implementation of hygiene promotion, sanitation and rural water supply, with technical support from NGOs and with DPHE mostly play a monitoring role. Private sector agencies have been also involved as co-investors.
- Support for private sector investment has been initiated on a pilot basis in the World Bank supported Bangladesh Water Supply Project and in the HYSAWA project of DPHE.

D. Gaps Identified within the Reform Program

72. Most of the reform initiatives outlined above are project based and influenced by project implementation protocols. There is a lack of uniformity in the implementation guidelines, framework and methodology articulated in different projects. Different donors have difference implementation processes although involving NGOs and assigning increased roles to Local Government is common. However, the future of decentralization remains uncertain due to uncertainty about political changes expected at Upazia Parishad level and lack of an appropriate institution at LGI level. Resource allocation is made centrally which is again more donor-dependent. Institutional weaknesses of LGIs are technical, financial and operational, and political will for change is not clearly visible.

V. RECOMMENDATIONS FOR IWRM

A. Summary

73. IWRM calls for effective planning and use of the groundwater and surface water resources of the country. This demands identification of water needs for specific uses and exploration of the potential for best use. As demand for WATSAN services calls for increased quantity and quality, better identification, use and protection of water resources appears to be urgent.

74. A recent IWRM initiative has recommended that a MOU be agreed upon by DPHE and WARPO with no further delay. The MOU has already identified protocols for cooperation and information sharing. Periodic meetings and dialogue should be held to identify issues and measures for improved cooperation. Research projects should be identified to map regional water demand and availability as well as threats to water resources from salinity and pollution.

75. DPHE as the sector's national agency should explore all possibilities of institutional support for change, and should exert leadership through its regional network ant through cooperation and technical support. Officials complain that the role of DPHE has been made unexpectedly insignificant in the process of program implementation and reform, the due role of DPHE remaining unnoticed and unappreciated. The institutional roles of LGIs and DPHE should be reassessed and coordinated as soon as the national Government and Local Governments at UZ level are re-established. DHPE-maintained regional laboratories with facilities for water quality surveillance should be integrated into the IWRM research program.

76. Local Government Institutions should be involved in the IWRM process, their tasks to be identified through regional consultation. Also, DPHE and LGI, being under the same Ministry, may help WARPO to facilitate domestic water supply in a more effective and sustained manner.

B. Roadmap

Table 1: Proposed Road Map

Proposed Activity	Time Frame
Signing MOU with Domestic Water supply Providers / Agencies (DPHE, WASA, LGIs)	September 2009
First Consultative Workshop with Domestic Water Supply Agencies by WARPO	December 2009
Prepare an inventory of existing data bases available by the relevant agencies	December 2009
Develop research protocols jointly with DPHE and WARPO identifying specific research need at regional level/ six divisions / hydro-geological diversity areas	March 2010
Implement Joint Research Program	July 2012

ANNEX B: REVIEW OF DATA MANAGEMENT SYSTEMS

ANNEX B: REVIEW OF DATA MANAGEMENT SYSTEMS

Contents

I. INTRODUCTION

A. Background

1. Water resources assessment requires systematic collection, assembly and reporting of hydrological, physiographic, demographic and socio-economic data. Physical measurements at measurement stations need to be taken with designated frequency and accuracy. The existing network of stations for rainfall, evaporation, discharge, sediment transport and water quality meets the standards of the World Meteorological Organization (WMO) 1974.

2. The government declared the National Water Policy (NWPo) in January 1999. The policy mandated the Water Resources Planning Organization (WARPO) to establish and maintain a National Water Resources Database (NWRD) by assembling information from various authorized data collecting agencies (DCAs). Generally, quality control is the responsibility of the data collecting agency. Each DCA has its own collection mechanisms with equipment and staff provided from its own budget, often supplemented through project funds. The National Water Resources Database team has prepared a draft "Spatial Data Quality Standards and Evaluation Principle and Guideline for National Water Resources Database Data Quality Management", designed to promote rigorous quality control by the DCAs.

3. The National Water Management Plan (NWMP) was finalized in 2001 and finally approved by the National Water Resources Council (NWRC) in March 2004. The National Water Policy specifies that the Plan should be updated every five years to suit the need and priorities of the Government in line with the Poverty Reduction Strategy Paper (PRSP) and the Millennium Development Goals (MDGs) and to include any outstanding issues not previously covered. For the implementation of the programs under the NWMP, provision must be made to continue and not cut back on collection of water resources data.

B. Document Purpose

4. The purpose of this document is to review the methods followed by the water resource data collection agencies to identify areas that need strengthening and accordingly provide recommendations.

5. It should be noted that in preparing the 2001 NWMP, data management was carefully examined (Draft Development Strategy, Annex K: Data Management). This current document intends to build on that earlier work rather than to try and duplicate what was already done. Nevertheless, there will be some overlap since many of the recommendations contained in the NWMP document have yet to be carried out and the issues remain.

II. WARPOS DATA BASE

A. National Water Resources Data Base

6. WARPO is mandated to maintain, update and disseminate the National Water Resources Database (NWRD), which is designed to meet the demand for data and information of planners, experts, researchers and managers in the water and related sectors[1]. The data contained in NWRD is collected from a wide range of sources and organized into a relational database format, to form the largest geo-spatial database in the country.

7. The NWRD section of WARPO consists of one Principal Scientific Officer (PSO), one Senior Scientific Officer (SSO) and two Scientific Officers (SO). This section is responsible for data procurement, processing, updating, archiving, inventory system, metadata, tool development and dissemination to internal and external users.

8. WARPO is also responsible for monitoring progress and updating programs of the NWMP[2]. This work, which is another form of data tracking, is carried out by the Monitoring and Evaluation Section of WARPO. As originally envisaged, the Monitoring and Evaluation Section was to consist of one PSO, one SSO and two SOs. While even this level of staffing appears insufficient, in reality the section currently consists of only one PSO without technical support. For all practical purposes, the Monitoring and Evaluation Section has been dormant until very recently, when a sole PSO was assigned to carry out this work.

1. NWRD Data Sets

9. As of February 2008 a total of 406 data layers were available within NWRD, categorized into three hierarchical levels – data group, data type and data layer. Most of the data layers consist of spatial data, time series data and attribute data. The data groups are[3]:

- **Base Data**: Cover administrative boundaries at various levels: national, divisional, district, Upazila and Union. The base data also cover other features such as airway, catchment, navigation, planning unit, power sector project, railway regions, river, road, water bodies and topography.
- **Surface Water**: Includes water level, discharge, salinity, sediment, river cross section and relevant Master Plan Organization (MPO) data.
- **Groundwater**: Covers water levels, water quality, abstraction, aquifer properties, lithology and information from MPO.
- Meteorological: Covers rainfall, evaporation, humidity, temperature, wind speed & direction, sunshine-hour data, etc.
- **Soil and Agriculture**: Includes geo-ecological zones, crop suitability, crop statistics, drought maps, fertilizer use, land type, agricultural land use and soil association.
- **Forest**: Includes forest land data.
- **Fisheries**: Covers fish catch data.
- **Socio-Economic**: Encompasses census, char land, and economic data.

[1] National Water Policy, Article 5.

[2] The total NWMP programme consists of 84 clusters variously implemented by 26 agencies.

[3] A comprehensive data list and summary information on the NWRD are available at www.warpo.gov.bd

- **Environment**: Covers data related to indicative parameters, industry, natural disaster and surface water quality.
- **Images**: Various satellite images like LANDSAT, IRS and SPOT satellite images covering different regions or the whole country are stored in CD-ROM and usually used for WARPO's internal analysis purposes.
- **Document and Report**: This new data group contains the digital version of the National Water Management Plan, December 2001.

2. Data Availability

10. Most of the data layers in NWRD consist of spatial data, temporal data and attribute data. Data are provided in both hard and soft copy. The database is designed using Oracle in the back-end to store the data, and Arc View GIS software for spatial query and display. Metadata for each data type are also available in the NWRD, which has been archiving its data layers since the National Water Resources Management Plan of 2004[4]. For various data groups, the status of the data layers is as follows:

Data Group	Number of data layers		Remarks
	As of Sep. 2000	As of Feb. 2008	
Base data	74	83	
Soil and agriculture	16	19	
Forestry	5	5	
Fisheries	18	30	
Socio-economic	50	55	
Images	-	-	40 CDs procured in 2001-2, kept offline
Documents/Reports	-	1	NWMP report 2004
Meteorological	30	33	
Surface water	110	116	
Ground water	39	46	
Environment	18	18	
Total	360	406	

Source: WARPO

11. Hydrometeorological data are especially vital for water resources development planning and design. Availability of these data from the various agencies is summarized below:

Data Type	Data Collecting Agency	Available Data Range	No. of Stations
Water Level (Non Tidal)	BWDB	1965 – 2003	293
Water Level (Tidal)	BWDB	1960 – 2003	188
	BIWTA	1977 – 2002	53
Discharge (Non Tidal)	BWDB	1934 – 2005	133

[4] Metadatabases are catalogues of data that enable the user to determine which data is available and where it is located in a clear and user friendly manner,

Data Type	Data Collecting Agency	Available Data Range	No. of Stations
Discharge (Tidal)	BWDB	1964 – 2005	14
Rainfall	BWDB	1961 – 2003	304
	BMD	1960 – 2001	31
Ground Water Level	BWDB	1967 – 2003	1,256
	DPHE	1986 – 2002	5,655
	BADC	1984 – 1991	1,474
	BMDA	1986 – 1999	50

Source: WARPO

3. Data Quality

12. Generally, quality control is the responsibility of the data collecting agency but NWRD checks for obvious errors in time series and spatial data. When supplying to data users, both original and corrected data are provided and data history is explained in the metadata. As previously noted, NWRD has drafted the "Spatial Data Quality Standards and Evaluation Principle and Guideline for National Water Resources Database Data Quality Management", designed to help introduce a rigorous standard of quality control by the DCA's. This document is yet to be finalized; the final version will be produced by CEGIS after the organization is contracted by WARPO later in 2009.

4. Data Accessibility

13. Data are available to all relevant users upon request through appropriate governmental authorities. The Director General, WARPO is the approving authority on such requests.

5. Data Updating

14. For updating the NWRD database, WARPO has to pay a royalty to the data collecting agencies, except in the case of BWDB data. Budgetary limitations have seriously restricted the updating effort, so that updating since the end of the NWMP project has been generally insignificant. However, some work has been done in the Integrated Coastal Resources Database (ICRD) of WARPO, supported under the Integrated Coastal Zone Management project. This database is expected to be merged with the NWRD later.

15. Progress on updating the NWRD database on development programs has been slow. From the end of the NWMP (2001) until August 2007 WARPO has requested 11 sectoral government agencies to provide their respective development activities in defined formats. Only BWDB and LGED have responded to date.

6. Data Archiving

16. All data are stored in a single oracle server. NWRD maintains a system of regularly archiving the data once or twice a month depending on frequency and extent of new data being added. A Data Tape Cartridge DLT VS-1 80GB (150GB when compressed) backup kit is used with Arc-Server software. The backup kit is normally stored in the IT section of the NWRD. WARPO works in rented premises and since it was established in 1987, WARPO has changed

its office location six times. This has imposed some constraints on maintaining a fully effective backup system since networking and other related infrastructure is disrupted.

7. Observations

17. There are some concerns associated with the current system that WARPO manages its data systems.

- Budgetary allocations for data procurement are irregular and generally inadequate.
- Staff available within the NWRD section to manage the data system are insufficient.
- The availability of permanent purpose built premises would facilitate the work of WARPO on a number of fronts but particularly in relation to managing the database system.
- Backup data should be stored off-premises.
- WARPO needs to be more proactive in updating the database of sectoral development programs related to the NWMP that are executed by various agencies. To achieve this the Monitoring and Evaluation Section needs strengthening.
- Apart from BWDB and LGED, most agencies involved in implementing the National Water Management Plan do not readily share their data with WARPO. Implementation status of the NWMP is an important aspect of updating this Plan and WARPO needs to strengthen its monitoring system for this purpose.

B. MOUs Between WARPO and Other Agencies

18. WARPO has signed Memoranda of Understanding (MOUs) with Bangladesh Water Development Board (BWDB), Local Government Engineering Department (LGED), Joint River Commission (JRC), Physical Infrastructure Division of the Planning Commission, Char Development and Settlement Project of BWDB, and the Center for Environmental and Geographic Information Services (CEGIS). These MOUs mostly concern data sharing arrangements. While the MOUs do provide the basis for intent of action, they are weak in terms of providing any measure of authority to WARPO if the counterpart agency fails to take the actions that were agreed to.

III. DATA COLLECTION AGENCIES

A. Introduction

19. Data systems of various agencies have been reviewed and issues related to collecting, processing, quality check, analysis, backup, archiving, accessibility and distribution have been assessed in order to formulate practical steps for improvement. The following sections describe the present practice in collection, processing, storage and distribution of data by various agencies, and recommend improvements.

B. Bangladesh Water Development Board

1. Institutional Setup

20. Bangladesh Water Development Board (BWDB) plays a key role in developing infrastructure for water management. Among other things, BWDB is responsible for hydro-meteorological data management.

21. Hydrometeorological data collection and processing in BWDB takes place under the Chief Engineer Hydrology through four Circle Offices. These are: (i) Surface Water Hydrology, (ii) Ground Water Hydrology, (iii) River Morphology and Research, and (iv) Processing and Flood Forecasting. The first three supply data to the fourth, which is responsible for processing, checking, quality control, analysis and distribution to users. The Processing and Flood Forecasting Circle also holds, archives and backs up the data. This Circle office employs three Executive Engineers, one each for surface water, ground water, and river morphology, and each Executive Engineer is supported by three Assistant Engineers and three data entry operators. The following table details the staff that are directly involved with data collection and processing and the changes to this staffing profile that resulted in downsizing BWDB staff over the past decade.

Staff Category	1998 Setup	Present Status	Vacant Positions	
			Number	Percent
Geologist	15	8	7	47%
Sub-divisional Engineer	14	4	10	71%
Assistant Engineer	33	9	24	73%
Sub-Assistant Engineer	57	32	25	44%
Data Entry Operator	35	14	21	60%
Driller/Assistant Driller	8	1	7	88%
Surveyor/Survey Khalashi	125	47	78	62%
Gauge Reader	187	106	81	43%
Programmer / Assistant Programmer	4	3	1	75%
Total	**478**	**224**	**254**	**53%**

Source: BWDB

22. It is apparent that the staff available to BWDB for maintaining the hydrometeorological data base has been reduced by more than one-half over the past decade. However, it is also noted that a significant proportion of the staff positions established for this work are survey

related and gauge readers. These two positions represent 320 staff or 67% of the total. Historically, there have been issues with the quality of the data collected and there is a case for outsourcing these two activities:

- BWDB as an organization should continue moving in a direction in which it manages rather than carries out the work (steering rather than rowing the boat). Managing the work has been the practice for decades with most of the construction activities for which BWDB is responsible and should become the practice for data collection and storage.
- Improved instrumentation (automatic gauges and so on) means that data collection can become less dependent on human interface and the corresponding errors. However, installing, monitoring, and maintaining or (in the case of surveys) using these instruments can require specialized skills not necessarily readily available within BWDB, where they would be available to organizations such as the Institute for Water Modeling (IWM) or the Center for Geographic Information Services (CEGIS).
- While looking only at monthly payroll, BWDB lower level staff appear inexpensive, but it is not clear that costs per unit of quality data are low.

23. Arguably, there is a need to increase the mid-level management staff under the Chief Engineer Hydrology to manage outsourcing data acquisition. However, it is also clear that the overall staffing within this group could be reduced, with data collection and entry systems outsourced and BWDB retaining an oversight and quality control function.

2. Data Collection

a. Surface Water Level

24. BWDB collects river water levels at 343 manual gauge stations and 29 auto recording stations. Of these, 213 are non-tidal and 128 are tidal. None of the auto gauges are currently operational because there is no technology to maintain them. Water levels in both tidal and non-tidal rivers are observed daily at 3 hour intervals, 5 times daily from 06:00 to 18:00 hrs). Fifty-four of the stations are designated for Flood Forecasting.

b. Discharge Measurement

25. BWDB maintains 112 discharge measurement stations, 110 on non-tidal and 2 on tidal rivers. Measurements are taken in all the major rivers, generally 2 to 4 times every month. Measurements are also taken once every week depending on the importance of the river. At the Harding Bridge on the Ganges/Padma, routine fortnightly discharge measurements are taken. However, daily measurements are taken during the months commencing from January to May to record minimum flows.

c. Sediment Transport Measurement

26. BWDB formerly had a program for collecting suspended sediment data at 26 stations. Four stations were located in the major Rivers, ten on Border Rivers, and 12 on minor rivers. Only six stations are in regular operation at present. Sediment samples are taken by Binkly samplers during discharge measurements.

d. Rainfall Stations

27. BWDB has 269 rainfall measuring stations of which 24 are auto recording. The auto recorders are currently inoperative pending repair, but all other stations are operating.

e. Evaporation Stations

28. BWDB has 39 evaporation observation stations, all currently in operating condition.

f. Meteorological Stations

29. BWDB has three meteorological observation stations, two in Dhaka and one at Pabna. Meteorological data include sunshine hours, temperature, daylight hours, wind speed and humidity. The two stations in Dhaka are presently in operating condition.

g. Surface Water Quality

30. BWDB conducts surface water quality monitoring in 10 important rivers, collecting samples from 120 locations. BWDB also samples salinity only at 100 other locations, mainly in the south and south-east.

h. Ground Water Levels and Quality

31. BWDB maintains 1,250 ground water level observation wells. Observations are normally made once a week, daily in a few important locations. Ground water quality is monitored at 117 stations, all currently operational.

i. River Morphology

32. BWDB conducts cross-section surveys at 1,050 sections in 60 major and important rivers, from the 310 listed rivers in the country. Survey are spaced at intervals of 6 km and are conducted every year. BWDB also conducts bathymetric surveys around major bank protection works.

j. Lithology

33. BWDB maintains a lithological database based on ground water observation, well bore logs, and similar data procured from the DPHE and BADC.

k. Aquifer Testing

34. More than 300 aquifer tests have been conducted by BWDB. More tests are planned in order to determine detailed ground water parameters in different regions of the country.

3. Data Processing and Backup

35. The Processing Cell has servers with 24 ports providing access to all support staff of the Executive Engineers. Latest data are generally available with a lag period of only 3 to 4 months. All processed data including historical data series are archived in the server. Backup is done in mobile hard disks (80 GB) which are reportedly stored in the BWDB head office building. A secondary backup on CDs is kept in the Superintending Engineer's office in the Processing and Flood Forecasting Circle.

36. Data are processed and preserved with Microsoft Access or Microsoft Excel software. Data delivery is also made in the same software formats according to the user's request.

4. Data Accessibility

37. To access data, users have to apply to the Superintending Engineer, Processing and Flood Forecasting Circle, and pay a royalty, varying with type of output, to the Deputy Director, Regional Accounting Center, BWDB. Raw data are available in the form of soft copies, CDs, Pen-drives or E-mail.

5. Identified Problems

a. Water Level Gauge Reading

38. Water level readers are employed either as regular employees, on an annual contract, or with fixed honorarium. Many regular employees have retired and were not replaced, so these positions have been vacant for a long time. Also, many contracts have not been renewed. Rates for honoraria are outdated and are no longer attractive to local people. All these problems can in some way be attributed to BWDB budgetary constraints. There is a need to resolve this since the data gaps developing during this period can never be filled.

b. Discharge Measurement

39. All discharge measurement activities of BWDB have been suspended since July 2007. BWDB has a fleet of vessels for discharge measurement. In addition, many country boats are hired for the purpose. Many vessel staff have retired without replacement, and many vessels are inoperative due to a lack of maintenance. Normally, discharge measurements are carried out by technical staff such as the Sub-Divisional Engineer and Scientific Officers. Ancillary expenditures for deployment of these staff and support persons including hiring of country boats cannot be made, due to absence of budgetary allocations.

6. Comments

40. Consideration needs to be given to the following:

- Hydro-meteorological data deserve a high priority for appropriate and cost effective national development activities in many sectors. About 60% of the of the staff positions approved in the standard setup (1998) for data collecting and processing are vacant. It is important to develop a strategy for data collection activities of the BWDB and ensure that appropriate budget allocations are made.
- The number of water quality monitoring stations should be increased.
- More aquifer tests are necessary to determine in detail the ground water parameters in different regions of the country.

7. Water Management Improvement Project Support for NWRD

41. Funded by the World Bank, the Water Management Improvement Project (WMIP) will rehabilitate about 200 existing BWDB subprojects and enhance institutional performance of BWDB and WARPO in water management. One of the activities of the project will be to assist in the maintenance, updating and dissemination of the NWRD through consultant support

provided to WARPO by CEGIS and the Institute of Water Modeling (IWM). A contract should soon be signed to start this assignment.

42. CEGIS and IWM will assist WARPO in maintaining, updating and disseminating the National Water Resources Database (NWRD) for its own planning as well as for the other data users. Their services will include six main activities: i) Updating of NWRD and IT Support, ii) Establishment of a high resolution remote sensing (RS) reference bank and corresponding ground control points (GCPs), iii) Network development, iv) Project MIS (P-MIS) development and implementation, v) MIS development for NWMP programme implementation and monitoring and vi) Review and update of the Integrated Coastal Resources Database (ICRD) as a subset of NWRD. Under this contract, CEGIS & IWM will update about 450 data layers in the NWRD with the available information.

C. Bangladesh Inland Water Transport Authority (BIWTA)

1. Introduction

43. Bangladesh Inland Water Transport Authority (BIWTA) is providing services through maintaining inland waterways and ferry routes in the country. Out of about 14,000 km inland navigable waterways, BIWTA is looking after nearly 6,000 km navigable only during the monsoon and 3,865 km navigable all year round. Its activities also include the production of Tide Table and Hydrographic Charts. This information is important for smooth operation in the navigation sector.

44. The Tide Table provides prediction of water levels at different points in the waterways for the following year. Hydrographic Charts contain layout of channel bank lines with presentation of series of cross-sections between the bank lines showing spot levels at the cross-section at certain intervals.

45. BIWTA is concerned with inland waterways extending down to Authority Buoy spot at Swandip. Although, BIWTA conducted oceanographic survey, since 1970 it has been vested with the Bangladesh Navy.

2. Institutional Setup for Data Management

46. The Hydrography Department of the BIWTA conducts hydrologic and hydrographic observations in the country. The Director Hydrography is the Chief of the Department.

47. The Hydrography Department carries out its responsibility through three sections: The Tidal Research and Study Section, the Survey Section and the Cartography Section. The sections consist of following manpower:

» Tidal Research and Study Section:
  - Senior Deputy Director – 1
  - Deputy Director – 1
  - Assistant Director – 2
  - Punch Operator – 2
  - Operator – 1 and Reader – 1 for each gauge station.

» Survey Section:
  - Deputy Director – 7
  - Assistant Director – 16

- Deputy Assistant Director – 22
- Leads man – 13

» Cartography Section:

- Deputy Director – 1
- Assistant Director – 1
- Deputy Assistant Director –
- Senior Draftsman – 2
- Draftsman – 5
- Drawing Officer – 1
- Tracer – 10

48. BIWTA has not reported any major problem regarding shortage of personnel for data collection and distribution.

3. Data Collection

a. Water Level Data

49. The Tidal Research and Study Section prepare the Tide Tables through collection of water level data at 45 stations spread over the tidal and non-tidal inland waterways. Locations of the stations are setout on the basis of establishing a suitable network for production of Tide Table and bench marks of hydrographic surveys for the navigational routes. Out of 45, 30 stations have auto gauges.

50. In each of the 45 stations, apart from auto recording in the auto gauges, water level data are collected manually to check any unprecedented defects in the auto gauges.

51. Data is collected from 6:00 am to 6:00 pm, hourly at some stations and 2-hourly in others, with invariably the highest and lowest water levels at each station. The Operators and readers in the gauge stations are under direct management of the Dhaka based Hydrography Department.

52. The observed data (both auto gauge data and manually observed data) are directly posted to the Hydrography Department.

b. Bathymetric Data

53. The Survey Section collects bathymetric data of the specified river reaches covered under the 45 gauge stations. Survey is conducted in all specified navigable routes in both monsoon and dry season, except those which dry up in the dry season. In the coastal belt, survey is normally done from November to January. In shallow river reaches, where the survey vessel cannot access, survey is done by manual sounding.

54. Each survey team includes Deputy Director/ Asstt. Director – Team Leader (1), Deputy Asstt. Director (2), and Leads man (1 or 2).

55. BIWTA has a fleet of 13 survey vessels, including 7 mother vessels and 6 survey vessels. Each vessel is equipped with Echo-Sounder, GPS and DGPS. Gauge station locations are used as reference for the survey. River cross sections are produced with echo sounders and positions are determined with GPS and DGPS.

56. Field sheets (hard copy) of hydrographic survey are supplied to the Cartography Section for production of hydrographic charts.

4. Data Processing, Quality, and Analysis

a. Water Level Data

57. Data entry, processing, quality check and analysis of the water level data are done in the Tidal Research and Study Section. The Tidal Processing, Analysis and Prediction software is used for quality check and analysis for prediction of water level for the following year in the Tide Table.

b. Bathymetric Data

58. Processing and quality checking of hydrographic survey data such as echo sounder impressions and GPS/DGPS data, are normally done by the team members in the survey vessels. The hard copy is supplied to the Cartography Section.

59. The Cartography Section prepares Hydrographic Charts for all the surveyed rivers.

60. Since 2000, the software installed in the devices in the ships used to translate the echo sounder reflections in to digital spot levels can no longer be operated for this purpose because of the lack of maintenance of the devices and because spares are no longer available.

5. Data Dissemination

61. The processed data can be disseminated to other users in four formats, both in hard and soft copies. Available formats are:

- Hourly water levels (for one year)
- Highest and lowest water levels (for one year)
- Monthly extremes (for one year)
- Monthly average (for one year)

62. The observed data are disseminated in hard copies only and the available information is:

- 7-days half hourly water levels (one page)
- Monthly highest and lowest water levels (one page)
- Auto recorder chart

63. The Cartography Section provides hydrographic charts in ammonia printed copies. No cross section tracings of the rivers are normally provided.

6. Data Backup and Archiving

64. Processed data and analyzed output are copied onto CDs at the end of each year and stored in the Tidal Research and Study Section.

7. Observations

65. The Assistant. Directors in the Tidal Research and Study Section are directly involved in water level data processing and analysis of all gauge stations. In addition, they have to look after receiving data, accounts, and administration relevant to all 45 gauge station staff as well as associated logistics. For this reason there is a long delay in data entry. As of today, data entry up to 2005 has been completed and 2006 is ongoing. So, limited manpower is an issue. Here too a case could be made for outsourcing data collection operations.

66. Although in the original setup there are provisions for one operator and one reader for each gauge station, only one person is presently assigned to each gauge station, except for the Aricha and Narayanganj stations. This should be rectified to ensure data quality.

67. The software used in the Tidal Research and Study Section does not provide formatted outputs. The analyzed values are reproduced manually in the required formats, which is time consuming. The devices used are obsolete but are not being upgraded.

68. Existing data backup systems need to be improved. Annual backups are insufficient and this activity should be conducted with a much greater frequency. Additional copies of the backup CDs should be preserved off-site.

D. Bangladesh Agriculture Development Corporation (BADC)

1. Introduction

69. The Bangladesh Agricultural Development Corporation (BADC) has been collecting and managing irrigation based data and serving as the main source of such information in the country. Primary data about ground water and surface water availability, operation and installation, coverage, irrigation and production costs of irrigation modes are required for irrigation project planning, implementation and research.

70. BADC supports agricultural development by providing data on usable ground water and surface water resources, irrigation modes, irrigation equipments, water quality, irrigation costs and production costs relevant to minor irrigation.

2. Data Management

71. BADC has an existing network that is spread throughout the country. The network includes 93 Zonal Offices at the Upazila level headed by an Assistant Engineer, and 31 Regional Offices at the district level headed by an Executive Engineer. BADC is headed by a Chairman who is assisted by the Member Director (Minor Irrigation), as well as a Chief Planning and other sectional heads located at the BADC Headquarters.

72. Previously, the Survey and Investigation Division headed by a Superintending Engineer conducted all minor irrigation related surveys. Since 1999, following the abolishment of the division, the newly created Survey and Monitoring (S&M) Project has been conducting these surveys with GoB financing. The S&M Project, operating from the Shech Bhaban in Farmgate, Dhaka, has completed its 1st phase in June 2006 (1999-2006) and the 2nd phase will end in June 2009 (2006-2009). According to the 1999 Detailed Project Proforma, the Project is expected to be extended beyond 2009 under the revenue budget.

3. Data Collection

73. BADC collects data on irrigation equipment, coverage and production by modes of irrigation, irrigation water quality, ground water levels, irrigation costs, and crop production costs throughout Bangladesh.

74. Existing irrigation equipment data are collected at Upazila level by the Zonal Offices under the supervision of an Assistant Engineer. For the irrigation equipment survey, about 1,000 enumerators are temporarily appointed every year, during the irrigation seasons. One enumerator surveys approximately 1,000 units of equipment. Information is collected on the

number of units by mode (DTW, STW, LLP, indigenous systems and gravity), area irrigated per unit, power source, and number of benefited farmers.

75. From 1999, irrigation equipment survey was conducted under the S&M Project of the BADC. Since 2005, the survey is jointly conducted by the BADC, Directorate of Agricultural Extension (DAE) and the Barind Multipurpose Development Authority (BMDA).

76. Ground water levels are collected from 10 production wells in each Upazila. A total of 2,800 wells, including about 500 observation wells (3" dia.), are used for ground water level observations. Concentration of observation points is more in the areas where DTW and STW irrigation is intense. Observation wells are normally installed where ground water irrigation is sparse. Ground water level data are on the 1st and the 16th of the month throughout the year. Automatic ground water level recorders have been installed at 149 observation points, mostly at Upazila head quarters. Out of 149 automatic recorders, 50 are electrically operated while the others are mechanical.

77. Water quality is determined in all Upazilas, more intensely in arsenic and iron prone areas. Measurements are taken twice a month throughout the year. A total of 230 portable water quality kits are used to measure 12 different water quality parameters. BADC has six reference laboratories located in six Divisional Offices. Samples showing an unusual range of parameter values based on the field testing kits are then sent to the Reference Laboratories for further analysis.

78. Irrigation cost and production costs of DTW, STW and LLPs for the boro (winter) season have been collected since 2007.

4. Data Processing and Quality Check

79. Raw field data are checked at zonal Offices. Senior Sub-Assistant Engineers and Sub-Assistant Engineers verify 5%-10% of the survey data. The Assistant Engineer also verifies another 10%. Data processing and checking is done at the S&M Project Office at Shech Bhaban in Dhaka and also at the field offices.

80. The S&M office has a Computer Section with 5 computer operators and 2 GIS operators. The Computer Section is equipped with ground water level monitoring software and water quality software which can delineate areas suitable for deep and shallow tube wells by analyzing prevailing aerial distribution of the wells and aquifer depths. The water quality software identifies areas of ground water contamination.

81. Under the S&M Project, computer facilities are already extended down to the Zonal and Regional offices. Installation of servers at the field offices is in process. In the near future, when this is completed, it will allow data storage in the devices at the S&M Project office.

5. Data Dissemination

82. BADC conducts field level workshops/seminars once a year with the farmers, DTW and STW users and other stakeholders to transfer information and develop awareness on aquifer condition and ground water quality.

83. Ground water automatic recorder information is published quarterly in the "Ground Water Auto Recorder Manual". Irrigation equipment survey data, ground water monitoring data and other minor irrigation related information are presented annually in the "Minor Irrigation Survey Report". Water Quality data are disseminated with the annually published "Water Quality for Irrigation" report. These reports, published since 1999, are available to the users with prior permission from the Member Director (Minor Irrigation) and Project Director, S&M Project.

6. Backup and Archiving

84. The soft database at the S&M Project office is saved in the computer hard disk. No other backup is in place. Hard copies of annual and quarterly reports are properly preserved. Two copies of each report are archived in the Central Library in the Head Quarter at Krishi Bhaban.

7. Observations

85. The S&M Project activities are important from the perspective of agricultural development support. The Project is operating with GoB funding. Provision must be made to continue the Project to ensure that all records remain available for future planning needs.

86. Systematic backup system of the data base should be developed. Soft copies should be preserved in a separate location (possibly in Krishi Bhaban) to escape loss of data from unforeseen events.

87. The program of electronic data storage system directly from field offices to the S&M Project Office at Krishi Bhaban is an excellent initiative. Implementation of this program should proceed faster.

E. Department of Public Health Engineering

1. Introduction

88. Department of Public Health Engineering (DPHE) is extending services for providing safe drinking water and hygienic sanitation in the rural areas of Bangladesh. In this context, it is providing statistics on the ground water table, water quality, existing infrastructures for drinking water development and distribution system and sanitation.

2. Institution

89. DPHE is providing its services through an existing institutional setup that comprises the Sub-Assistant Engineers (SAE) offices at the Upazila level, Divisional Engineers offices at District level, and extending up to the Circle offices, Additional Chief Engineers offices and Chief Engineers office at the Dhaka Headquarters. A Sanitation Secretariat under the Planning Circle at Head Quarter takes care of rural sanitation services.

90. Data collection and other activities of the field offices at Upazila and district levels are controlled by the Additional Chief Engineers (Works) at HQ. Data management and information services are managed by the Additional Chief Engineers (Planning) through the Ground Water Circle and Planning Circle offices at the HQ.

91. The SAE offices in all Upazilas consist of one Sub-Assistant Engineer and four Mechanics that are the primary resources for information collection activities.

3. Data Collection

92. Ground water table data and samples for water quality are collected at all Unions in the country by the Upazila based SAE offices of the DPHE. Observations are conducted at specified development wells (HTW, STW and DTW) in the Unions established by the DPHE. Water table data are collected once a week during the dry season (mid March – end of May). Observations are made manually and no auto recorders are used at any of the wells.

93. Sanitation data are collected in each Union, all over Bangladesh, through the SAE offices and sent to the Planning Division at Head Quarter.

4. Data Compilation, Processing and Quality Check

94. The ground water level data are sent to the Research and Development Division of the Ground Water Circle by mail. Data are compiled, checked, processed and analyzed in the Program and Coordination (P&C) Division and Survey Research and Investigation (SIR) Division under the Planning Circle at Head Quarter. The SIR Division deals with the Upazila and district level urban data, while the P&C division deals with the rural data.

95. From 1991 to 2005, data were collected and processed under a project funded by UNICEF and other donors. The P&C division has been entrusted with the assignment since 2005.

96. The P&C division has a computer section since 2001 where data are entered into a database. Normally, the Assistant Engineers are responsible for data entry.

97. The sanitation data are compiled, processed and checked at the Sanitation Secretariat at the Head Quarter in Dhaka.

5. Data Dissemination

98. DPHE disseminate information in the form of reports. The Program and Coordination Division prepares a monthly “Water Sources Status and Coverage” report. The report provides Upazila wise data on ground water table, water quality, number of development wells (HTW, STW and DTW) with present status and coverage. Reports have been continuous since 2001 but irregular before that.

99. The Computer Division prepares yearly reports on rural and urban water supply information in two separate volumes entitled “Urban Water Supply Data Book” and “Rural Water Supply Year Book”. These reports contain Paurashava/Upazila wise data on the number of production wells, overhead tanks, treatment plants, length of water supply pipelines, service connections, hand tube wells, daily water production and pumping hours. These reports have been prepared since 1997 and 1999, respectively. A web page is being developed in the DPHE where all above data will be available.

6. Backup and Archiving

100. The raw and processed data are not properly archived. Computer data are saved on the hard drives of several computers.

7. Observations

101. In most cases, the SAE offices have less than the four Mechanics that they should have. With their reduced number of staff, it is often not possible to collect the large volume of data in each Union within the short period of time allowed (mid March to May).

- Ground water level observations are made in the development wells by removing the well-head devices. It is very likely that the measurements are taken before the water levels inside the wells are stabilized with the outer aquifer level. This is a potential source for error.
- Backing up of data on various computer hard drives has risks losing parts of the database. Data needs to be systematically archived.

F. Bangladesh Meteorological Department (BMD)

1. Introduction

102. The Bangladesh Meteorological Department (BMD) is the authorized Government organization for all meteorological activities in the country. It maintains a network of surface and upper air observatories, radar and satellite stations, agro-meteorological observatories, geomagnetic and seismological observatories, meteorological telecommunication system, and exchange of information with other international organizations.

2. Data Management Institution

103. The organization was established in this region in 1883 with 8 meteorological stations in Barisal, Comilla, Dinajpur, Faridpur, Maijdee court, Mymenshingh, and Rangpur. Among other early stations are Bogra (1884), Jessore (1867) and Satkhira (1877). Presently, BMD maintains a network through 80 offices all over the country. The Department has its Headquarters in Dhaka and two regional centers: the Storm Warning Centre (SWC) in Dhaka and the Meteorological & Geo-Physical Centre (M & GC) in Chittagong.

3. Data Collection

104. BMD observes different meteorological parameters both for surface and upper air all over Bangladesh and around the clock. It collects 41 types of meteorological and seismological data. Data types, in broad categories, are surface and upper air temperature, relative humidity, cloud, wind speed and direction and surface atmospheric pressure and rainfall. It also collects agro met data, seismic data and astronomical data. Data are collected at 35 observation stations including 4 radar stations and 2 seismological stations.

105. The major agricultural related data and frequency of observations are as follows:

- Temperature — 3-hourly
- Relative humidity — 3-hourly
- Rainfall — Daily up to 2002 and 3-hourly since 2003
- Sunshine — Daily
- Soil moisture — 12-hourly
- Pan evaporation — 12-hourly

106. BMD exchanges climate data with other countries through the World Meteorological Organization (WMO).

4. Data Processing and Dissemination

107. BMD extracts, maintains quality control, processes, archives and publishes climatic data for various users. Data processing, quality check and analyses are conducted in the Headquarter at the Meteorological Complex in Dhaka. It has a computer section with software for data processing, checking, analysis and prediction. BMD publishes climatic data for use of various concerned agencies at home and abroad. BMD prepares and analyzes all weather charts and makes interpretation on the basis of analyses. BMD also provides weather forecasts for public, farmers, mariners and aviators on routine basis and also issues warnings for severe weather phenomena such as tropical cyclones, tornadoes, nor'easters, heavy rainfall, etc. Data are available in specified formats both in hard and soft copies.

5. Data Backup and Archiving

108. Data are backed up and archived in hard copies and also as soft copies in servers and CDs.

G. Bangladesh Bureau of Statistics

1. Introduction

109. The Bangladesh Bureau of Statistics (BBS) is responsible for the provision of reliable and timely official statistical information for policy planning, research, and decision-making. As the leading statistical organization in the country, it provides user focused official statistical information and statistical service to an international standard for national planning and development. With it's headquarter in Dhaka, BBS performs its function under the administrative control of the Planning Division, Ministry of Planning.

2. Institution

110. At present, BBS has 23 Regional Statistical Offices, 94 Zila Offices and 497 Upazila Offices. The total strength of BBS 4,054 persons. In their headquarters, BBS has seven functional wings including five subject matter wings and two service and administrative wings:

» Subject matter Wings
  - Census Wing
  - National Accounting Wing
  - Demography and Health Wing
  - Industry and Labor Wing
  - Agriculture Wing

» Service and Administrative Wing
  - Computer Wing
  - Finance, Administration and Management Information System Wing

111. One Director/Joint Director is responsible for each wing and works under the control and guidance of the Director General, BBS.

3. Data Collection

112. The Bangladesh Bureau of Statistics collects all census data through its 497 Upazila offices under the guidance of 23 regional offices. The Agriculture Wing, the most relevant section to water resources development planning, undertakes agricultural surveys for major and minor crops for estimation of production, land utilization, non-crop statistics (i.e. livestock, forestry and fisheries) and agriculture products. The Agriculture Wing has been undertaking different programs all over the country throughout the year for collecting agricultural statistics. Agricultural Statistics data are collected and compiled by BBS. Other data are collected from secondary sources and also compiled by BBS. The structural statistics are generated through full count/sample census normally at a regular interval of ten years, following FAO guidelines.

4. Methods of Data Collection and Estimation of Crop Statistics

113. Both subjective and objective methods are used to obtain crop statistics. The subjective method is used for estimating minor crops, while the objective method refers to the use of probability sample areas and objective yield measurements. Crop-cutting is conducted mainly for determining the yields of major crops. These two methods are presented below.

a. Subjective Method

114. Crop estimation is usually initiated at Upazila level. The Upazila statistical offices select one mouza from each Union by simple random sampling. A household list is then prepared within the selected mouza and the households are stratified according to farm sizes (large, medium and small farmers). By simple random sampling, one large, one medium and three small farmers are selected. The Upazila statistical offices collect data through interviews of those selected farmers for crop area and yields of current and previous year. To estimate the proportion of crop area, all five farmers are interviewed. Current year crop area of the Union is obtained by multiplying the rate of proportion with the crop area of the previous year. The Upazila area is determined by adding up the Union figures and district estimates in the same manner by adding up Upazila estimates. The same procedure is followed to estimate crop production. Here also, the five randomly selected farmers are interviewed.

b. Objective Method

115. A total of 9,348 sample cluster plots are identified throughout the country for purposes of measuring the area cultivated and the yields of major crops.

116. These clusters are visited four times per year and the acreage under different crops in each plot is recorded by the field staffs in a prescribed schedule. The filled in schedules are sent to head office through regional statistical offices. These forms are checked, scrutinized and then processed for area estimation. Area estimates by crop and by district are determined by the ratio method.

117. Yields for major crops (aus rice, aman rice, boro rice, wheat, jute and potato) are estimated through crop cuts within the clusters. The cuts are located randomly within the sample plots. Circular cuts totaling 100 ft^2 are obtained from three concentric circular cuts. District estimates of yields are simple averages of yields computed from the sample plots. The area estimates multiplied by the yield estimates provides the production estimate for the district. The national estimates are obtained by totaling district estimates.

5. Data Processing and Quality

118. Census data collected through its 497 Upazila offices are sent to the Subject Matter Wing at head quarter for further processing. The Computer Wing at headquarter is responsible for data processing of various census and surveys. The Computer Wing is well equipped with about 150 trained personnel responsible for processing the census and survey data.

119. The Computer Wing works on design and development of database and customized software to cope with the requirements of the BBS. It also provides support and planning for network administration

6. Data Dissemination

120. The Bangladesh Bureau of Statistics produces annual reports and 10-yearly census reports. The Computer Wing is the data bank of all BBS data providing all census and survey data to users who include researchers, academics, government, international organizations and donor agencies. All monthly, quarterly and annual publications as well as census and survey reports of BBS are printed and published by the Reproduction, Documentation and Publication (RDP) Branch attached to the Finance, Administration and Management Information System Wing. Questionnaires, training manuals, maps and charts are also printed by the RDP Branch.

121. The Agriculture Wing also prepares an annual publication entitled the Yearbook of Agricultural Statistics of Bangladesh. This Yearbook focuses exclusively on data related to agriculture.

7. Data Backup and Archiving

122. The Computer Wing preserves all census and survey data in electronic media. It directs and coordinates all aspects of planning, installation, operation and maintenance of data, server-based applications and computer systems. The Computer Wing is responsible for the implementation of optical data archive and networking system. It preserves all census and surveys data conducted by BBS.

123. The Reproduction, Documentation and Publication Branch maintains a library located in the Answari Building, Topkahana Road, Dhaka. All monthly, quarterly and annual publications as well as census and survey reports are made available to all users in the library. The Computer Wing preserves all census and survey data in electronic media and provides data to the users whenever they need.

8. Observations

124. BBS has excellent logistical support through its Computer Wing including high level computing resources (hardware and software) with competent staff. It has the required skills to coordinate all aspects of planning, installation, operation, and maintenance of data, server-based applications and computer systems, network administration and design and development of database and customized software to cope with the requirements including troubleshooting of software and hardware. Its Reproduction, Documentation and Publication activities including data backup, archiving and dissemination are of an adequate standard.

125. The Upazila is a relatively large geographical area for only two staff to collect agricultural data. The methodology employed results in data that is very approximate. It is also difficult for only one Survey Officer at the district level to cover all Upazilas. The reliability of the collected data is often questioned. Resource assessments suggest that assigning a Survey Officer at the Upazila level would improve the quality of collected data to a considerable extent.

H. Soil Resources Development Institute

1. Introduction

126. The Soil Resources Development Institute (SRDI), under the Ministry of Agriculture, conducts soil surveys all over Bangladesh and determines area wise soil classification, land use, flooding, soil drainage, cropping and soil fertility. During the then Soil Survey of Pakistan,

soil surveys were only use for classification of soil. Fertility status, as a part of soil surveys, was introduced by SRDI since Bangladesh independence.

127. Since 1987 SRDI has been coordinating the the work of other agricultural research institutions to produce an Upazila wise directory on soil classification, land use, and soil fertility and other information related to agriculture development.

128. From 1980 to 1986, the Soil Moisture Study, with FAO assistance performed soil observations on hydraulic conductivity, infiltration, moisture retention, gravimetric moisture content and soil structure stability, bulk density and particle density. The program covered most areas of the country in the Ganges and Teesta flood plains, Barind and Madhupur areas and old estuarial flood plains. The southern saline areas and piedmont (foot hill areas) were not included in the program.

129. With the objective of detailing soil characteristics and soil fertility throughout the country (Union wise), SRDI completed a Reconnaissance Survey in 1989. Following the Reconnaissance Survey, SRDI has also completed a "Semi detailed Survey" in 2006 and is now expanding the range of analysis and information collection and updating previous survey data to cover the period from 1987 to 2007.

2. Institutional Setup for Data Management

130. SRDI conducts its activities through 20 field offices established at all old administrative districts. Each field office includes a Senior Scientific Officer, Scientific Officers and Field staff. The Office of the Director, SRDI, is at the head quarter in Dhaka. It has a Central Laboratory, Data Processing and Statistical Section, Cartography Section and a Central Library at the head quarter. SRDI has recently established two Soil and Watershed Management Research Stations at Bandarban and Khulna, in the piedmont and saline areas respectively, to collect soil information for agricultural development.

3. Data Collection

131. SRDI collects soil data in 460 Upazilas through its field offices. It receives assistance from other institutions for data collection and secondary information, including the Bangladesh Agricultural Research Institute (BARI), the Bangladesh Rice Research Institute (BRRI), the Department of Agriculture Extension (DAE), the Bangladesh Agricultural Research Council (BARC) and the Bangladesh Institute of Nuclear Agriculture (BINA).

132. Soil samples are collected at 50,000 specified points in 460 Upazilas. The sample points are located with the help of remote sensing images. Samples are collected with hand augers. It takes about a year, or even more, for a team to collect data in assigned areas.

133. The soil samples are analyzed in 21 laboratories of which 11 were established by SRDI, 4 inherited from BARI and 6 from BADC. SRDI also has 12 mobile soil testing laboratories, mounted on covered vans, which can test soil on-site.

134. A total of 14 types of analysis are performed in the laboratories including parent materials of the soil sample, drainage condition, relief (topographic) characteristics, physical properties, pH values, electric conductivity and soil nutrition.

135. SRDI has recently introduced extension services to farmers at Union level providing information on block-wise soil characteristics and soil nutrition. With the assistance of the Upazila Agricultural Officers of DAE, 4 or 5 Upazilas in each district receive these extension services. The DAE Sub-Assistant Agriculture Officer (SAAO) (formerly Block Supervisor - in charge of a Union) works with the SRDI team and local farmers to locate appropriate soil test

points. A record card containing test reports on soil nutrition and recommendations on appropriate fertilizer use is given to each farmer. Each team of this extension service consists of one Senior Scientific Officer (SSO) and two Scientific Officers (SOs) of SRDI.

4. Data Processing and Quality Checking

136. In each District Office, a "Nirdeshika Cell" compile, process and check raw test result data in formats defined at head quarter. The District Offices have computer facilities procured under a DANIDA financed project. Hard and soft copies of data are sent to the Central Data Processing and Statistical Section (also known as GIS Section) at the head office in Dhaka. The GIS Section maintains a database on soil characteristics and land quality and produces maps showing areas of different soil category. Water bodies identified by reconnaissance surveys are also shown in these maps. The Bandarban and Khulna Research Stations also prepare similar reports.

137. The GIS Section has two servers and software including ARC-Info, ARC-View, ARC-GIS and Customized Software (SOLARIS) which process soil and GIS data.

5. Dissemination

138. SRDI publishes Upazila-wise soil reports in Bangla entitled Directory of Land and Soil Resources Use. The reports contain information on land classification, soil group, physical and chemical properties of soil, and also other information like climate, geological scenario, surface and ground water resources, irrigation system, cropping pattern, population and land use. These reports provide farmers at the Union level with information on soil nutrition and recommendations on fertilizer use. They also include soil and land use maps of the respective Upazila. These are available only on hard copies.

139. An excellent program is being developed jointly between the Ministry of Commerce and SRDI. As agreed in an MoU between the two agencies, the Ministry of Commerce will develop software to provide farmers with advice on fertilizers, irrigation requirement and crop selection based on the SRDI Upazila soil survey.

6. Data Backup and Archiving

140. The GIS Section of SRDI backups the database in a separate server and CDs every 10 or 15 days. However, these are stored on-site. Hard copies of all reports and maps are preserved in the Central Library.

7. Observations

141. Union-wise soil data collection requires extensive resources. This is made possible because of the joint effort of SRDI and other institutions. This approach could serve as a model for some of the other data collecting agencies.

142. Copies of data backup in CDs should also be preserved in a separate location (other than the SRDI head quarter).

I. Institute of Water Modeling (IWM)

1. Introduction

143. The Institute of Water Modeling (IWM) is a centre of excellence in the field of mathematical modeling and related sciences. Almost all the projects undertaken by IWM need some type of data to address specific problems. At the start, the data to be acquired and the source of data must be identified correctly, as no amount or depth of subsequent analysis can make up for a lack of data quantity or quality.

144. Problems and objectives need to be clearly defined, as they dictate the data to be obtained and analyzed to address the objectives. The quantity of data, their quality, and how they are sampled and measured has implications on the choice and effectiveness of the data analysis techniques used in modeling and other analysis. Consequently, IWM always pays special attention to collection, quality and storage of data.

2. Collection

145. IWM collects data from both primary and secondary sources. Primary data is collected through field surveys, while secondary data is collected from various organizations including BWDB, BIWTA, SRDI, BARC, LGED, and RHD.

3. Quality Control

146. After collection, data are checked for quality using different types of software, both commercially available and custom-made. A quality control system is applied to the quality management process.

4. Data Storage

147. IWM developed a central database management system to store and maintain each piece of data collected from primary and secondary sources. After checking the quality, data are stored in a central database. The database has been developed to run in a client/server environment and any authorized user in IWM can access the database through the network. They can select and download data for modeling as well as for research purpose.

5. Types of Data

148. The IWM collects, stores and maintains the following data:

- **Ground Water Data**: Ground Water Level
- **Meteorological data**: Evaporation and Rainfall.
- **Water Quality**: Dissolved Oxygen, Salinity, Water Temperature, and Sediment.
- **Bathymetric Data**: X-Section Data and Bank Alignment Data.
- **Topographic Data:** Land Topography.

149. Specific data, collection and processing method, and data management are provided in the following table.

No.	Type of data	Equipment/Methodology for Data Collection	Data Processing	Data Management
1.	Water Level (Non tidal)	Collected by installing staff gauge. The gauges are connected with the nearest available BWDB or SoB Bench Mark. Gauge readings are taken from 6 AM to 6 PM at 3 hr intervals. Gauges are frequently inspected by the Surveyors. The period of data collection depends on project requirement.	Data is processed following IWM Data Processing Manual in the computer and checked for consistency	Data is preserved in the project record/database. If the duration is longer, it is also transferred to the Survey Database.
2.	Water Level (Tidal)	Collected by installing staff gauges. The gauges are connected to the nearest available BWDB or SoB Bench Mark. Gauge readings are taken at 30 or 60min intervals. Readings are continuous or 6 hrs to 10 hrs depending on the project requirement. Gauges are frequently inspected by the Surveyors.	Same	Same
3.	Discharge (Non-Tidal)	a) Medium/Minor River: Measured by using a Propeller Type Current Meter (Valeport BFM 001 or DNC 1) following the ISO Manual. b) Major River: Measured by Workhorse Rio Grande ADCP from RD Instruments coupled with DGPS	a) Data is processed using an Application Programme developed in house for computing discharge using Area Velocity Method. b) Data from ADCP is processed by using Win River Software of RD Instruments and ATF-ADCP Tools developed in IWM	Same

No.	Type of data	Equipment/Methodology for Data Collection	Data Processing	Data Management
4.	Discharge (Tidal)	a) Directional Current Meter: The measurement is taken for a full tidal cycle of around 13 hours. The number of verticals (1 to 3) is selected depending on the river width and channel geometry. Observations are taken at 30min intervals and at 6 point method. Cross-sections are taken with a DGPS and Echo-sounder. Water level is recorded at the same time as current observations. b) ADCP and DGPS: The observation is done across the whole river/channel at intervals of 30 min or 1hr, depending on the river width and travel time to cross the river. Water level is recorded at the same time as current observations.	a) Current Meter data is processed in the computer by using Application tool developed in house. b) Data from ADCP is processed by using Win River Software of RD Instruments and ATF-ADCP Tools developed in IWM	Data is preserved in the project record/database. If the duration is longer, it is also transferred to the Survey Database.
5.	Velocity Profiling	Done by ADCP and DGPS usually at places of erosion or river training works.	Data from ADCP is processed by using Win River Software of RD Instruments and ATF-ADCP Tools developed in IWM	Data is preserved in the project record/database.
6.	Cross-section Survey	Done by the conventional method of sounding in shallow rivers. For deeper rivers, DGPS and an Echosounder are used. The dry/ shallower part is surveyed by using an optical level. All cross-sections are connected from the reference bench marks (BWDB/SoB) and the bench marks are interconnected to check for consistency.	Data is processed using IWM Data Processing Manual.	Data is preserved in the project record/database and also in the Survey Database.
7.	Bathymetric Survey	DGPS and Echosounder are used for the survey. The dry/shallower part is surveyed by using optical level. All cross-sections are connected from the reference bench marks (BWDB/SoB)	Data is processed using Hydro Pro Software to remove spikes, correct water levels, and export to ASCII / text format. Data is also processed with Terramodel, Excel, and ArcView to plot cross-sections, bathymetric maps, navigation chart and so on.	Data is preserved in the project record/database and also in the Survey Database.

No.	Type of data	Equipment/Methodology for Data Collection	Data Processing	Data Management
8.	Suspended Sediment	Suspended sediment samples are usually taken during discharge observation. Sediment Samples are collected using the pump-bottle technique.	The samples are tested in the IWM Laboratory to determine total concentration or grain size distribution	Data is preserved in the project record/database
9.	Bed Samples	Bed samples are usually taken using a Grab Sampler	The samples are tested in the IWM Laboratory to determine grain size distribution	Same

6. Data Dissemination

150. The IWM disseminates data on demand based on certain conditions. Data is disseminated mainly for academic and research use at a nominal cost. Any person or organization requiring data can apply to the IWM, mentioning both spatial and time extents of data. The IWM then provides a soft copy of data. Sometimes approval from the concerned agencies/organizations is required prior to data being released.

J. Center for Geographic Information Service (CEGIS)

1. Introduction

151. The information required for water related problems and issues are not limited to only time series information of hydro-meteorological data, but also include GIS and remote sensing information for location specific solution. A number of databases are maintained by CEGIS on soil, agriculture, hydrometeorology, environment and satellite based images.

2. Hydro-meteorological data

152. Most of the hydro-meteorological data are collected from various sources including BWDB, BMD and BIWTA. To support the development of WARPOs National Water Resources Database, CEGIS collected the following two major categories of water related data mainly on daily frequencies.

Hydrological data
- Water level
- Discharge
- Groundwater
- River cross section

Meteorological data
- Rainfall
- Temperature
- Humidity
- Wind speed
- Sunshine hour
- Evaporation

153. Hydro-meteorological data is categorized mainly as time series, spatial and attribute data. Nearly all the station information is maintained as attribute files or shape files describing the information on station, positional information and other related parameters.

3. Time Series Data

a. Water level Data

154. The total number of non-tidal stations maintained by BWDB is around 296, and time series data are available for 259 stations. The total number of tidal water level stations of BWDB is 188, and data are available for 176 stations. Data for water level stations is available from 1960 to 2003 in average, but extent of data availability is different for each station. A number of recent data are found to be erroneous in terms of magnitude and behavior. Recent data also have more missing values compared with earlier data, and this hinders data processing as considerable effort is needed for data infilling and consistency checking.

b. Discharge data

155. The total number of the non-tidal discharge stations of BWDB is 135, and time series data is available for 125 stations. The total number of tidal discharge stations of BWDB is 16, and time series data is available for 12 stations. Data from water level stations is normally available from 1934 to 2003, but the extent of data availability varies from station to station. No discharge information is available in the coastal zone of the country.

c. Ground water level

156. A time series data layer representing the weekly groundwater levels has been collected from BWDB. The total number of BWDB monitoring wells is 1,256 located throughout the country. The data layer was collected in soft copy. Both groundwater depth and level are available in the NWRD. For this data, layer information is normally available from 1960 to 2003, but not for all stations. There are a number of missing values in some stations. The NWRD has also collected additional ground water level data from BADC, BMDA, and DPHE.

d. Groundwater quality data

157. A time series data layer of 20-differnent parameters related to groundwater quality has been collected by BWDB in around 117 monitoring wells. The data has been collected in digital format from BWDB and is available for 109 stations from 1972 to 1997. Unfortunately, the data is scattered, and there is no fixed interval of data collection. The NWRD has also collected various parameters of ground quality from DPHE.

IV. RECOMMENDATIONS

A. Data Collection and Storage

158. The equipment, trained manpower and financial resources of the various data collecting agencies are often inadequate to collect, process and publish data in a timely manner. BWDB closed some water level stations when gauge readers retired and were not replaced. In addition, many of the non-departmental gauge readers under BWDB are no longer interested to work with the old remuneration package and this has created serious constraints in data collection. The BBS data collection system receives adequate support from the government as it is important to national strategic planning. Similarly, hydro-meteorological data plays a key role in the planning and design of various development projects. There is an opportunity to outsource the collection and storage of hydrometric data to agencies that include IWM and CEGIS as well as other private sector firms but there is clearly a need to ensure that hydrometric data collection continues.

159. Most projects in the water sector have their own form of data collection and information processing, and present their outputs in the form of reports and project databases. There is no formal requirement that the reports or data are forwarded to a central archive. As a result, some valuable research data and findings may be lost or are not available to other users. WARPO needs to examine the issues related to the data acquisition systems and work with the data collection agencies to formulate a set of practical steps that would improve data collection, storage, retrieval and accessibility.

160. Technological change in instrumentation is rapid, and new technologies for gathering information more accurately and safely should be adopted as quickly as practicable. Newer technologies usually involve easier field procedures and less effort for collecting data than traditional methods. Remote sensors can collect, store and / or transmit data without human error with proper setup and calibration. Well-calibrated hydrodynamic models allow interpolation of water levels and flows within a sparse observation network.

161. NWMP documents overlap in data collection activities. BWDB and BMD collect meteorological data, BWDB and BIWTA as well as IWM and CEGIS collect water level and morphological data. BWDB, DPHE and BARC all have responsibilities for groundwater data. This situation remains little changed over the past decade since this was documented[5]. This has resulted in duplication of some of the work, gaps between data collected and user needs, inconsistent data formats, and needless expenditures. There is a need to provide a stronger institutional shape to the data management related activities that leads away from data collection on a project basis to more systematic and direct support to the National Water Resources Database by all the water resources data collecting agencies.

B. Quality Control

162. At present, there is no standards in place for checking and maintaining the quality of water resources data at a national level. The problem of data quality control is widespread and profound, permeating even the most basic data and affecting the entire data collection process. When agencies are assigned the responsibility to collect data, this responsibility should include data collection in accordance with recognized standards. To be effective, quality control must be exercised from the point of collection, and this can only be implemented by the data

[5] August 2000, Draft Development Strategy: Annex K

collection agency. Each agency must be provided adequate funding to ensure required data quality. The data collecting agencies will also have to train the required staff for this purpose. Other mechanisms that would support quality control include:

- Centralizing quality control since incoming data can be assessed against a broader data set and would reduce the cost of quality control.
- Feedback from data users also helps improve data quality.

163. To improve data quality, the NWRD team has prepared a draft "Spatial Data Quality Standards and Evaluation Principles and Guidelines for NWRD Data Qualify management". This document is designed to help introduce a rigorous standard of quality control. This draft document needs to be agreed to, and used during implementation by all the data collection agencies.

164. According to the National Water Policy, WARPO is responsible for updating the NWMP every five years. In preparing the 2001 NWMP, data was checked for completeness and consistency for the period 1966-1995. About 10 more years of data have been collected and needs checking. In preparation for updating the National Water Management Plan, it is advisable that the Government be proactive and finance this work.

C. Data Storage and Archiving

165. The current situation is that large quantities of data are spread over many different organizations. A common theme throughout these organizations is the absence of sound backup and archiving policies for the electronic data that they retain and the corresponding failure to adapt their backup and archiving systems to new infrastructure that is introduced as the computer technologies evolve. In part this problem also results from insufficient financing, which in turn is an outcome of the relatively low priority placed don the value of raw data.

166. It is recommended that any agency involved in the collection and storage of primary water resources data have in place a robust policy for backing up this data in the short-term and archiving the data for long-term storage as a precondition to financing the collection of the data itself.

D. Dissemination of Information

167. As noted in the National Water Management Plan, it is necessary to ensure that the necessary legislation is in place to allow the open exchange of data between organizations, particularly to the NWRD and from there to the public. While a related issue is cost recovery, the NWMP concluded that for a number of reasons, financing of data collection should remain within the public sector.

ANNEX C: MANAGING RIVER EROSION – THE ADAPTIVE APPROACH

ANNEX C: MANAGING RIVER EROSION – THE ADAPTIVE APPROACH

Contents

I. BACKGROUND

A. Preamble

1. One of the three Integrated Water Resources Management pillars is Water Management Instruments. These instruments include water resource assessments, economic instruments, conflict resolution, information management and exchange, as well as strategies and plans. Many of these instruments, among other things, are also linked to disaster risk management. Within Bangladesh river erosion, particularly along the major rivers, is one form of disaster since it impoverishes people who have lost their property, it destroys infrastructure including flood embankments, the latter which in turn creates floods extending the hardship over a broader area, and it paralyzes investments adjacent to these rivers.

2. This annex presents a strategy for mitigating river erosion and is based on experience gained in protecting vulnerable reaches along the Brahmaputra River. This strategy, referred to as an "*adaptive approach*" is relatively low cost but importantly, acknowledges the experience of much more costly approaches to river erosion protection. Namely, that there are no permanent solutions when dealing with rivers of the magnitude of those in Bangladesh. Consequently, there is a need for long-term monitoring of erosion protection works and a requirement that the responsible institutions have both the financial resources and the capacity to implement remedial works on an on-going basis. The strategy evolved from work done as part of the Jamuna-Meghna River Erosion Mitigation Project (JMREMP)[1].

B. Background

3. The *adaptive approach* provides a practical flexible response to riverbank erosion in accordance with the characteristics of major rivers in Bangladesh. The *adaptive approach* breaks with the traditional project-based method of implementing riverbank protection limited to treating a comparatively short reach of the riverbank only after completing all necessary design and approval processes. The difficulty with this traditional approach is reflected in a comment by Dr. Hartmut Brühl, member of the Panel of Experts of JMREMP: "*BWDB needs to adapt to what the river does, simply because the river will not adapt its behavior to BWDB rules and procedures*." In other words, man-made rules and approaches are more effective when they respond flexibly to the vagaries of nature. This is especially true for the difficult conditions of the major rivers of Bangladesh, flowing through one of the largest and most unstable deltas in the world.

4. The *adaptive approach* postulates that riverbank erosion can only be successfully addressed if the four major rivers (Brahmaputra/Jamuna, Ganges, Padma - combined flow of Jamuna and Ganges, and Lower Meghna – combined flow of Upper Meghna and Padma) are considered as an interconnected system of nationwide extent. The approach is not confined to the construction of riverbank protection: it extends to comprehensive management of riverbank erosion covering non-technical as well as technical elements. In detail, the adaptive approach defines the following procedures as required for successful erosion management in a dynamic river environment:

[1] The Jamuna-Meghna River Erosion Mitigation Project was implemented by the Bangladesh Water Development Board with Asian Development Bank financial support. Technical support was provided by Northwest Hydraulic Consultants Ltd, (Canada), Resource Planning and Management Consultants (Bangladesh) and Beller Consultants (Germany).

(i) Erosion management works are implemented under Government approved, rolling multi-year Development Project Pro-forma (DPP) for each of the four major rivers. This allows flexible and fast reaction to acute erosive attacks without requiring separate government approval for protection of each individual eroding area.

(ii) Annual protection work is prioritized based on morphological analysis and prediction of future erosion patterns, identifying critical locations and probable losses in terms of settlements, land, and infrastructure.

(iii) Stabilization of riverbanks is conducted over relatively long reaches, many kilometres in length.

(iv) Regular bankline and river surveys are conducted to follow up on site developments. These follow-up studies play an important role in the planning of adaptation and maintenance works.

(v) Protective work is implemented in a phased manner, which allows a flexible response to continuing river erosion as well as adaptation of the work to the river's actual response to the protection, and simultaneously takes care of required non-technical measures like land acquisition and resettlement.

(vi) A modernized construction system with built-in quality control is implemented, to ensure that all endangered bank areas under water are fully covered with protection. Systematic diving inspection plays a major role in this system.

(vii) Regular coordination is maintained with other organizations such as Inland Water Transport Authorities on issues related to navigation and dredging, in order to minimize negative impacts.

(viii) A wide range of non-technical issues related to riverbank erosion management is regularly addressed, including safeguard issues of environment and involuntary resettlement, disaster risk management, targeted social support to erosion victims, and conservation of fish and marine life.

II. RATIONALE AND CONCEPTS OF THE ADAPTIVE APPROACH

A. Physical Factors

1. River Morphology

5. In many places, the large rivers in Bangladesh are in a process of widening, which results in permanent riverbank erosion, loss of valuable floodplain land and infrastructure, and erosion of flood embankments with sudden devastating flooding during the monsoon season. The location of erosion continually shifts, making erosion protection work difficult to plan and implement (Figure 1).

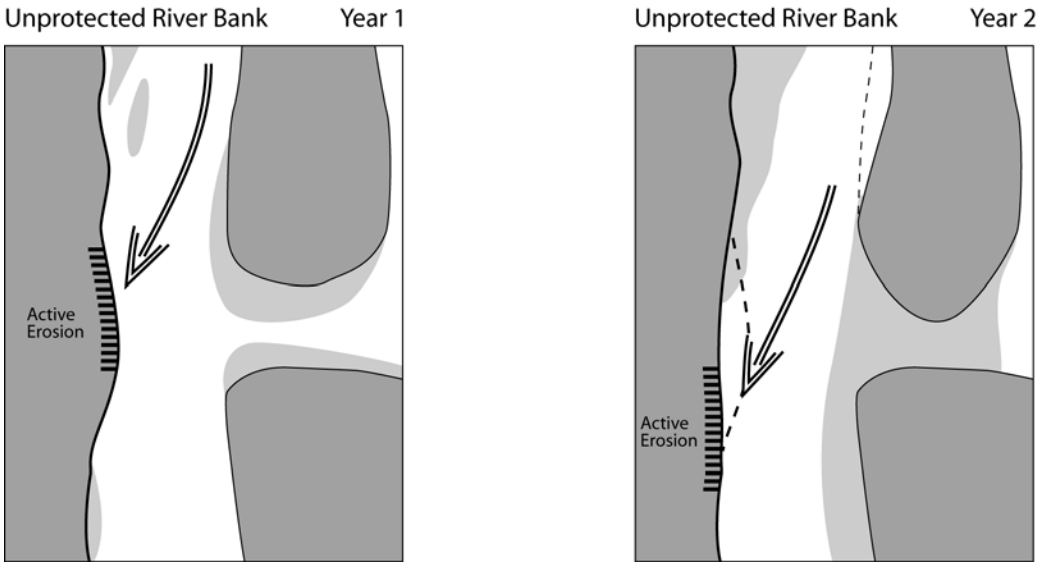

Figure 1: Major rivers are characterized by permanently shifting locations of erosive attacks on riverbanks

6. River behavior cannot be predicted many years in advance, partly because the volumes of monsoon rainfall and the corresponding runoff are unpredictable. Predicting one to two years in advance generally achieves reasonable reliable results, whereas longer-term predictions do not. The constantly changing river patterns often result in bypassing or outflanking river bank protection works.(Figure 2).

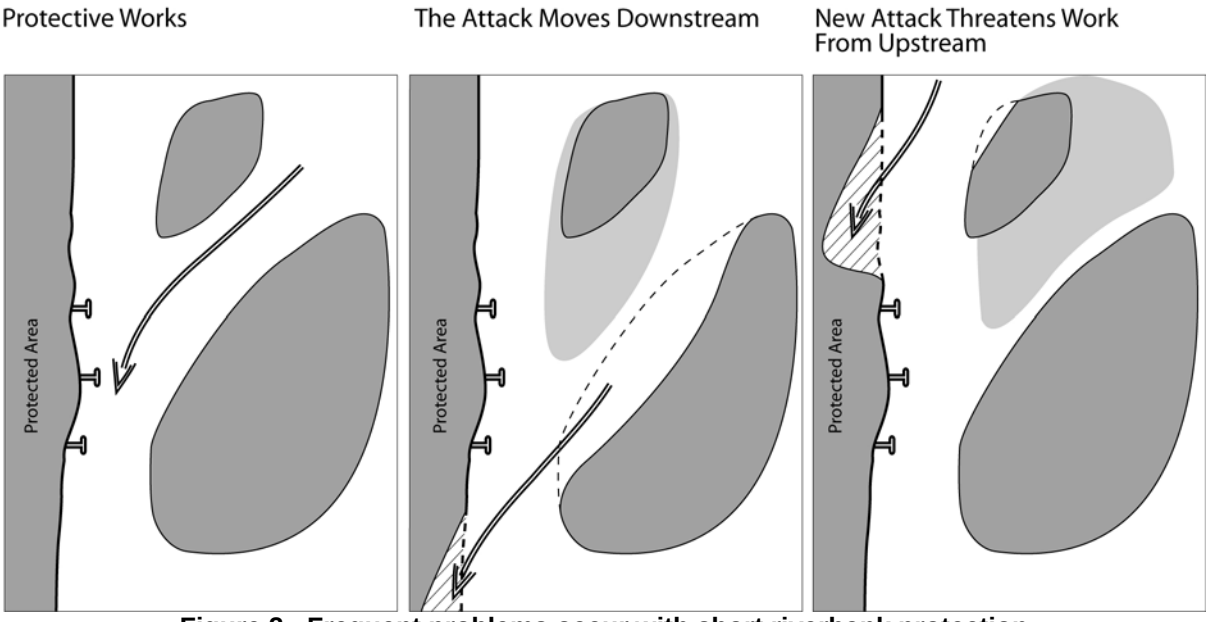

Figure 2: Frequent problems occur with short riverbank protection

2. Erosion Rates and Scour

7. Swift rates of riverbank erosion during a major river attack can undermine existing work without leaving time for adequate reaction. Vertical scour of the riverbed can reach 20 m in less than three weeks (Figure 3). For this reason every protective work requires contingency quantities of protection elements available at the deepest point at the end of the slope. This toe protection is commonly designed as a falling apron (refer to Figure 6). JMREMP used a falling apron at the toe that was 15 m wide and 3 elements thick. This is generally sufficient to protect the slope for up to 20 m of scour.

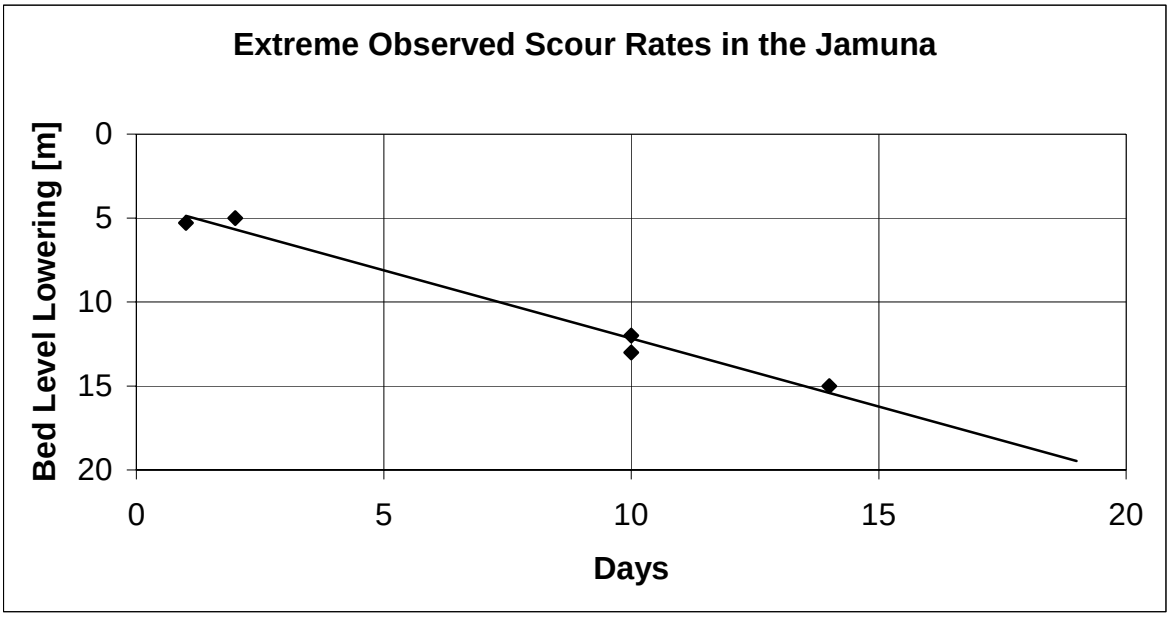

Figure 3: Scour Rates observed at Bank Protection Works (5 m in 1 day, 10 m in 7 days, and so on)

3. Slope Stability for Varying Soil Characteristics

8. Geotechnical slope instability is a common immediate reason for failure of riverbank protection. In the consolidated soils commonly found along river banks, slopes of 1V:2H are at the borderline of stability. In unconsolidated char soils only much flatter slopes of 1V:3.5H or less are stable (Figure 4).

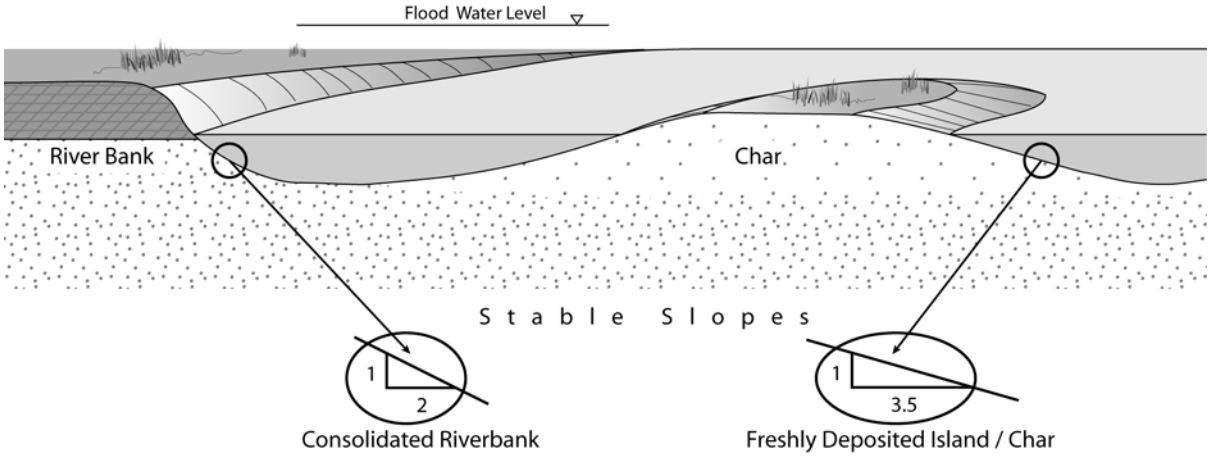

Figure 4: Stable natural slopes along consolidated riverbanks and recently deposited islands / chars

4. Launching Heaps and Falling Aprons

9. Cost-effective riverbank protection commonly relies on the falling or launching principle. Two types of protective systems make use of this principle: (i) Launching heaps, and (ii) falling aprons. The launching heap is a large concentrated stockpile of loose, protective elements like rocks or concrete blocks placed along the native bank line. Once the erosion reaches the stockpile, the loose elements respond to the erosion by sliding down the riverbank providing a protective cover layer (Figure 5). Falling aprons are used to secure riverbank protection works at the toe, often deep under water. While the falling apron also consists of loose elements, unlike the launching heap, these elements are placed as a relatively thin but wide layer (Figure 6). Falling aprons also respond to erosion by their elements sliding down the slope, thus preventing the work from undermining.

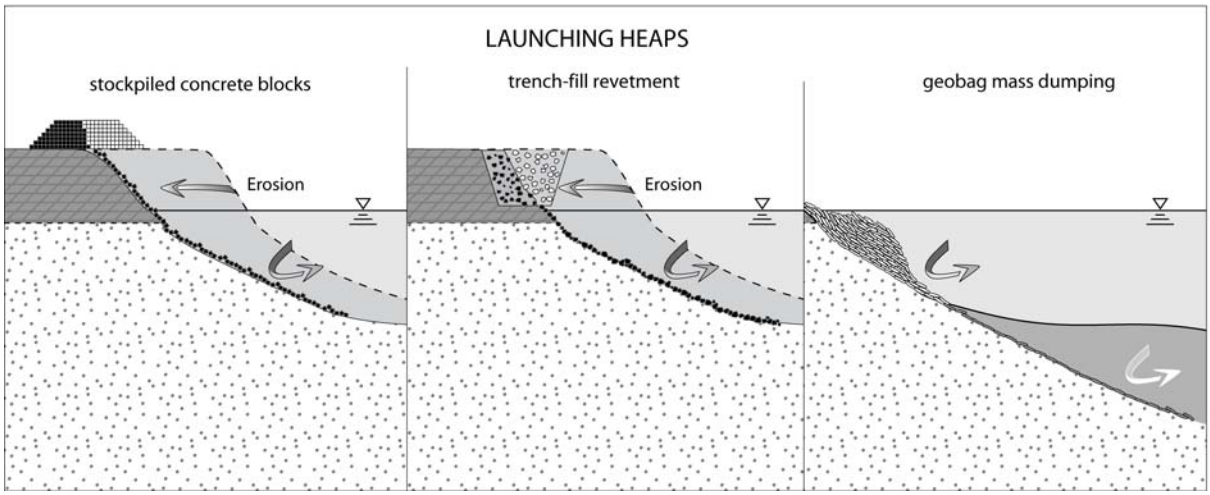

Figure 5: Launching heaps illustrated

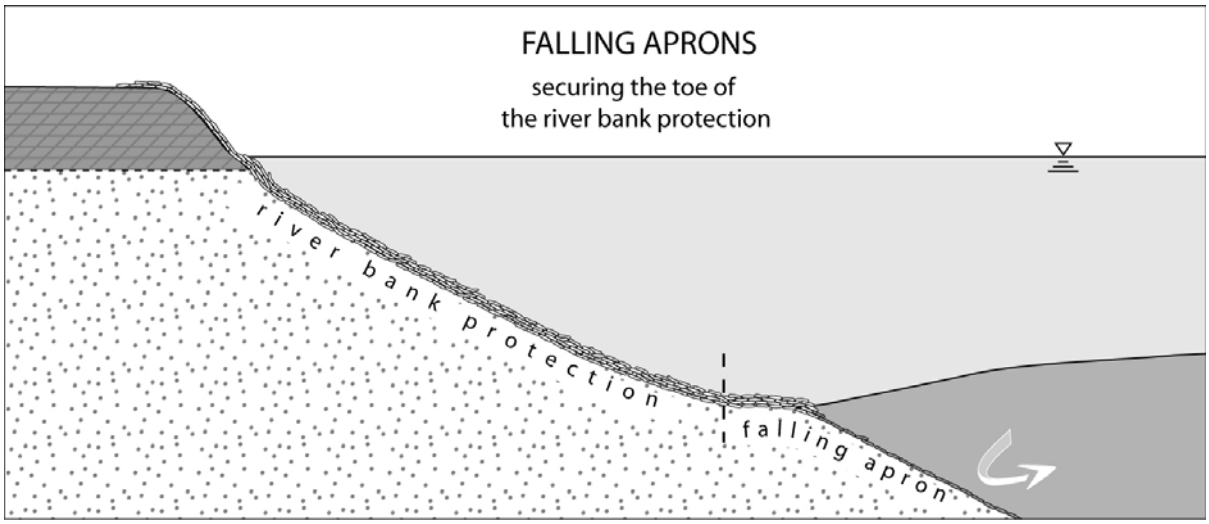

Figure 6: Falling aprons illustrated

10. It is often assumed that after launching protected river slopes are about 1V:2H, but actually they range from about 1V:2.5H for round boulders to 1V:1.5H for cubical concrete blocks (refer for example to Inglis' model tests at Poona, published 1949, and FAP 21 experience in Bangladesh, published 2001). Quarried rock and geobags produce slopes of about 1V:2H (Figure 7). These slopes are at the boundary of geotechnical stability along consolidated riverbanks, but can also be found at greater depth underlying unconsolidated soil strata. The latter implies that deeply placed falling aprons are likely to be more successful, as they launch on more consolidated soils.

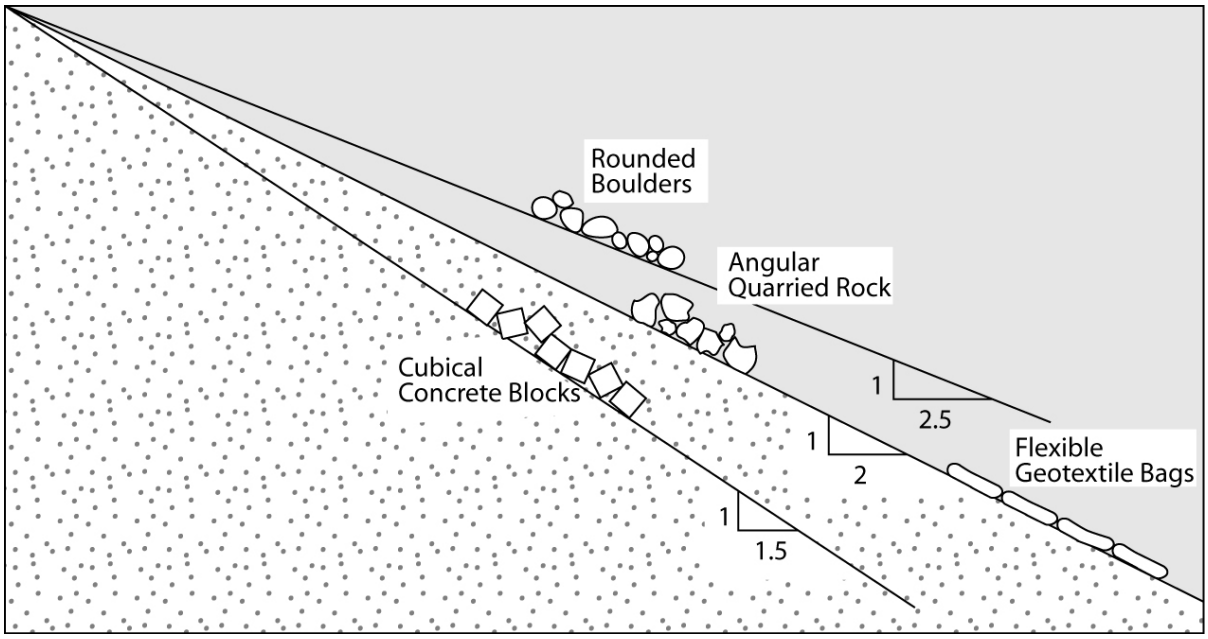

Figure 7: Slope angles for different types of falling aprons.

5. Filters and Covering Thickness

11. Single layers of coarse protective elements placed on fine subsoil are not stable. Even though the currents cannot move the heavy elements, they can remove subsoil through gaps between them, leading eventually to the collapse of the cover layer (Figure 8). The problem is greater the more uniform and the smaller the protective elements are. Traditional design formulas for falling aprons (and launching heaps) aim to provide a cover thickness of 1.5 times the average thickness of the individual protective elements after launching. This is the maximum thickness usually achievable under field conditions, as the launching elements slide easily over the subsoil but not over each other. It is acknowledged that even though falling aprons provide a fast immediate response to riverbank erosion, they require upgrading to provide stable protection.

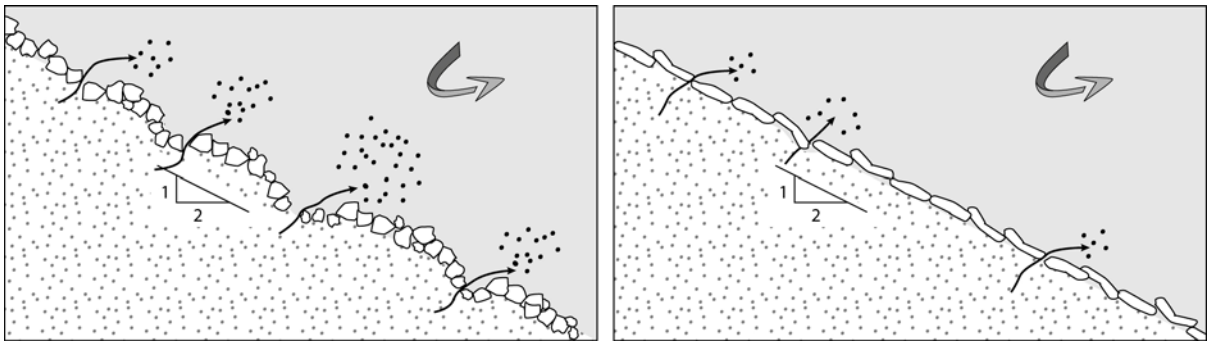

Figure 8: Falling aprons provide about one layer of slope coverage after launching, which is insufficient for long-term protection.

12. Successful long-term stability of a protective layer depends on: (i) having filter material to separate the layer of protective elements from the subsoil, or (ii) placing multiple layers of protective elements.

13. Filter layers are of two types: (i) a dense geotextile filter fabric, or (ii) a granular filter. If no fabric is used, the pores of the granular filter layer need to be sufficiently small such that the finer underlying soil cannot pass through, which often means placing several layers of granular material with gradually increasing grain sizes (Figure 9). Filters are difficult to place in the strong currents often experienced in the main rivers of Bangladesh. For this reason, when using relatively uniform protective elements, multiple layers are often the only technically feasible option, even though they are less cost-effective.

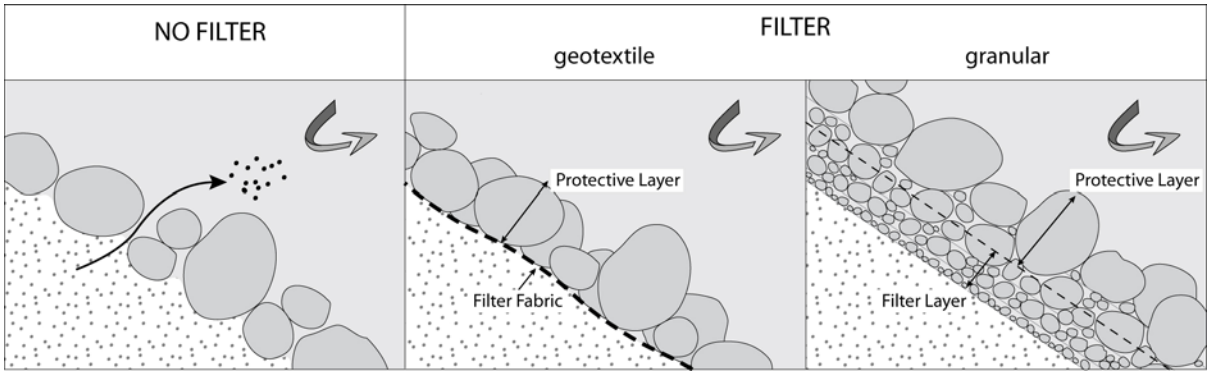

Figure 9: Filter principles

14. In Bangladesh uniform materials are commonly used for riverbank protection. This means that in the absence of filters, the layer thickness needs to be quite large to protect the fine local subsoil from being washed out (Figure 10). Multiple layers can only be provided through direct dumping from the river.

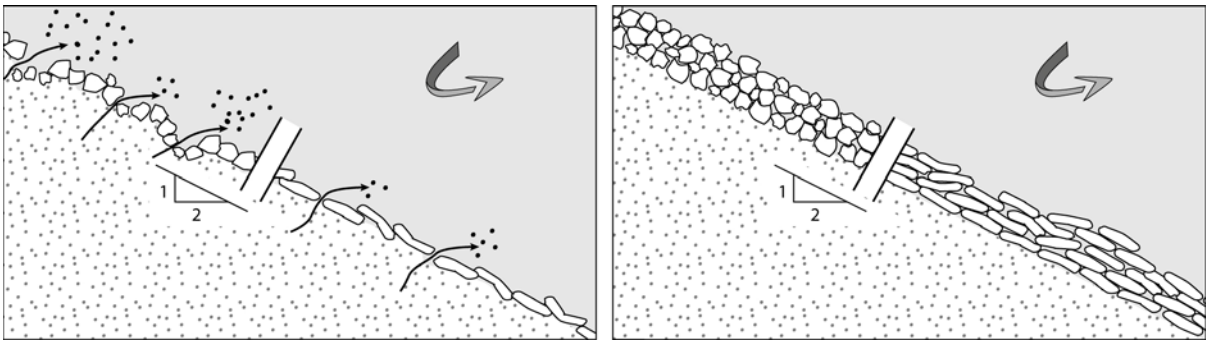

Figure 10: Protection of fine subsoil without filters requires several layers of protective elements as shown with two examples of rock and geobags

B. Administrative Factors

1. Government Approvals

15. Government approval for new work traditionally requires administrative procedures that often take one year or more. In the case of riverbank protection projects, the river has often shifted during this time so that the project may not be required any more because the erosion stopped at the location under consideration. In the meantime new erosion may have started somewhere else, where work would be urgently required but is not approved. This situation calls for a rolling five-year Detailed Project Proforma (DPP) for the major rivers, whereby lump-sum approval is requested for many kilometers of protective work to be implemented in response to erosive attacks at priority locations.

2. Contracts for Procurement and Construction

16. Contracts need to distinguish between (i) procuring protective elements, and (ii) constructing the work. Materials are procured in advance and stockpiled at strategic locations along the river for immediate use in emergencies and for general use for riverbank protection work. Construction contracts distinguish between first protecting the underwater part, and then the part above low water level. The latter work is carried out in subsequent years after the bank has been stabilized.

III. ELEMENTS OF THE ADAPTIVE APPROACH

A. Immediate (or Emergency) Protection – to address acute bank erosion

17. Immediate protection is intended to stabilize the underwater part of the riverbank at locations of sudden and acute erosion. Acute erosion at settlements, flood embankments, or important infrastructure requires a quick response. The best response is to place immediate protection in the form of a heap of loose elements dumped from the riverbank. Erosion undercuts the heap and the loose elements launch down the slope, providing a thin protective layer (Figure 11 and Figure 12). The slope after launching must be geotechnically stable if future instability problems are to be avoided. Consequently, immediate protection is a suitable measure only in consolidated soils where riverbank slopes under the falling apron are already at the border of geotechnical stability. Immediate protection using launching heaps is generally unsuitable on unconsolidated char soils, where direct dumping of primary protection (see below) is the only feasible solution to maintain flat existing slopes.

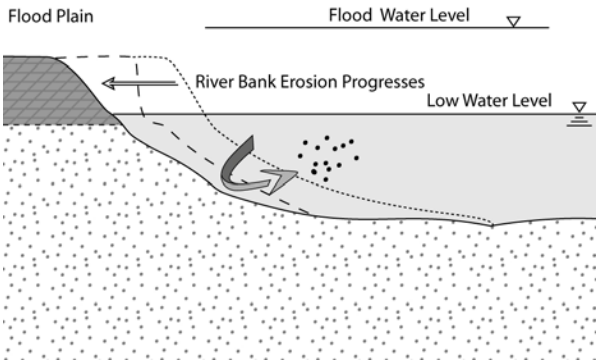

Figure 11: The eroding riverbank

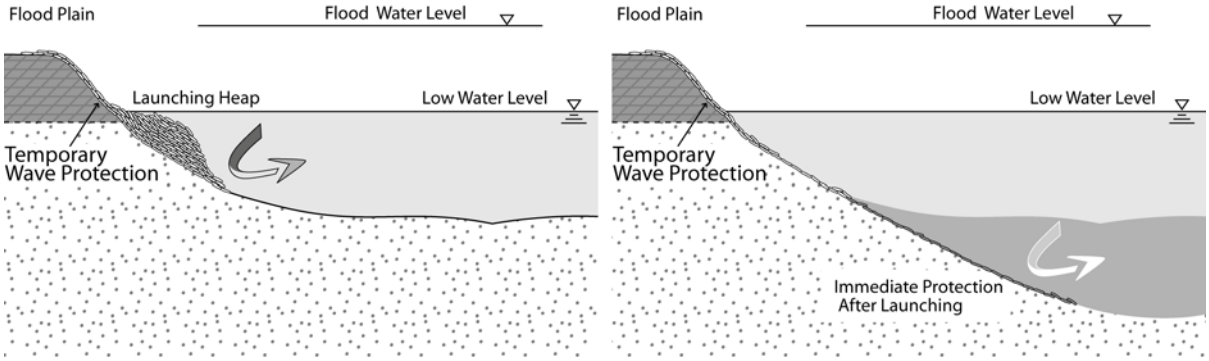

Figure 12: Acute erosion of riverbanks is mitigated through immediate protection

B. Primary Protection – the Main Long-Term Protection

18. Generally within one year after the construction of immediate protection, primary protection is constructed or added to provide a reliable coverage of the thinly launched layer of immediate protection. Primary protection takes the form of relatively long revetments that to a certain extent can respond to future river changes (Figure 13).

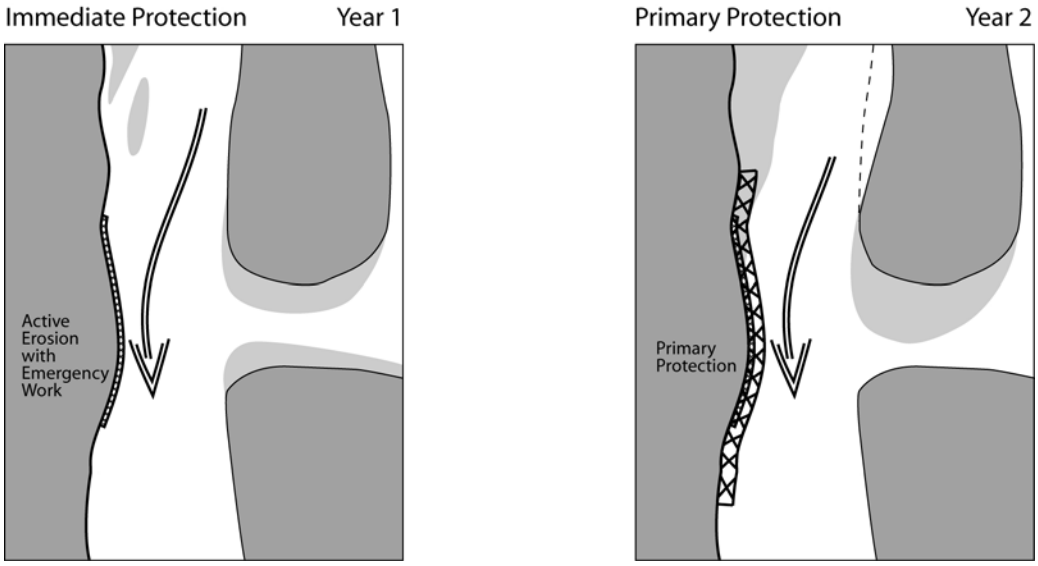

Figure 13: Primary protection should exceed the length of the immediate protection to respond to future river changes

19. The work at the toe of the bank is completed by placing a wide falling apron to prevent undermining of the major protection (Figure 14). To achieve several layers of slope coverage, the work is executed through systematic dumping from the river. The practice adopted in JMREMP was to place, on average, three layers of geobags on to the launched falling apron. However, the work needs to be constructed to suit the actual river situation as surveyed during construction, and then checked for completeness through diving inspections.

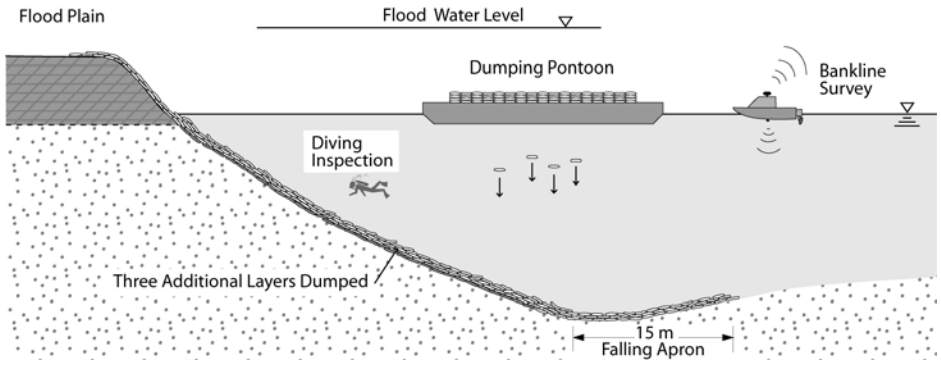

Figure 14: Primary protection stabilizes the bank and prevents future erosion.

C. Monitoring and Adaptation

20. After completing the primary protection, monitoring, evaluation, and adaptation is necessary to respond to ongoing river changes, particularly in terms of depth and shifting of erosive attacks on new areas upstream or downstream of the protected reach. Monitoring and evaluation is of utmost importance during major attacks when the falling apron actively launches (Figure 15). Adaptive protection is provided only where it is required to address ongoing erosion.

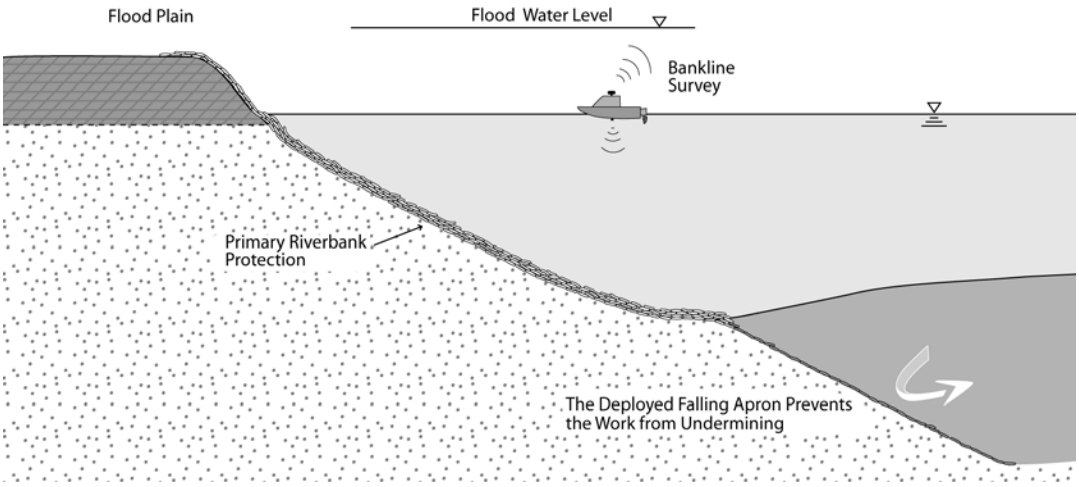

Figure 15: The falling apron built with the primary protection launches and protects the work from undercutting.

21. The duration of this phase depends on the morphological patterns of the river, however experience indicates that it should be continued for at least five years to address a range of issues that can arise during river response to major protective works.

22. Adaptive protection basically involves extending the protection to deeper levels to prevent undermining and failure. Systematic and regular diving investigations can identify weak zones for subsequent spot repair. After addressing land acquisition and resettlement, permanent wave protection above low water is also installed during this phase (Figure 16).

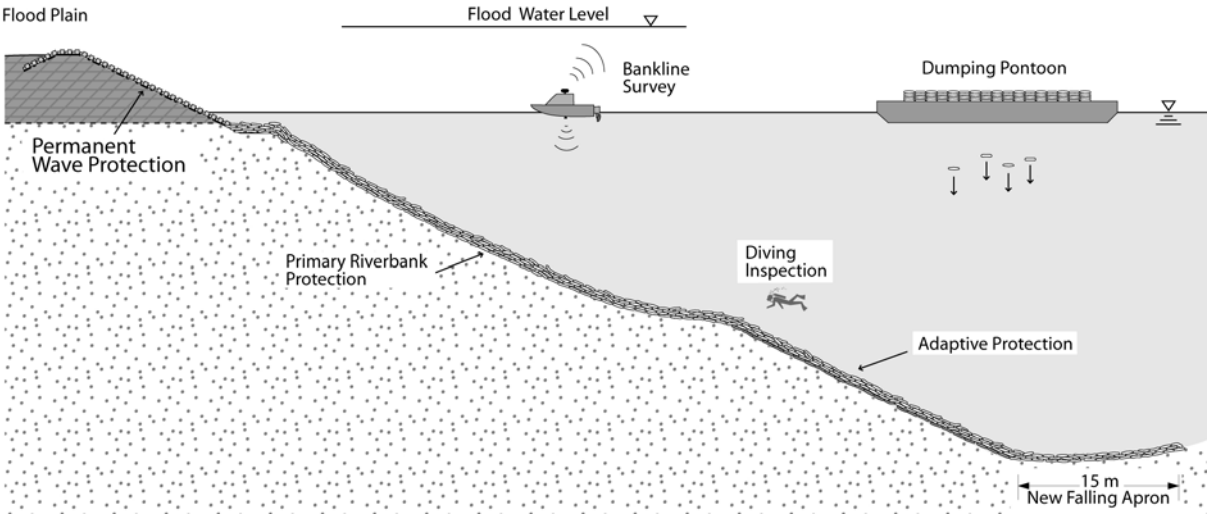

Figure 16: Adaptation of riverbank protection to greater depth. Adaptation work after part of the primary falling apron has deployed provides a berm and additional geotechnical stability.

23. An important point regarding the adaptation process is to initiate adaptive protection before the full 15 m width of the primary falling apron has launched. Leaving an unlaunched berm about 5 m wide can greatly improve the factor of safety against geotechnical slope failure especially when the river becomes very deep.

D. Supplementary Protection – to improve long-term stability

24. Supplementary protection may be constructed after a number of years, to upgrade existing protection that has launched to great depth and is under frequent river attack. It generally takes the form of an extra layer designed to improve sustainability (Figure 17). Supplementary protection is generally built five or more years after starting the protective works and after at least two rounds of adaptation.

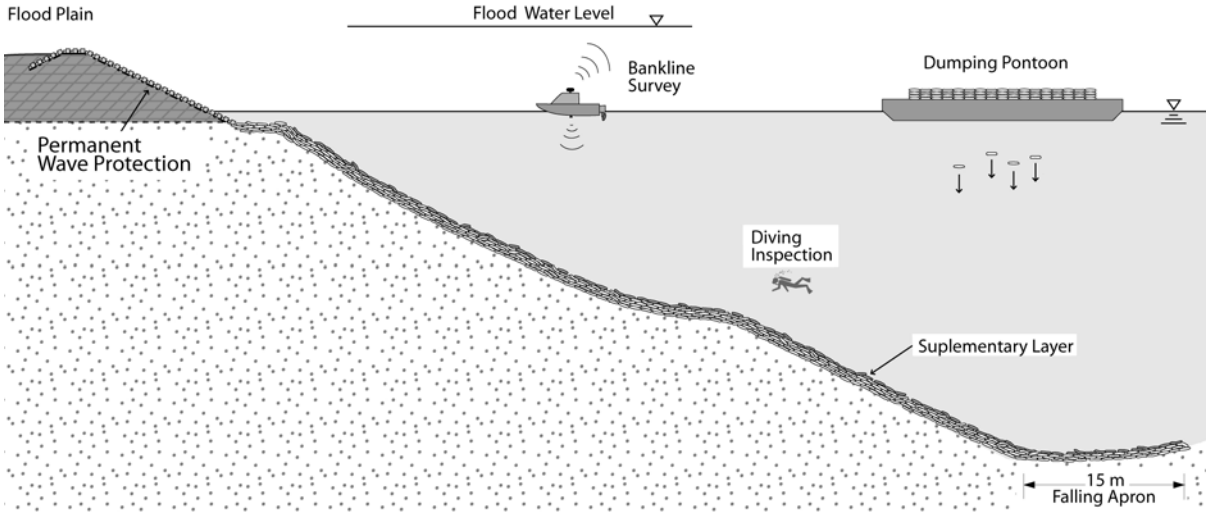

Figure 17: Supplementary protection increases the reliability of protection against future major attacks.

E. Maintenance – keeping the riverbank stable

25. Maintenance should extend over the lifetime of the work. It generally consists of spot repair and adaptation to weaknesses. Maintenance depends on regular river surveys and diving investigations, to identify weak spots and long-term changes to the protective elements (Figure 18).

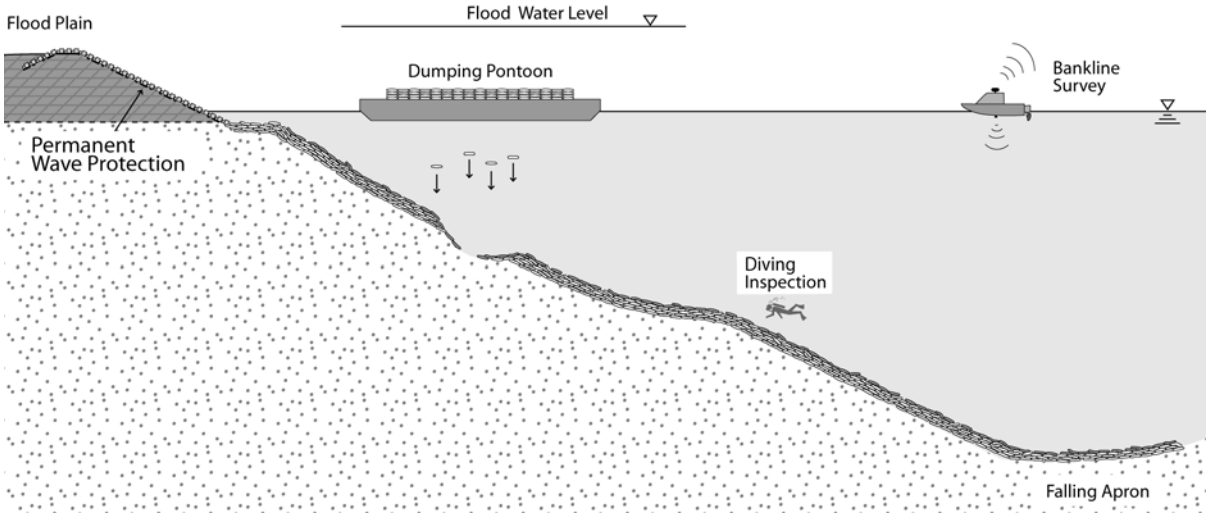

Figure 18: Maintenance depends on bankling surveys and diving inspection for spot repair of problematic zones.

ANNEX D: THE CASE FOR REVISING THE WARPO ACT

ANNEX D: THE CASE FOR REVISING THE WARPO ACT

Contents

I. INTRODUCTION

1. The WARPO Act (1992) announced the creation of a new organization, specified financing arrangements, set out the management structure, and described the organizations mandate. The management structure specified a Board of Directors, an Executive Council, an Executive Director supported by two Directors, and a Technical Committee. The Act then proceeded to deal with powers, responsibilities, and liabilities.

2. Following on from the original mandate as specified in the WARPO Act, several subsequent policies expanded on the role of WARPO. The National Water Policy (1991) assigned responsibilities to WARPO. This was followed by the Coastal Zone Policy (2005), which added to these responsibilities. Mandates coming from these various policies included activities such as: (i) providing clearance to water sector projects, (ii) fulfilling an advisory role to ECNWRC and NWRC, (iii) overseeing the implementation of and ensuring the integrity of the National Water Management Plan, and (iv) implementing an Integrated Water Resource Management concept throughout the country.

3. These additions to the WARPO mandate were never formalized by changes to the WARPO Act with the result that expectations of various stakeholders in terms of the responsibilities, and the authority of WARPO have become somewhat unclear. WARPO has prepared and submitted to the Ministry of Establishment an Organizational Development Plan to strengthen WARPO by enhancing the staffing profile, to clarify their roles and responsibilities, and to demonstrate that they can fulfill the additional responsibilities that they will assume. Nevertheless, it is necessary to review and amend the WARPO Act (1992).

4. To initiate the process of amending the WARPO Act (1992), the Act was reviewed by the RETA Team[1]. This document summarizes their comments and provides recommendations that may be considered in preparing an amended WARPO Act.

[1] RETA refers to a Regional Technical Assistance Team that was fielded by the Asian Development Bank to support WARPO in furthering the process of identifying actions that would promote integrated water resources management.

II. RESPONSIBILITIES ASSIGNED TO WARPO

A. Water Resources Planning Act (1992) Mandates

5. The responsibilities assigned by the WARPO Act (1992) include the following:

(i) To formulate water resources master plans in an environmentally sustainable manner and to develop national water resources.

(ii) To draw up national work plans and policy relating to scientific utilization and conservation of water resources;

(iii) To advise other concerned organizations regarding the development, utilization and conservation of water resources;

(iv) To co-operate with any institution in conducting surveys involved in the development of water resources, utilization and conservation and if necessary, conduct special surveys regarding any such matter;

(v) To evaluate and analyze matters which develop due to the undertaking of measures by any institution involved in development, utilization and conservation of water resources and to advise on such matters;

(vi) To develop standards of education, training and professionalism relating to the utilization of water resources;

(vii) To collect and analyze information regarding the utilization of water resources and to disseminate the same;

(viii) To organize and conduct national seminars, and having obtained the prior approval of the Government, international seminars, conferences and workshops regarding water resources;

(ix) To perform such other functions as may be conferred by the Government regarding water resources.

B. Responsibilities Assigned through the National Water Policy (1999)

6. While not yet formally included within the Act that governs WARPO's activities, the National Water Policy assigns to WARPO the following:

1. Routine Core Services

(x) To establish and maintain the National Water Resources Database (NWRD) and Management Information System.

(xi) Upkeep of water resource assessments

(xii) Monitoring implementation of the National Water Management Plan (NWMP) and its impacts

(xiii) To act as a "clearing house" for all water sector projects identified by different agencies and reporting to the ECNWRC on their conformity to the NWMP.

(xiv) To be the Secretariat to the National Water Resource Council (NWRC) and the Executive Committee of the National Water Resource Council (ECNWRC).

(xv) To respond to ECNWRC and NWRC requests for information and advice.

2. Periodic Services

(i) To manage updating of the National Water Management Plan at regular (assumed 5-year) intervals.

(ii) To contribute to Five Year Plans

(iii) To provide ad hoc advice on policy, strategy, institutional, and legal issues

(iv) To undertake special studies, as may be required from time to time.

C. Responsibilities Assigned by the Coastal Zone Policy (2005)

7. The Coastal Zone Policy requires that WARPO:

(i) Co-ordinates the development initiatives taken by different agencies in the coastal zone;

(ii) Establishes a Program Co-ordination Unit (PCU) at WARPO.

D. Responsibilities Assigned by Others

8. In addition to the foregoing, the National Water Management Plan, and the National Water Resources Council require that WARPO undertake to:

(i) Centrally coordinate and monitor implementation of the National Water Management Plan.

(ii) Develop a Water Management Information System (WMIS), and Monitor and Evaluate the impacts of the National Water Management Plan (NWMP) as well as non-plan projects.

(iii) Prepare and update the National Water Law revising and consolidating the laws governing ownership, development, appropriation, utilization, conservation, and protection of water resources.

(iv) Prepare and update regional and sub-regional plan related to water resources utilization, interventions with in the framework of IWRM.

(v) Prepare and update the National Water Policy (NWPo) and any other policy including regional and sub-regional policy related to Water Resources Management.

(vi) Resolve interagency conflicts related to water development and management and report to ECNWRC;

(vii) Assist with and undertake specialized, multi-disciplinary and cross-sectoral training on Integrated Water Resources Management (IWRM), Information Technology, and other related fields to relevant agencies.

(viii) Maintain assessments of water resources, delineate sub-regions and zones and assist relevant agencies in establishing water stress areas, flood vulnerable areas, zones for brackish aquaculture for planning of new projects and regulations for location of new industries on the basis of water availability, effluent discharge possibilities, and so on.

(ix) Coordinate and monitor and evaluate the implementation of Coastal Zone Policy, the Coastal Development Strategy, and Project Implementation Plans related to Integrated Coastal Zone Management through a Program Coordinating Unit.

III. ANALYSIS AND RECOMMENDATIONS

A. Analysis

1. Functions

9. When WARPO was established in 1992, the functions envisaged were similar in scope to those of the predecessor agency – the Master Planning Organization. Over the course of the subsequent decade with the numerous developments that took place in the water sector, the vision for WARPO came into sharper focus and with that, the expectations of the organization changed. Despite the change in expectations, the mandate provided under the original Act neither included the additional functions, nor provided the resources that would be required to meet these expectations. Consequently, many of these designated functions have never been fulfilled.

10. Arguably, the most relevant, and the most necessary of the functions that expanded on the original Act were those described in the National Water Policy (1999), All of the others are essentially subsets of either the existing mandate of WARPO or of the functions described in the Policy. The Act needs revision to accommodate the functions newly described in the National Water Management Policy. Namely, activities related to a National Water Resources Database, monitoring implementation of the NWMP, and functioning as a "clearing house"[2].

2. Staffing

11. Staffing related issues at WARPO primarily fall into the two categories of funding, and leadership. With regards to funding, the issues are employment conditions and inadequate staffing levels to fulfill the additional tasks that have been described. In short, any revised Act needs to deal with all of these at the same time as it deals with the changing mandate.

12. Of the functions described in the Policy, several of the routine core services require an expanded and specialized staff. Namely, managing the Nation Water Resources Database, and functioning as a "clearing house". The financial implications of providing these core services are:

- Increased funding commitments are required on an on-going basis to support increased staffing levels,
- Improvements in employment conditions are required to ensure that specialist staff can be attracted and retained.

13. Updating the National Water Management Plan, which is a periodic service, requires intermittent support from a range of specialists and these could arguably be provided through contractors (consultants). This has been past practice, however, the effect that this operational modality has had is that funding support to WARPO is adequate during the intermittent periods when these plans are being prepared but funds are inadequate in the intervening periods.

14. As currently framed, WARPO can only offer low (GOB) salaries. Combined with this, there is little opportunity for advancing the careers of the permanent staff that are employed there. The quality of the leadership varies depending on the assigned individual but a general difficulties is that WARPO Leadership is generally assigned from among senior staff of BWDB.

[2] The issues associated with a National Water Resources Database are discussed separately in Annex B

While there is some logic to selecting individuals with such a background in water resources, it does not reinforce the separation between policy and implementation and does not encourage other water planning and using agencies to interact with WARPO.

3. Positioning WARPO

15. Altogether there are some 35 central Government organizations, affiliated with 13 different Ministries that are relevant to the water sector. While the Ministry of Water Resources, as the focal Ministry for managing water resources, clearly has a key role in policy, planning, and financing interventions in this sector, there are significant elements of the water sector over which this Ministry has limited knowledge or control. Since IWRM is a comprehensive approach to the development and management of water, it follows that the national agency responsible for the coordinated planning of water across all sectors should not be situated under one of the sector ministries.

16. Alternatives to the current structure, in which WARPO is situated under the Ministry of Water Resources would be locating the Organization either within the Prime Ministers Secretariat or within the Ministry of Planning. In either case, the outcome would be:

- A clear separation between policy, planning, and implementation.
- Improvement in the ability of WARPO to monitor the implementation of the National-level water Management Plans.
- Generally improved access to information from the various water using organizations.

4. The Case for Change

17. WARPO needs to become a national center of excellence for water management planning. To some extent WARPO, after supporting the delivery of a comprehensive and integrated National Water Management Plan, has again relinquished into an extended period with few accomplishments and as such has fallen short of expectations for some of the following reasons:

- The Organizations mandate has been altered and expanded but without a commensurate increase in staffing.
- Guidance provided by the ECNWRC has been limited as have the meetings of the ECNWRC.
- Day-to-day management has had an organizational vision that is short-term and generally limited to engineering.
- Leadership has been seconded from among the senior management of BWDB. These appointments are considered secondary to leadership positions within BWDB itself, and do little to separate policy and planning from implementation.
- Employment conditions are not conducive to recruiting and retaining qualified specialized staff that would provide technical leadership and technical excellence in a national planning exercise. There is ample successful experience (CEGIS and IWM) of alternative models for restructuring WARPO, which would address many of the employment and leadership issues.

18. Three broad qualitative criteria for an institution of excellence have been identified as:[3] (i) has the institution survived for a long period without compromising its mission and goals, (ii) is it perceived by its environment and interested public as having intrinsic value, and (iii) has it begun to act in some ways, as a standard setter, an exemplar, for other institutions in its particular field. WARPO scores relatively well on the first in that its mission and goals have been clearly defined within the original Act (1992). The subsequent changes that were introduced were rational and consistent with the original mandate. The responsibility for the failure to provide support to WARPO such that the additional tasks could be carried out belongs elsewhere. In regards the second criteria, WARPO is perceived by stakeholders as having intrinsic value. This is best evidenced by the key role defined for WARPO in dealing with one the nations most important natural resources - water. However, WARPO has clearly not evolved into an exemplary institution and the challenges associated with this are considerable.

B. Recommendations

19. The key recommendation is that the WARPO Act (1992) be revised. A revised WARPO Act needs to consider:

- Broadening the mandate of WARPO to accommodate the various task that have been identified for WARPO subsequent to the original mandate,
- Re-positioning WARPO within the Governments institutional framework to a location that more appropriately reflects the responsibilities of WARPO as the national water planning agency ensuring that planning is integrated across multi-sectors, that the implementation of the plans is monitored, and that policy and planning is separated from implementation.
- Lessons learned and experience from the manner in which CEGIS and IWM were established and financed to ensure that adequate financing is made available and to provide an operational modality that accommodates the needs of highly qualified technical specialists that are needed for WARPO to properly fulfill its mandate.
- Establishing a mechanism for appointing leadership in which merit, commitment, and interest are deciding factors.

20. The potential exists for WARPO to become the organization that was envisaged. An organization that provides strong direction and leadership to the development of water resources. However, a range of specific actions are required for that goal to become a reality. Revising the WARPO Act would be a first step, subsequent steps would be largely within the hands of the leadership provided to the organization.

[3] "Launching Knowledge-Institutions of Excellence in national Water Sectors: Lessons from 50 years of Indian Experience in Institution Building", Tushaar Shaw

ANNEX E: TOWARDS AN UPDATED NATIONAL WATER MANAGEMENT PLAN

ANNEX E: TOWARDS AN UPDATED NATIONAL WATER MANAGEMENT PLAN

Contents

ATTACHMENT

I. INTRODUCTION

A. Background

1. The National Water Management Plan (NWMP) was finalized in 2001 and finally approved by the National Water Resources Council (NWRC) in March 2004. The Plan provides a framework within which all concerned with the development, management, and use of water resources and water services in Bangladesh can plan and implement their own initiatives/activities in a coordinated and integrated manner, confident that in doing so they are contributing to achievement of the national goals. The plan's conceptual framework is founded on an assessment of needs, opportunities and constraints throughout the sector. The assessments made during Plan preparation have highlighted the spatial and sub-sector diversity of water resources.

2. The National Water Policy suggests that the Plan should be updated every five years to ensure that it continues to address Government priorities and remains in line with the Poverty Reduction Strategy (PRSP), the Millennium Development Goals (MDGs), and that the Plan addresses any new or outstanding issues not previously covered.

B. Document Purpose

3. The purpose of this document is to provide input to planning and operationalizing a review of the NWMP, to contribute to the NWMP update process, and to further actions that promote integrated water resource management. To accomplish this, the RETA team worked with the Water Resource Planning Organization (WARPO) to review issues that are relebvant to this process.

II. NATIONAL WATER MANAGEMENT PLAN

A. Overview

4. The Government of Bangladesh set out the National Water Policy (NWPo), outlining a holistic and integrated approach towards sustainable water resources management in Bangladesh. The policy recognizes the central participatory role of local stakeholders in all activities in this sector and details the responsibilities of various water service agencies and institutions. Approval of the NWPo in 1999 was followed by a series of actions to operationalize the policy. One of the key actions was to prepare the NWMP.

5. The National Water Management Plan was prepared with three central objectives that were consistent with the National Water Policy and with National goals as expressed through other strategic planning documents including the Millennium Development Goals, the Five Year Plan[1]. The objectives are:

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

6. The Plan is presented over three time horizons: short term (2000-05), medium term (2006-10) and long term (2011-25) perspective plan. The three main categories of programmes are cross-cutting programmes, National-level programmes, and Regional-level program. The Plan presents 84 programs grouped into eight clusters and provided an indicative cost of US$18 billion.

B. Plan Contents

1. Institutional Development

7. The evolution of the institutional framework was expected to have mostly taken place by 2011 years and was expected to bring about[2]:

- 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 decentralized 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 the Zila level and below being carried out by a mix of LGIs, community-based organizations and the private sector
- The municipalities progressively taking over full responsibility for providing their own water-related services supported by the private sector.

[1] The Poverty Reduction Strategy was introduced at a later date.

[2] Excerpted from the National Water Management Plan, Annex B: Development Strategy

8. These changes were expected to result from a series of 10 programmes. The programmes and the current known status of these programmes is described later in this chapter.

2. Creation of an Enabling Environment

9. The main aim of this cluster is to provide 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. Tasks identified to accomplish this included:

- strengthening legislation;
- strengthening the research and information management system;
- defining zones for planning and regulatory purposes and developing guidelines and procedures to ensure appropriate standards are met and practices are followed;
- strengthen the processes for involving all stakeholders in planning and management of water resources;
- promoting private sector participation in the water sector;
- strengthening demand management in the water resources sector by developing more robust regulatory and economic instruments; and,
- ensuring the availability of and access to adequate investment resources.

3. Main River Development

10. This cluster aims to ensure that the main river systems are comprehensively developed and managed for multipurpose use through measures that include a system of barrages and other structural and nonstructural measures. The activities that would achieve these aims focus on:

- Studies to asses inter-regional potential developments, to investigate the potential for developing the waters of the Brahmaputra to meet medium and long term requirements, and to review and update the master plan for erosion control in the Brahmaputra.
- Surface water resources development for multi-purpose use.
- River management and erosion control.
- Hydropower development in the Eastern hills and in conjunction with barrages when they are constructed.

4. Towns and Rural Areas

11. This cluster aims to satisfy the increasing demand for safe drinking water and sanitation in towns and rural areas. In addition, towns are to be provided with adequate flood protection and storm water drainage. Targets are presented in table 1.

Table 1: Indicative Targets for Towns and Rural Areas

	2010	2025
Water Supply		
Provision of Arsenic Mitigation Facilities	100%	100%
Access to Safe Water for basic needs	100%	100%
Provision of Household piped water (towns)	70%	90%
Provision of household piped water (rural)	10%	40%
Water quality surveillance	60%	100%
Sanitation		
Access to appropriate sanitation	100%	100%
Provision of household water borne sanitation (towns)	30%	70%
Provision of household water borne sanitation (rural)	10%	20%
Private Sector Participation		
Town water supply and sanitation	15%	25%
Rural Water supply and sanitation	95%	95%
Flood Protection & Storm water Drainage (towns)		
Provision of flood protection in towns	75%	100%
Provision of storm water drains in towns	40%	70%

Source: National Water Management Plan

5. Major Cities

12. This cluster includes programmes for Statistical Metropolitan Areas, namely Dhaka, Chittagong, Khulna, and Rajshahi. The population of these cities is expected to triple over the next 25 years. The programs include (i) bulk water supply; (ii) sanitation and sewerage systems; and (iii) flood protection and storm water drainage. Significant technical assistance to promote institutional and financial reforms is also envisaged, which could include integrated land and water resources planning and management; commercialization of the urban water and sanitation sector to encourage private sector participation through management contracts, Build Operate, Transfer schemes, and concessional agreements; introduction of market-oriented financial systems, and establishment of an appropriate regulatory framework. Indicative targets for the major cities are provided in Table 2.

Table 2: Indicative Targets for Major Cities

	2010	2025
Water Supply		
Access to safe water fro basic needs	100%	100%
Provision of Household piped water	75%	90%
Sanitation		
Access to appropriate sanitation	100%	100%
Provision of household water borne sanitation	70%	85%
Flood Protection & Storm water Drainage		
Provision of storm water drains	70%	100%

Source: National Water Management Plan

6. Disaster Management

13. This cluster acknowledges that some people will always be at risk but aims to provide the means by which through a combination of structural and non-structural measures and to the extent feasible people are adequately warned of an approaching disaster, are equipped to survive the disaster with as much as possible of their assets intact, and receive adequate

support for rebuilding their lives in the aftermath. Key activities include: (i) cyclone protection through construction of shelter-cum-schools in areas of highest risk at appropriate density; and (ii) flood proofing for the rural population in the low-lying haor basins, in the char lands, combined with raising key roads, (iii) riverbank maintenance and erosion management, (iv) development of reliable drought forecasting and warning systems.

7. Agriculture and Water Management

14. This cluster aims to support the expansion and diversification of agricultural production and the maintenance of food security. The water sector contribution is to remove constraints caused by shortage or excess of water. The programs places primary focus on the continued expansion of minor irrigation development through groundwater and low-lift pumps, mainly through private sector investments. Other programs include: (i) developing public irrigation systems by improving the performance of existing BWDB irrigation schemes, expanding existing schemes, and constructing new schemes, (ii) river improvements, (iii) rationalizing existing flood control and drainage infrastructure. Coastal studies supported by some level of reclamation is also envisaged.

8. Natural Environment and Aquatic Resources

15. The main aims of this cluster are to provide clean water for multipurpose use on a sustainable basis, restore and maintain fish habitats, preserve wetlands, and protect the aquatic environment. The latter by institutionalizing environmental impact assessment and management procedures. Three key areas of focus have been identified: (i) water pollution and control including the preparation and implementation of a national pollution control plan; (ii) water management for fisheries by formulating and implementing a national fisheries master plan and constructing fish passes, (iii) water management for ecologically sensitive areas by improving water and environmental management of critical areas including the Sundarbans and the Haor basin, (iii) Mass mobilization through public awareness and empowerment programs to ensure that planning and implementation is sustainable, and (iv) Institutional reforms and strengthening of the concerned organizations.

III. NATIONAL WATER MANAGEMENT PLAN IMPLEMENTATION STATUS

A. Background

16. WARPO is responsible for monitoring progress and updating programs of the NWMP. This work is assigned to the Monitoring and Evaluation Section of WARPO. As originally envisaged, the Monitoring and Evaluation Section was to consist of one Principal Scientific Officer, one Senior Scientific Officer and two Section Officers. While even this level of staffing is insufficient for the amount of work that is required to monitor a the broad range of activities that the NWMP specifies, the Monitoring and Evaluation Section currently consists of only one Principal Scientific Officer without any technical support. The Principal Scientific Officer was assigned very recently while prior to this, the Monitoring and Evaluation Section has essentially been dormant.

17. WARPO recognizes that the implementation status of the NWMP provides, among other things, an important baseline for updating the NWMP. Accordingly, WARPO requested 11 water-related Government agencies for the status of work that had been carried out in relation to the NWMP. Only BWDB and LGED responded. Many of these agencies have their own sector development plans and monitor their work against those plans. As well, WARPO has not been proactive in pursuing this information in part because of staff limitations and has little authority to require that the information be provided. In reviewing the NWMP in 2003, ADB noted that "Once [the plan] is launched, its implementation needs to be continually monitored, and its contents regularly enriched and expanded on the basis of relevant sector operations"[3]. This has not happened.

18. What follows is a somewhat generalized and subjective review of the status of the individual programmes that were defined in the NWMP. This notwithstanding, it is clear that effort needs to be directed towards an improved understanding of what parts of the NWMP have been completed and what remains but perhaps more importantly, to document the experience and lessons learned from the work carried out to date.

B. NWMP Implementation Progress

1. Institutional Capacity Building

19. Table 3 summarizes implementation progress of the cluster related to Institutional Change.

Table 3: Status of Institutional Capacity Building Cluster

MIS REF	Title	Key Programme Objective	Progress
ID 001	Local Government Needs Assessment for water Management	Outline management structure, procedures and human resources requirements for local water sector development and management by LGI's agreed by all stakeholders.	No progress.
ID 002	Independent Regulatory Bodies for Water Supply and Sanitation Service Sector	Independent regulatory bodies for water supply and sanitation services established and fully functional	No data.

[3] ADB, Nov 2003, Water Sector Roadmap: Bangladesh

ID 003	FCD and FCD/1 Management Rationalization	100% of transferred FCD/1 schemes considered sustainable under decentralized management by programme year 16	In progress. Options for management transfer of large scale schemes are being assessed under the Command Area Development II Project.
ID 004	BWDB Regional and Sub-regional Management Strengthening	BWDB internal organization structured to plan, develop and manage river improvement programmes with established capacity	Some progress. Through the Jamuna-Meghna River Erosion Mitigation Project two River Erosion Mitigation (REMs) teams have been set up.
ID 005	Local Government Capacity Building for Water Management	LGI water management operational capacity consistent with the needs of decentralized water management in Bangladesh	In progress. Some water management training provided to LGIs through the Second Small Scale Water Resources Development Sector Project.
ID 006	WARPO Capacity Building	WARPO established as a centre of excellence	Limited progress. An Organizational Development Plan is in process.
ID 007	Department of Environment Capacity Building	Department of Environment capacity building programme completed	In progress with various donor agency support.
ID 008	Disaster Management Bureau Capacity Building	Disaster Management Bureau capacity building programme completed	In progress with various donor agency support.
ID 009	Capacity Building for other Organizations	Reliable predictions of extreme climatic events (both short and long term), and morphological changes; and effective wetland management procedures	Some progress on reliable predictions of extreme climatic events. Considerable progress on morphological predictions (CEGIS),
ID 010	BWDB Capacity Building	BWDB capacity building programme completed	In progress.

2. Enabling Environment

20. Table 4 summarizes implementation progress of the cluster related to the Enabling Environment.

Table 4: Status of Enabling Environment Cluster

MIS Ref	Title	Key Programme Objective	Progress
EE 001	Support to the Preparation of New Legislation	Final Draft National water Code establishing GoB's obligation to manage water as a public good while facilitating the participation of equitable, well regulated, community based organizations presented to Parliament	Preparation of a National Water Code, which brings together all existing legislation, is pending.
EE 002	Field Testing of Participatory Management Models	A range of appropriate and replicable institutional models for decentralized water management in Bangladesh	Considerable progress through a range of projects. More effort needed to share best practices.
EE 003	Water Resources Legislation – Preparation of Supporting Ordinances	An easily understood legal framework for water sector development and management	Final draft of a National Water Act has been readied for submission to Parliament.
EE 004	Project Preparation Procedures – Guidelines and Manual	Water sector programme and project preparation regulated by an approved set of guidelines and manuals	Numerous guidelines and manuals have been prepared though additional work is required for major schemes.
EE 005	Regulatory and Economic Instruments	Regulatory and Economic instruments in force	Partially addressed through the National Water Act.
EE 006	Field Testing & Finalization of Guidelines for Participatory Water Management	Guidelines for Participatory Water Management applied to all relevant programmes and projects	Are being applied.

MIS Ref	Title	Key Programme Objective	Progress
EE 007	NWRD Improved Data Collection and Processing Facilities	All water sector reports archived in digital format and available to all users in hard or soft copy	In progress
EE 008	Water Resources Management Research and Development Studies	Research playing a Key role in NWMP updates	Limited progress on some of the ten specific research progress.
EE 009	Water Resources Management Long Term Research and Development	Bangladesh's water sector considered to represent a regional center of research excellence	No progress.
EE 010	Raising Public Awareness in the Wise Use and Management of Water	Effective public demand for sustainable water resources management	The specialist Unit to lead this was not set up in WARPO. As designed, no progress.
EE 011	Private Sector Participation in water Management	Full but regulated access to water sector investment and service delivery opportunities to the private sector	In progress. Some progress in WSS sector. Options being explored for major surface water schemes.
EE 012	Water and Environment Funds	Increased pollution clean up and arsenic mitigation catalyzed by grants and subsidies	No progress.
EE 013	Alternative Financing Methods for Water Management	Increasing use of non-traditional financing for water sector development and management	Limited progress.

21. Overall, there has been progress in relation to the specific programmes that were designed to strengthen the enabling environment. However, accomplishments resulted from programme related tasks being added to specific investment projects rather than a concerted and focused effort driven by the Government administration including WARPO.

3. Main Rivers

22. Table 5 summarizes implementation progress of the cluster related to the Main Rivers.

Table 5: Status of Main Rivers Cluster

MIS REF	Title	Key Programme Objective	Progress
MR 001	Main River Studies and Research Programmes	A sound basis for strategic decision-making and the planning of future Main River development accepted by the due authorities	Limited progress. 6 studies were identified with partial progress made on GDA, and major river training.
MR 002	Main River Abstraction Projects	Increased irrigated areas, environmental health, navigability and other conditions	No progress.
MR 003	Ganges Barrage and Ancillary Works	Increased dry season water availability in the GDA in Bangladesh	Government initiated feasibility study.
MR 004	Meghna Barrage and Ancillary works	Increased dry season water availability in the NE and SE regions	No progress.
MR 005	Brahmaputra Barrage and Ancillary Works	Increased dry season water availability in the NW, NC and NE regions	No progress.
MR 006	Regional River Management and Improvement	Sustainable river development and management works	Some progress. Morphological forecasting and mapping of infrastructure carried out by CEGIS.
MR 007	Ganges Dependent Area Regional surface Water Distribution Networks	Increased dry season water availability in the GDA in Bangladesh	No progress.
MR	North East and south	Increased dry season water availability	No progress.

MIS REF	Title	Key Programme Objective	Progress
008	East regional surface water Distribution Networks	in the Northeast and Southeast Regions	
MR 009	North Central and North West Regional Surface Water Distribution Networks	Increased dry season water availability in the Regions	No progress
MR 010	Main Rivers Erosion Control at Selected Locations	Socio-economic impacts of erosion minimized	In progress. BWDB has developed a relatively low cost adaptive approach to mitigate erosion.
MR 011	River Dredging for Navigation	Navigation traffic enabled	Limited progress. Maintenance of waterways has received low priority.
MR 012	Hydropower Development and Upgrading	Profitable hydropower generation	No progress

23. Many of the programmes in this cluster are medium to long term developments and as such, minimal progress would be expected. Implementing this cluster is also relatively capital intensive representing almost 25 percent of the overall NWMP budget. With donor financial commitments limited, Government has not been in a position to proceed on many of these initiatives.

4. Towns, Rural Areas, and Major Cities

24. Tables 6 and 7 summarize implementation progress of the clusters related to the Towns and Rural Areas and the Major Cities.

Table 6: Status of Towns and Rural Areas Cluster

MIS Ref	Title	Key Programme Objective	Progress
TR 001	Urban Arsenic Mitigation	Arsenic free potable water available to 100% of large and small town populations	See text below
TR 002	Rural Arsenic Mitigation	Arsenic free potable water available to 100% of rural population	See text below
TR 003	Large and Small Town water Supply and Distribution Systems	100% of large and small town population have access to formal water supplies	See text below
TR 004	Rural Water Supply and Distribution systems	100% of rural population has access to formal water supplies	See text below
TR 005	Large and Small Town Sanitation and sewerage System	100% of large and small town populations have access to sanitation facilities	See text below
TR 006	Rural sanitation	100% of rural populations have access to sanitation facilities	See text below
TR007	Large and Small Town Flood Protection	All large and small towns protected from 1:100 year floods	Some progress. The Secondary Towns Improvement Project is providing flood protection among other things to selected towns.
TR 008	Large and Small Town Storm water Drainage	Storm water drainage installed in all large and small towns	Some progress. Secondary Towns Improvement Project.

Table 7: Status of Major Cities Cluster

MIS REF	Title	Key Programme Objective	Progress
MC 001	Inventory and Asset Management Plan of Water Supply & Sanitation Sector	Detailed development plan for water supply and sanitation facilities in the Statistical Metropolitan Area's	In progress
MC 002	Dhaka Bulk water Supply and Distribution systems	100% of Dhaka's population have access to formal water supplies	About 70% served.
MC 003	Chittagong Bulk Water Supply and Distribution Systems	100% of Chittagong's population have access to formal water supplies	About 55% served
MC 004	Khulna Bulk Water Supply and Distribution Systems	100% of Khulna's population have access to formal water supplies	About 51% served
MC 005	Rajshahi Bulk Water Supply and Distribution Systems	100% of Rajshahi's population have access to formal water supplies	About 40% served
MC 006	Dhaka Sanitation and Sewage System	100% of Dhaka's population have access to sanitation facilities	About 27% connected to the public sewer system
MC 007	Chittagong Sanitation and Sewage System	100% of Chittagong's population have access to sanitation facilities	No data
MC 008	Khulna Sanitation and Sewage System	100% of Khulna's population have access to sanitation facilities	No data
MC 009	Rajshahi Sanitation and Sewage System	100% of Rajshahi's population have access to sanitation facilities	No data
MC 010	Dhaka Flood Protection	Dhaka protected from 1:100 year flood	No data
MC 011	Dhaka Storm water Drainage	Dhaka served by storm water drainage	In progress
MC 012	Chittagong Flood Protection	Chittagong protected from 1:100 year flood	No data
MC 013	Chittagong Storm water Drainage	Chittagong served by storm water drainage	No data
MC 014	Khulna Flood Protection	Khulna protected from 1:100 year flood	No data
MC 015	Khulna Storm water Drainage	Khulna served by storm water drainage	No data
MC 016	Rajshahi Flood Protection	Rajshahi protected from 1:100 year flood	No data
Mc 017	Rajshahi Storm water drainage	Rajshahi served by storm water drainage	No data

25. More than 50 percent of the urban population has access to piped water supply. About 100 of the over 250 municipal towns have piped water supply. The piped water system in Dhaka serves 70% of the population while Chittagong, Khula, and Rajshahi serve 55%, 51%, and 40% respectively. These systems primarily serve the urban core. Peri-urban and slum areas continue to relay on tube wells. While this level of progress falls short of NWMP targets, the agenda is moving forward. Expediting the programme requires that:

- major investments to meet the growing demand for water
- local governments, the private sector, and civil society have greater involvement to improve service levels in water supply,
- service coverage be expanded to reach disadvantaged social groups, and
- drinking water quality be monitored.

26. The goal of achieving total sanitation by 2010 was announced by Government in 2003 as the objective of the Total Sanitation campaign and this was roughly consistent with the sanitation goals set out in the NWMP. Since then, Government considers that national sanitation increased by 15%. Sanitation in urban areas have been slower than rural initiatives, in part because of the burgeoning urban population. It is estimated that only about 27% of the population in Dhaka is connected to the public sewer system. To achieve the targets set out for the provision of and access to sanitation facilities, increased levels of financial resources will need to be allocated and the use of simple pit latrines as a solution of choice in urban areas and flooded areas needs to be reconsidered.

5. Disaster Management

27. Table 8 summarizes implementation progress of the clusters related to Disaster Management.

Table 8: Status of the Disaster Management Cluster

MIS Ref	Title	Key Programme Objective	Progress
DM 001	Cyclone shelters and Killas	775 multi-purpose shelters and 1369 killas constructed in cyclone prone areas	In progress
DM 002	Bari-level Cyclone Shelters	43,776 bari-level cyclone shelters	In progress
DM 003	Flood Proofing in the Char lands and Haor Basin	3,500,000 char land and haor basin inhabitants in flood proof dwellings	In progress
DM 004	National, Regional and Key Feeder Roads- Flood Proofing	100% of all national and feeder roads raised by 1m in high and .5 m in low risk areas; 20% of feeder and rural roads raised by 1 m in high risk areas	In progress
DM 005	Railway Flood Proofing	100% of all high risk railways raised by 1 m and 100% of low risk railway raised by .5 m	No Data
DM 006	Supplementary Irrigation and Drought Proofing	Increased quality of life in target areas.	In progress

28. Prior to 2008, 1,500 multi-purpose cyclone shelters had been constructed in the coastal areas. The National Strategy for Accelerated Poverty Reduction 2 (NSAPR 2) reports that 1,841 were constructed by 2008. Following the devastation created by cyclone Sidr, (late 2007), Government committed to the construction of an additional 2,000 cyclone shelters.

29. The disaster management cluster within the NWMP is somewhat narrowly defined with a focus on cyclones, flood proofing, and drought. Other areas of concern are earthquakes, tsunamis, warning systems, and overall emergency response. The shortcomings within the NWMP approach were recognized and a Comprehensive Disaster Management Programme was initiated in 2004. The Programme has met with particular success in implementing Community Risk Assessments, community-level Risk Reduction Action Plans, and small-scale risk mitigation interventions. In addition, the programme has been responsible for developing legislation in the form of a Draft Disaster Management Act to strengthen Governments ability to coordinate a response to disasters. Additional investments by the World Bank will assist with the recovery of the agriculture sector (following cyclone Sidr), reconstruction and improvement of multi-purpose shelters, rehabilitate the coastal embankments, and long-term disaster risk management.

6. Agriculture and Water Management

30. Table 9 summarizes implementation progress of the clusters related to Agriculture and Water Management.

Table 9: Status of the Agriculture and Water Management Cluster

MIS Ref	Title	Key Programme Objectives	Progress
AW 001	Promotion of Expanded Minor Irrigation and Improved On-farm Water Management	Average return per unit of water increased in minor irrigation areas	No progress
AW 002	Improved Performance of Existing Public Surface Water Irrigation Schemes	Increased returns per unit of water and labour on public irrigation areas	No progress
AW 003	New Public Surface Water Irrigation Schemes	Increased area under public surface water irrigation	No progress
AW 004	New Public Deep Tube well Irrigation Schemes	Increased area under public deep tube well irrigation	No progress
AW 005	Improved Water Management at Local Government Level	Local rivers, feeders canals and main drains restored, rehabilitated, upgraded as appropriate	On-going. LGED small-scale water management interventions.
AW 006	Improved Water Management at Community Level	Sustainable sub-secondary water use efficiencies of 60% for paddy and 75% for dry foot crops	No progress
AW 007	Rationalization of Existing FCD Infrastructure	Increased returns per unit of water and labor in public irrigation areas	Limited Progress. Initiatives include the Water management Improvement Project and the Command Area Development Projects.
AW 008	Land Reclamation, Coastal Protection and Afforestation	1550 km^2 of new coastal land protected; and land reclamation and accretion study document	On-going. Estuary Development Project and CDSP.

31. Progress is urgently needed in several key areas in this cluster. Bangladesh has a net cultivable area of about 8 million hectare (ha) with currently about 4.5 million ha irrigated. The irrigated area contributes an estimated 13 million metric tons of cereals (mainly rice). About 90% of this irrigated area is provided by the private sector, mainly from groundwater with minimal public sector financing though there is uncertainty as to the impact of arsenic. The National Water Management Plan (NWMP) considers that an additional area of up to 1 million ha can be irrigated by groundwater in the future, thereby contributing an added 5 million metric tons to food production. At current consumption rates this would feed an additional population of between 25 million and 30 million people, the estimated increase in population over a 15 year period. However, by 2050, the population is forecast to increase to 230 million from the current population estimated at 135 million.

32. New publicly financed large-scale surface water schemes on an additional 1 million ha as identified by NWMP would further contribute to maintaining a balance between food production and population growth. However, the NWMP also acknowledges low irrigation intensities and productivity on the existing major surface water schemes and enhancing the performance of these schemes through rehabilitation of water management infrastructure and better O&M is urgent.

7. Environment and Aquatic Resources

33. Table 10 summarizes implementation progress of the clusters related to Environment and Aquatic Resources.

Table 10: Status of the Environment and Aquatic Resources Cluster

MIS REF	Title	Key Programme Objective	Progress
EA 001	National Pollution Control Plan	National Pollution Control Plan agreed	Limited Progress
EA 002	National Clean-up of Existing Industrial Pollution	Multi-purpose water use not constrained by quality considerations	Limited progress
EA 003	National Water Quality Monitoring	Reduction of gross/persistent pollution	Limited Progress
EA 004	National Fisheries Master Plan	Wild fish stocks conserved or increased	A draft Inland Capture Fisheries Strategy prepared
EA 005	National Fish Pass Programme	Sustainable increase in floodplain fish catches, in terms of both numbers and diversity	Negative Progress. See text below.
EA 006	Unspecified Regional Programmes	Improvement in region-specific environmental characteristics	See text below
EA 007	Improved Water Management in The Haor Basins of the North East Region	Water- related regulations established	Limited progress: activity included within the on-going Water Management Improvement Project
EA 008	Environmentally Critical Areas and Integrated Wetland Management	Improved levels of protection extended to existing and new environmentally critical areas	Some progress: Integrated Coastal Zone Management Plan and Policy. Government declared 4 sites within the coastal zone as ecologically critical areas[4].
EA 009	Improved Water Management and Salinity control in the Sundarbans	Pending	No data
EA 010	Public Awareness Raising and Empowerment in respect of Environment Issues	Effective public demand for sustainable environmental stewardship	Limited Progress.

34. During the years since the completion of the NWMP, programmes and projects have been put in place that:

- Strengthen the capacity of the Department of Environment to develop rules and guidelines, enforce, monitor, coordinate, and to generally improve delivery of environment related services.
- Alleviate arsenic water contamination by installing deep tube wells, harvesting rain water, and expanding water distribution systems.
- Improve air quality in selected major cities through air pollution control strategies for the transport sector, air pollution monitoring equipment and training, and air pollution inventory and source assessment.

[4] The Ecologically Critical Areas are: Teknhaf Bay at Cox's Bazaar, Saint Martin's Island, Sonadia Island, and areas around the Sundarban Reserve Forest.

- Support natural resource management and biodiversity conservation, sustainable land and water management, improved and cleaner urban environment management and sustainable development and environmental governance.,
- Introduce participatory management systems to conserve biodiversity in the Sundarbans.

35. Almost 30% of all inland fish species are in some danger of extinction and there is a possibility that inland major carps, Indian Salmon, and other coastal in-shore fisheries could collapse. Inland and coastal capture fisheries are generally in decline as a result of loss of floodplain habitat to agriculture and urbanization, overfishing, discontinuities along fish migration passages, significant reductions in dry-season discharges, and increasing pollution[5]. It is recognized that the poor are most dependent on natural resources and therefore are most affected by any loss of capture fisheries.

36. The environment and aquatic resource cluster as defined in the NWMP requires updating. A 2006 World Bank environmental assessment identified the following priority issues:

- environmental risks to human health;
- protection of water quality in Dhaka;
- management of capture fisheries;
- sustaining soil quality; and
- strengthening institutions for environmental management.

37. All but soil quality relate directly to water use and reflects a more comprehensive approach to the environment than that taken by the NWMP[6]. Institutional strengthening is included in the institutional cluster but a critical issue is surface water quality and urban degradation in and around the major urban centers. Dhaka being the most important because of its current size and rate of growth.

8. Other Activities

38. WARPO prepared a number of Preliminary Project Proforma that are intended to move forward some of the NWMP agenda. These include:

- Alternative Source of Drinking Water Supply in Arsenic Affected Area (August 2005)
- Strategy for Reducing Vulnerability of Flow (May 2005)
- Updating NWMP (2005)
- Development of Update Digital Elevation Model for Bangladesh (2005)
- Flood Zoning and Risk Mapping for Floods in Bangladesh (2005)
- Determination of Stream Water Availability in the Dry Season (2002)
- Water Management in Flood Prone Areas in Bangladesh (2002)
- Ground Water Resource Assessment in Bangladesh (especially for NW Region)
- Formulation of Strategies Towards Framing of District Water Management Plan Project (2002)
- Alternative Source of Financing (2002)

[5] The World Bank, 2006, Bangladesh Country Environmental Analysis

[6] The Country Environmental Analysis suggests that the economic losses that these five issues represent amounts to 4.3% of GDP.

IV. UPDATING THE NATIONAL WATER MANAGEMENT PLAN – CONSIDERATIONS

A. Preamble

39. Apart from the instruction within the NWMP itself, there are key reasons for updating the NWMP:

- The policy, legislative, and strategic framework have changed since the NWMP was prepared.
- As noted in the previous chapter, there has been some progress in implementing NWMP initiatives. Completed work needs to be assessed, lessons documented, and remaining work evaluated against changing priorities.

40. This section describes changes in the strategic framework that would have some bearing on the process of revising the NWMP.

B. Policy, Legislative, and Strategic Framework

1. National Strategy for Accelerated Poverty Reduction (2005)[7]

41. The National Strategy for Accelerated Poverty Reduction (NSAPR) was an outcome of an extensive consultation process, included input from the most senior levels of Government, and addressed weaknesses identified within the 2003 Interim Poverty Reduction Strategy Paper. One of the identified weaknesses was the absence of strategy for water resources management. The NSAPR deals with all facets of water management at a strategic level, building on the work of the NWMP.

42. Consistent with its purpose, the NSAPR establishes strong linkages between the various aspects of water resources development and poverty. The poverty agenda transects the entire spectrum of water related issues ranging from water-related hazards to natural resources access and access to services. The following are emphasized:

- **Institutional Development**. The NSAPR identifies as a prominent step the progressive withdrawal of central government agencies from activities that can be performed by local institutions and the private sector to decentralize decision-making with stakeholder participation.
- **Flood Protection**. Flood protection is given the topmost priority and it will be implemented for zila and upazila towns. Also, identified as critical flood prone areas are the char lands, coastal areas, haors and other deeply flooded areas.
- **Irrigation**. Government will continue to promote minor irrigation in the private sector, water conservation for multi-purpose use, rationale use of existing FCDI projects, and a limited number of new irrigation schemes. However, the NSAPR also notes that where surface water irrigation is possible, it is cheaper and more pro-poor than ground water irrigation.
- **In-filling of Rivers and Canals**. Gradual siltation is raising river beds and reducing dry-season discharge. These flows are to be augmented. While large-

[7] Government of Bangladesh, Planning Commission, General Economics Division, Bangladesh Unlocking the Potential: National Strategy for Accelerated Poverty Reduction October 2005.

scale dredging is not considered feasible, rivers and canals will be excavated using human labor.

- **Drainage Congestion**. Noakhali and Khulna are identified as specific areas where drainage congestion is making the land unproductive. Alleviation measures include dredging and tidal basin management.
- **Sunderbans and Wetlands**. Many poor people are dependent on wetland resources and their access to these resources needs to be ensured through legal and administrative measures.
- **Trans-boundary Rivers.** The NSAPR notes various issues associated with the trans-boundary rivers and states that these will be discussed with India at appropriate levels.
- **Inland Water Transport.** The NSAPR specifies the need for inter-project coordination to facilitate clearance under bridges, and designing and locating regulating structures. Dredging is not mentioned here.
- **Water Supply and Sanitation.** The Government, through the NSAPR commits that proper water and sanitation will be provided with 100% coverage by 2010. This is well ahead of both the Millennium Goal Targets of 50% coverage by 2015 and the NWMP targets which aim to achieve full water supply coverage by 2010 but full coverage of sanitation facilities by 2025.
- **Environment.** Attention is given to five issues; (i) agriculture land degradation and salinity, (ii) biodiversity, (iii) public commons, (iv) afforestation and tree plantation, and (v) urbanization-related environmental issues. Water-related recommendations include introducing public hearings where projects have significant environmental impacts, preparing environmental impact assessments, increase expenditure on environmental awareness, expand and renew the depleted public commons, introduce community-based participatory natural resource management, and enact laws and regulatory frameworks that recognize the rights of ethnic minorities and local people to local common property resources.
- **Water Pollution.** To combat surface water pollution introduce land zoning of industries, strengthen water quality monitoring, enforce existing Environment Conservation Act and Rules, introduce waste reception and treatment facilities at ports, and reduce effluent discharges.

43. The NSAPR addresses the need for good governance, which is also an important element of an integrated water management framework, and identifies the following as key priorities in the governance agenda:[8]

- **Improving Implementation Capacity.** Considers that problems here are generally either personnel related (recruitment, training, promotions, placement, postings, and so on) or work related (coordination, meetings, supervision, monitoring, expenditure control, delegation, decentralization and so on). Several other identified problems issues include planning and project cycle, poor result orientation in project choice, and sub-optimal use of information flows.
- **Promoting Local Governance.** The NSAPR acknowledges shortcomings with past attempts at decentralization. In reviewing the lessons learned, the conclusion is reached that there is a need for simultaneously pursuing the

[8] One other priority related to reforming the criminal justice system is not discussed here since there is no direct link to water management.

agendas of political and functional decentralization while emphasizing partnerships between local government bodies and other local actors. A renewed agenda is to be emphasized which promote decentralized service delivery and encourages local economies.

- **Strengthening the Anti-Corruption Strategy.** Acknowledges that there is a broad consensus view that corruption has emerged as a critical governance issue and analyses the complex causalities of corruption. The NSAPR concludes with recommendations that include: (i) Operationalizing the Anti-Corruption Commission on a priority basis, (ii) Continuing financial management reforms, (iii) Strengthening oversight functions, (iv) Improve recruitment and HRD institutions to improve administrative quality, (v) Strengthen information flows and thereby transparency.
- **Improving Sectoral Governance.** The NSAPR identifies infrastructure and disaster management as the key water-related sectors that are in urgent need of specific sectoral agendas to promote the goals of growth and poverty reduction.

44. While generally consistent with the NWMP, the poverty focus of the NSAPR leads to a strategy with a somewhat different emphasis than that of the NWMP, which is a more technical document driven by an assessment of the resource and by the National Water Policy. The areas emphasized in the Governments PRSP are also those which received financial priority. It is important that in revising the NWMP, the focus of the updated Plan be closely aligned with Government's poverty agenda. This notwithstanding, the NSAPR was superseded by the NSAPR 2 in late 2008.

2. Poverty Reduction Strategy Paper 2 (2008)[9]

45. The first Poverty Reduction Strategy Paper was introduced for the period from 2005 to 2007. This was extended by one year and a second Poverty Reduction Strategy Paper (NSAPR 2) was prepared and became effective in 2008. In general, the approach to reducing poverty outlined in NSAPR 2 is similar to and builds on the first NSAPR. However, NSAPR 2 takes account of changing ground realities within the country and considered the following:

- The increasing vulnerability of Bangladesh to natural disasters.
- The insufficient domestic production of food.
- The impact of the anti-corruption drive.
- The effects of alternative fuel production on international food prices and availability.
- The impact on the exporting sectors in Bangladesh of slower than expected growth in developing countries.

46. NSAPR 2 presents a roadmap for pro-poor economic growth that consists of five strategic blocks: (i) macroeconomic environment for pro-poor economic growth, (ii) critical areas of focus for pro-poor economic growth, (iii) essential infrastructure for pro-poor economic growth, (iv) effective social protection for vulnerable people, and (v) human development. These strategic blocks have five supporting strategies: (i) ensuring participation, (ii) social inclusion and empowerment, (iii) promoting good governance, (iv) ensuring efficient service delivery, environment and tackling climate change for sustainable development, and (v) enhancing productivity and efficiency through technology.

[9] Government of Bangladesh, Planning Commission, General Economics Division, Moving Ahead: National Strategy for Accelerated Poverty Reduction 2, 2008

47. The two strategic blocks of relevance to the NWMP are: critical areas of focus for pro-poor economic growth, which includes water resources development and management; and human development, which includes water supply and sanitation. The latter outlines a strategy that is entirely consistent with the approach of the first NSAPR and this needs to be reflected in an updated NWMP.

48. Water resource development and management is presented as a cross-cutting issue with the following strategic thrusts:

- Expand the multi-purpose use of the main rivers through development that includes navigation and hydropower.
- Rehabilitate and maintain flood protection and storm water drainage systems in a fully participatory manner and protect rural and urban areas from floods.
- Manage the impact of disasters, which includes cyclone protection facilities, early warning and forecasting [for all water-related disasters], flood proofing, manage river bank erosion as well as drought, rationalize use of ground water [because of arsenic contamination], and adapt responses to account for effects of climate change.
- Manage water in relation to agriculture through public sector irrigation, better protection from flooding, and improved drainage.
- Protect the natural environment and aquatic habitat by reducing pollution, taking account of the needs of fisheries, and raising stakeholder awareness.
- Strengthen institutions.

49. The strategy for water resource development (except for water supply and sanitation) presented in this NSAPR 2 is broad and somewhat open-ended. Given that these NSAPR's are being revised on a more-or-less regular basis every three years or so, it would seem that there is a need to focus more carefully on achievable targets within that planning period.[10] In this regard, a revised and updated NWMP has the potential to provide strong direction to the accelerated poverty reduction planning process.

3. Coastal Zone Policy

50. Government approved a Coastal Zone Policy (CZPo) in response to a recognition that:

- the coastal zone lags much of the rest of the country in terms of socio-economic development,
- people are vulnerable to many coastal hazards and the physical environment is deteriorating, and
- the coastal zone has the potential to contribute significantly to national development.

51. The CZPo considers the coastal zone as a special management area, establishes an integrated planning and policy framework through agreed common principles, and creates an enabling environment. The latter defines the institutional, legal and regulatory framework as well as the processes for harmonization and coordination. The CZPo initiates a process that commits various ministries, departments and agencies to harmonize and coordinate their activities in the coastal zone and elaborates the basis for a firm coordination mechanism.

[10] It is understood that a third NSAPR will be prepared in 2009.

52. Like the National Strategies for Accelerated Poverty Reduction, the CZPo focuses on poverty reduction as a central goal. The CZPo is unique in that it transcends sectoral perspectives so the focus here is on the aspects of the CZPo that relate to water and more specifically, elements of the CZPo that should be considered in revising the NWMP.

53. The CZPo framework is articulated through eight development objectives.[11] Of these, four include water-related issues:

- **Meet basic needs and enhance livelihood opportunities**. The water focus here is on sanitation, safe drinking water, and measures to facilitate coastal navigation. While the NWMP adequately addresses the first two, there is no direct reference to coastal zone navigation, which is important for commerce and communication in that region.[12]
- **Reduce Vulnerabilities**. The vulnerabilities identified with the coastal zone mainly relate to water and include drought, erosion, floods, cyclones, and storm surges. There is a need to integrate the coastal aspects of the CZPo into the "Comprehensive Disaster Management Plan" as well as the national strategies for accelerated poverty reduction. The emphasis of the CZPo is on the vulnerability of the poor so for example, while the NWMP addresses provision of effective erosion management measures (on main rivers), unlike the CZPo it is silent as to the impact on the victims and falls short of recommending (or costing) rehabilitation of these victims.
- **Sustainable management of natural resources**. The water issues identified under this objective are specific to the coastal zone and include ensuring adequate discharges to preserve the coastal estuary ecosystem, capturing tidal water by constructing small reservoirs for minor irrigation, rainwater harvesting, excavating ponds and tanks combined with local technologies for water treatment to increase safe water supply, and managing ground water in a sustainable manner.
- **Conservation and enhancement of critical ecosystems**. As with the NWMP, CZPo identifies the requirement for sewage treatment plants for major cities in the coastal zone. However, it also identifies the need to deal with discharge of bilge water and oil spills according to international conventions, and the need to monitor sea level rise with contingency plans designed to deal with related effects.

54. As noted above, the CZPo specifies a range of measures that are not taken account of in the NWMP. Importantly, the CZPo also recognizes that it is at odds with earlier policies and strategies and as such dictates that coastal zone management will be mainstreamed. Specifically, that existing policies are to be harmonized and that coastal issues are to be incorporated in all future policy and strategy documents.

[11] These development objectives are: Economic growth, Basic needs and opportunities for livelihoods, Reduction of vulnerabilities, Sustainable management of natural resources, Equitable distribution, Empowerment of communities, Women's development and gender equity, and Conservation and enhancement of critical ecosystems.

[12] There is reference in the NWMP to river dredging for navigation as part of the Main Rivers cluster.

C. Other Considerations

1. Climate Change

55. While the climate change vector remains unclear, currently projected or modeled effects of climate change in Bangladesh include:

- Rise in sea-level, in the order of 300 mm by year 2030 and 700 mm by 2075.
- Rise in monsoon season temperature, of 0.7°C by 2030 and 1.1°C by 2050.
- Rise in dry season temperatures, of 1.3°C by 2030 and 1.8°C by 2050.
- Increase in monsoon rainfall, of about 10% by 2030 and 25% by 2050.
- Long-term reduction of dry season rainfall.

56. Temperature changes would affect the timing and rate of snowmelt in the upper Himalaya, which would alter the flow regime in the rivers originating from there. Lower dry season rainfall and increased water demands due to higher temperatures would increase upstream abstractions from rivers and reduce flows entering Bangladesh. Increased flooding would also occur due to increased monsoon rainfall, and higher sea levels would have a negative impact on drainage and would require that coastal infrastructure be upgraded to prevent flooding.

57. The foregoing list of impacts is at best indicative but the point is that the most recent available information as to climate change needs to be explicitly dealt with in the process of updating the NWMP.

2. Pollution of Water in and around Cities and Towns

58. Managing the rivers in and adjacent to Cities and Towns has not been addressed in the NWMP. The rivers around all of the major cities and towns are polluted, mainly from domestic and industrial wastewater discharges. Water pollution exacerbates the problem of water scarcity, particularly in the dry season and inadequate drainage of the polluted water further increases the exposure of the urban populations to the effects of polluted water. Support is being provided for measures that abate pollution in the rivers adjacent to Dhaka and this experience needs to be incorporated into an updated NWMP along with strategies for many of the remaining cities and towns.

3. Revised Hydrological Regions / Divisions

59. After approval of NWMP (2004), two new city divisions were created, Barisal and Sylhet. These should be included in an updated NWMP.

60. To mainstream the CZPo (2005), an option in updating the NWMP would be to carve out a coastal region. This would lend some focus to the specific water-related issues that are addressed in the CZPo and would ensure that the NWMP responds to these issues.

4. NWMP Financing and Absorptive Capacity

61. The NWMP investment and financing requirements were based on the level of funding that Government providing to the sector at the time the NWMP was prepared – 0.59% of GDP and an assumed GDP growth rate between 5% and 6% over the Plan period. Even so, it was recognized that there was a funding gap and that alternative funding would need to be mobilized.

62. While there has been progress in implementing the NWMP, the progress is less than what was envisaged during the short and medium term horizons of the NWMP.[13] In updating the NWMP it will be necessary to review financing and financing mechanisms, absorptive capacity of the service delivering institutions, and the implementation performance of these institutions to ensure that the revised investment program is more closely aligned with what is achievable.

5. Sustainable Operation and Maintenance

63. The National Water Policy stipulates the following with regards to O&M of water resources schemes.

- For FCDI projects, water rates will be set to cover the full delivery cost of the irrigation component.
- Collection of these fees will, to the extent possible, be undertaken through means such as leases with beneficiaries and other target groups given preference for such contracts.
- Government will finance all other operation and maintenance costs for the foreseeable future.
- Water charges realized from beneficiaries for O&M in a project will be retained locally for the provision of services within that project.
- Effective beneficiary participation and the commitment to pay for O&M will be realized at the project identification and planning stages.

64. The NWMP builds on these topics but provides little meaningful practical direction as to their implementation – in any of the water using sectors. Inadequate operation and maintenance continues to be the most significant problem associated with most investments in the water sector. Progress towards workable solutions has been slow and the attendant consequences impact on investment outcomes but more importantly undermine the agenda to reduce poverty. Assuming an updated National Water Management Plan that is refocused in line with Governments National Strategy for Accelerated Poverty Reduction an important strategic theme will be programmes that promote sustainable operation and maintenance.

[13] The medium term horizon extended from 2006 - 2010

V. UPDATING THE NWMP

A. Introduction

65. The NWMP (2004) was prepared through a systematic process that engaged and sought input from a broad spectrum of stakeholders through consultations, workshops, bilateral discussions and a web site. What emerged was a thorough and integrated plan for the management of water resources in Bangladesh. A rolling framework plan that was neither static nor prescriptive. This notwithstanding, it is not entirely clear to what extent the various stakeholders – ministries and line agencies – have made use of the NWMP in designing their own investment strategies, programs, and plans.

66. In part, a difficulty lies in the delay in updating the NWMP. It is arguable that this delay is responsible for the disconnect between the poverty focus of the National Strategies for Accelerated Poverty Reduction and the NWMP. Budget allocations were based on the former.[14] The point is that a comprehensive and integrated NWMP can simply not remain relevant for an extended period of time in a dynamic physical and institutional environment and this demands that a higher priority be placed on updating the NWMP to ensure its relevancy.

B. Going Forward

67. Recognizing the need to update the NWMP, WARPO has prepared a Preliminary Development Project Proforma / Proposal (PDPP) entitled National Water Management Plan II (see attachment 1). This PDPP provides background to the planning process, defines the scope of work, and provides a cost estimate for updating the NWMP. The suggested schedule for this work is a July 2009 start with completion in 2012.

68. There are several important issues that need to be resolved.

- **Financing**. The PDPP does not identify a source of financing for this exercise. Setting financing in place requires time and so the intended start date is likely unrealistic.
- **WARP Institutional Capacity**. While the process of updating the NWMP would provide a considerable measure of institutional strengthening, WARPO remains understaffed and the budget estimate does not include the cost of strengthening WARPO. Some support is being provided to WARPO through the Water Management Improvement Project but a sustained increase in financial allocations is a key element to WARPO fulfilling its mandate.
- **Monitoring.** There was little if any effective monitoring of the implementation of the 2004 NWMP. While this was identified as an important component of the implementation process, the resources were not mobilized within WARPO for this to have taken place. To ensure an understanding of the factors that had a significant bearing on the implementation of the NWMP, the extent to which goals and objectives were achieved, and the constraints that emerged, the process of updating the Plan will need to incorporate an evaluation phase.

[14] For example the 22 June 2008 budget speech reflects the priorities of the National Strategy for Accelerated Poverty Reduction and of the Tk 3,190 billion total projected expenditure, Tk 2,567 billion was set aside for implementing the Strategy. The balance was allocated to interest payments and defence.

69. While the PDPP is in the approval process, there is a need to identify a source of financing for the project, and in concert with the financier to prepare terms of reference for the international and local consultants that would support WARPO in updating the NWMP. Ideally, at some point in the process of finalizing these materials, the Executive Committee of the National Water Resource Council would meet, review and sanction the process. This is considered an important step since the work related to updating the National Water Management Plan will again require integration across of information and analysis across all the water using sectors.

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

FORM PDPP
November 2008

PRELIMINARY DEVELOPMENT PROJECT PROFORMA (PDPP) FOR AIDED PROJECTS
ON

National Water Management Plan-II (NWMP-II)

WATER RESOURCES PLANNING ORGANIZATION (WARPO)
MINISTRY OF WATER RESOURCES
GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH
PRELIMINARY DEVELOPMENT PROJECT PROFORMA/PROPOSAL (PDPP) FOR AIDED PROJECTS

1.0 Project Title: **National Water Management Plan - II (NWMP - II)**

2.0 *i)* Sponsoring Ministry/Division*:*

Ministry of Water Resources (MoWR),
Government of the People's Republic of Bangladesh

ii) **Executing Agency:**

Water Resources Planning Organization (WARPO)

3.0 Expected date of Commencement and Completion

Start date: July 2009 **Completion date: June 2012**

4.0 Relevance of the proposal with concerned Sectoral allocation

The proposed project is aimed to assist all concerned agencies and Ministries to undertake projects/programs that have direct or indirect impact on the Water Resources Management in Bangladesh. The project will prepare a framework plan with in which concerned agencies will undertake projects to boost Agriculture, fisheries, undertake Flood Control, Irrigation & Drainage project, improve Disaster Management, improve Navigation, improve environment etc in the short, medium and longer term.

5.0 Main Objective and Brief description of the Project

5.1 Objective:

Overall objective of the project is to update the National Water Management Plan (NWMP) 2001, addressing emerging new challenges, planning needs, institutional reforms, refine the long-term national water management strategy and revise the portfolio of programs of the NWMP for the medium and the longer term. Specific objectives are as follows:

- Review New National policies and Strategies and harmonize with new developments both Nationally and Internationally;
- Development and establishment of a framework for systematic evaluation and assessment of water resources management options within the broader multi-sectoral resources allocation context;
- Assessment of Bangladesh's water and land resources and their medium and long term potential and constraints;
- Further strengthen the framework to enable stakeholder participation in the water sector planning process and regular public review of progress.
- Develop capability of WARPO as Apex planning organization emphasizing technical, environmental, socio-economic and participatory planning;
- Develop capability for "Clearing House" role as advisory and regulatory function of WARPO according to National Water Policy 1999 (NWPo);
- Develop capability for "Monitoring and Evaluation" role of WARPO;
- Finalize the Water Law, Planning guidelines etc for dealing with water sector planning and management issues;
- Establish a unified code of practice in the Flood and Water development and Management.
- Transfer of technical and managerial skills through intensive in-country and overseas training.

5.2 National Water Management Plan (NWMP)

The NWMP (2001) has also been prepared within the policy and strategy framework established by the Government. The National Water Policy (1999) provides the overall directions to articulate the specific goals and objectives for the water sector within the Strategy and policy framework of the Government. The Bangladesh water and Flood Management Strategy (1996) also provides guidance for the development of the plan. NWMP is an Integrated Water Resources Management (IWRM) Plan to improve the *efficiency* in the water resources management in the country. National Water Management Plan lists priority programs to be implemented by the year June 2005, a medium term and long-term programs to be implemented by the year June 2010 and June 2025 respectively.

People's Participation and Consultation with different stakeholders were undertaken to identify issues and options to support defining the Strategy of the Plan. This exercise has been unique in the macro planning exercises and would also help for future support of planning efforts,

criteria and procedures for screening of projects for inclusion in the implementation portfolio. A functioning National Water Resources Database (NWRD) has been created and extensively used for the preparation of the NWMP. A series of working papers and reports providing background to technical aspects of the supporting studies and recommendations on institutional, legislative, economic and environmental issues were prepared. NWMP is framework Plan and line agencies are expected to develop their own project plans within the framework of this Plan.

The Seventh meeting of the National Water Resources Council (NWRC) held on 31st March 2004 with the Honorable Prime Minister in the Chair approved the NWMP. The NWRC also approved the decision of the 12th ECNWRC Meeting. Decisions are:

(a) Proposed short-term programs (from 1st year to fifth year) of the "National Water Management Plan" should be taken up for implementation immediately.

(b) WARPO will take up studies on the issues those are identified as knowledge gap in the "National Water Management Plan" and complete the studies within 2 to 3 years. The following studies should be taken up for implementation on priority basis:

- Availability of Surface Water and Groundwater in respect of quality and quantity.
- Identification of causes of river bank erosion
- WARPO and Bangladesh Haor and Wetland Development Board will jointly prepare Master Plan for Wetland Management.
- The recommendations and observations of the Water Expert Committee should be taken into consideration during the updating of "National Water Management Plan".

The draft PRSP document entitled “Unlocking the potential” has identified all the NWMP programs to be directly or indirectly linked to the reduction of poverty. In order to implement the NWMP, line agencies has been informed to prepare their projects in compliance with the NWoP and NWMP. However some vital institutional strengthening, precondition for the coordinated implementation of NWMP is still pending.

5.3 Historical Background

National level planning of the water resources of Bangladesh dates back to 1964 when the East Pakistan Water Development Board’s Water Master Plan was published. Later in 1986 the Master Plan Organization 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, a series of five regional plans and supporting studies, culminating in the Bangladesh Water and Flood Management Strategy (BWFMS) was prepared by the Flood Plan Coordination Organization (FPCO) in 1995. This has now been revised and is being re-issued.

These reports and the accompanying studies have contributed to a very substantial appreciation of the nation's water resources, although successive plans have varied significantly as to how best develop them. BWFMS report noted the limitations of earlier plans, which had focused too heavily on agricultural development with much not appreciation about the social and environmental impacts of water resource development. BWFMS recommended that the Government should formulate a National Water Policy that addressed these issues and a comprehensive NWMP should be prepared within this framework.

5.4 Monitoring the implementation of NWMP

WARPO has a broad range of roles to play in the Water Sector. Important roles of WARPO involves updating of NWMP, act as "Clearing house" for screening projects for implementation in compliance with NWMP, implement Monitoring and Evaluation of the project/programs impacts in view of updating of NWMP and reviewing water resources system. Other important roles are to act as Secretariat to Executive Committee of NWRC and update and disseminate National Water Resources database (NWRD) etc.

According to NWRC directives issued on 31st March 2004, Water Resources Planning Organization (WARPO) will centrally coordinate the implementation, monitoring of the "National Water Management Plan". However majority of the functions of WARPO related to the above roles are not operational. Very recently an Organizational Development Plan (ODP) for WARPO has been drafted with a view to operationalize the roles of WARPO.

The Organizational Development Plan (draft) (ODP) of WARPO has identified that screening of projects and monitoring the impacts and act as secretariat to ECNWRC as per framework plan would provide required position and tools to monitor and coordinate the NWMP implementation. Progress in implementing these roles would provide future guidance for updating the programs and screening of options for revised NWMP. In the updating process a more structured, systematic planning procedure requires development on top of what has been achieved in the NWMP project

5.6 Recommendations for reducing vulnerability to flood

In the backdrop of flood of 2004, a National Workshop entitled "Options for Flood Risk and Damage Reduction in Bangladesh" was held during 7-9 September 2004. The workshop identified a set of recommendations on future flood management, which needs further development through implementing well-designed studies. The project would review the recommendations and undertake a number of studies in conformity with the recommendations of the workshop.

5.7. Scope of NWMP Update Work:

a) Updating of NWMP: "Water Efficiency Plan"

Updating of NWMP is a periodic task of WARPO and the scope of work needs not to be underestimated. NWMP has identified several issues, problems and 87 programs under 8 cluster for implementation. Update of NWMP is considered to be a more then just reviewing the impacts of portfolios of programs/projects under each of these programs. The NWMP has been completed in December 2001 and since then actual situation has not changed so much, but new problems, objectives and new priorities of actions have emerged. There are some issues to be looked into a fresh, which has been identified as knowledge gap and NWMP has kept reservation about it. New priorities have emerged as a result of development in the co-riparian countries and also international policy and strategies have changed.

Though basic framework would continue to be useful, many new details and new assessment and approach may be useful in some occasion in view of recommendations made by ECNWRC, Committees who reviewed the NWMP programs and different international strategies and plans. More specifically current policies, programs, plans would be reviewed in view of water-use efficiencies and the implementation of Integrated Water Resources Management Plan guidelines and accordingly programs and plan would be updated.

Update of NWMP as before would a framework plan comprise a rolling plan for the next five years, an indicative plan for the subsequent five years and a perspective plan for the long term as before. In addition to the update of NWMP Strengthening of WARPO's function and implementation of the recommendations on mitigation of vulnerability to Floods would be under taken during this project.

i) The Analytical Framework followed under the NWMP would be reviewed and a systematic objective analysis of water resources system, demand and impacts of variety of options under different scenarios would be developed and placed at WARPO for a sustainable planning practices.

A new conceptual and operational computational framework may be developed through further consensus on the tools, models, identified system and decision support Indicators.

Tools developed at IWM and used during the preparation of NWMP would be updated and new tools and models would require development.

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ii) Sustainable limits of groundwater use and its implication with the present development situation would be investigated combining the implication of arsenic and other quality problems as long-term plan. Salinity intrusion in the upper and lower aquifer as a result of increase abstraction, anticipated sea level rise and required strategy to be pursued in the coastal area would be investigated;

iii) Existing measures in river maintenance, erosion control, land accretion and coastal zone management would be reviewed that impact medium and long-term planning;

iv) Long-term implication of climatic changes and developing appropriate responses would be investigated. Bangladesh is seriously vulnerable to the Global Climatic Changes. The consequences of the issue have been tangentially addressed by the NWMP. It is important to investigate the scientific basis of the issue and appropriately address them in the National Water Policy and analyze the programs in the NWMP on how these changes is going to affect our water resources sector and what would be the mitigation measures, which are essential from framing the strategy.

v) Relationship between water and the natural environment assessing the in-stream demand and establishing key indicators for its sustained development would be investigated. Sectoral demand of water resources with adequate emphasis of environment flows needs to be studied;

vi) Current status of Arsenic mitigation, its research findings on the future extent of contamination and the implications for food safety of irrigating with arsenic contaminated

water and the effectiveness of treatment method for domestic water supplies would be reviewed and appropriate strategies would be suggested;

vii) Sharing of international river water resources is of great importance for Bangladesh. Successful implementation of the NWMP will greatly depend upon the ensured sharing of water common river waters in the longer terms. India has already declared their National Water policy and formulated a perspective plan for inter basin water transfer. It would be important to review our policy (if necessary update the NWPo) in this relation and investigate strategic options for reducing the consequences in view of anticipated basin wide water development in the medium and longer term.

viii) The ongoing deterioration of water quality of river system, ponds and other perennial bodies is of growing concern to the public and relevant management organizations. With in the mandate of WARPO to monitor the situation a reliable database with information of water quality, identification of pollution points, distribution of pollution and exposure to ecosystem, human health is required to be established including standardization of quality parameters etc;

ix) The NWRD developed under the NWMP would be further upgraded with new data layers under a component of Water Management Improvement Project (WMIP). Major task relevant to NWMP update would be to develop tools that would help planing exercises during updating of the programs. Efforts will be to develop data shearing protocol, automated data collection and dissemination using newly developed IT facilities;

x) People's Participation and the associated consultation process would be the key features of the updating NWMP. People's needs, views and preferences would be taken into account in Water Sector planning, implementation and management. The approach and methodology applied in the preparation of NWMP also mentioned in the GPWM and NEMAP (National Environmental Management Action) consultation process would be updated to provide an updated appropriate model for WARPO and updating the NWMP;

xi) Reviewing the programs of the NWMP based on the outcome of the above studies and analysis and peoples participation a development strategy would be selected with an updated program portfolio for implementation in the short term, medium and longer term. The implementation plan will include responsible implementation body along with their responsibilities, list of resources required, time and phasing and costs involved.

xii) An investment portfolio of national, regional and sub-regional projects prepared by sector agencies will be reviewed by WARPO under the project for implementation. Appropriate guidelines, approach and criteria will be developed for reviewing the projects under the "Clearing house" function of WARPO.

b) Institutional Development of WARPO.

An institutional review of water sector with particular emphasis on WARPO would be under taken during the project period. A revised institutional setup, organogram, rules ad regulation would be prepared and the role of "Clearing house", Monitoring and Evaluation" would be established during the project period.

c) Reducing vulnerability to Floods:

Major floods that have been a regular feature for the last 100 years damage infrastructure, livelihood and stakes are high in the social, environmental and economic context. With the advent of the Global Climate Change there seems to have increasing tendencies of major events and therefore should not be regarded as the exception these days. All the indications are that they will become more, not less, common. It is therefore required to review the options both structural ad non-structural measures and options for reducing vulnerabilities due to flood. A number of studies would be proposed under the review according to the recommendations of the National workshop organized soon after the flood of 2004 during 2-9 September 2004. The proposed studies are:

i) Review of vulnerability and risks due to all water related natural disasters such as erosion, flood and cyclone and update the structural and non-structural options for its mitigation (G2-001);

ii) Guidelines would be developed so that planing, implementation and maintenance of roads, highways, railways and cross drainage structures, brings and flood mitigation embankments, appurtenant structures and water ways carried out in an integrated manner with emphasis on unimpeded drainage (G2-002);

6.0 Relevance of the Project with the short/medium/long term policies/plans/programs

- Updating of the National Water Management Plan will be carried out within the policy and strategy framework established by Government. The NWMP prepared in 2001 was fully consistent with the Fifth Five Year Plan (1997/98 –2001/2). The FFYP provided a comprehensive view of all development sectors in the country, and is unique in this respect.
- The FFYP by definition was short term in nature but provides clear insight of future directions. Key points are the move towards decentralised planning and devolution of authority to local Government. Continued emphasis was given to the roles of markets and the private sector. Poverty alleviation and food self-sufficiency represent cornerstones of GoB policy. Greater attention was given to the environment and issues of social and gender equity, and more investment is targeted at tackling the problems of rapidly growing urban centers. In the water sector attention was given to improving existing infrastructure and services together with works on the major rivers, including programs for both Ganges and Brahmaputra barrages.
- Currently there is no Five-year plan in operation. However Poverty Reduction Strategy paper ("Unlocking Potential" PRSP (2005)) issued by the Government gives us more emphasis on the programs/projects that are justifiable from the poverty reduction concern.
- Government of Bangladesh has made significant commitments to the improvement of livelihood for the population of Bangladesh in view of Millennium Development Goals of Johannesburg (2002);
- The above commitment and strategy of the government seems to reinforce the directives of the National Water Policy (1999). These seems to reinforce the articulate the specific goals and objectives of economic development, poverty alleviation, food security, public health and safety, decent standard of living for the people and protection of the natural environment.
- Therefore objective of the project is in line with the development perspective reflected in the short/medium and long term all development plans including those of Government commitments.

7.0 Relevance with other Development Programs of the concern sector:

Updating of National Water Management Plan (NWMP) will provide lists of programs to be implemented by concerned agencies that use of water resources or affects the water resources. Agencies concerned including their respective Ministries are BWDB, BADC, Local Government Division, City Corporation, LGED, BRDB, DHPE, WASAs, BIWTA, R&H, BMDA, BFDC & BFIDC, DMB, DoForest, DoFish, DoE, DAE etc.

The Plan will guide the agencies for under taking projects within the framework. The project therefore is directly relevant to the development programs of these agencies and relevant Ministries.

8.0 Expected Socio-economic benefits/outputs of the project

The National Water Management Plan deals with issues and options on hydrological regions of Bangladesh, its water rights and allocation of water resources, public and private involvement, public investment, water supply and sanitation, fisheries, navigation, agriculture, industry and environment etc.

The overall objective of the plan would be 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 Plan is to ensure overall benefit to the socio-economic and environmental situation in Bangladesh.

Expected outputs of the project are a portfolio of revised programs proposed by National water Management Plan (2001) with financial allocation and time frame to be implemented by different agencies.

9.0. i) Estimated amount and cost of the proposed project:

Total estimated cost of the Project is 129 crore TK (21.76 million US $). Expatriate support would cost 21 percent of the cost to employ 220 person-month and Local expertise would cost about 46 percent (including special studies) of the cost to employ 590 person-month.

Summary of Cost -Estimate of the Project

Sl. No	Item	Total cost in thousand US$	Total Cost in Lakh	F/E COST	TAKA COST	GoB COST	PROJECT AID	RPA	CD/VAT
A1	Local Consultant	1999.4	1189.7		1189.7		1189.7	1189.7	
A2	Expatriate Consultant	4654.5	2769.4	2769.4			2769.4	0.0	
A3	Project Input (in kind)	886.4	527.4		*527.4*	*527.4*			
A4	Project Input	1542.9	918.0		918.0	468.0	450.0	450.0	250.0
A5	Special Studies	7899.2	4700.0	940.0	3760.0		4700.0	3760.0	
A6	Equipment	2194.1	1305.5	360.0	945.5	600.0	705.5	345.5	600.0
A7	Training	523.9	311.7	260.0	51.7		311.7	51.7	
A8	Escalation	963.6	573.3		573.3	573.3			
	Sub-Total (A)	19777.5	11767.6	4329.4	7438.2	1641.3	10126.3	5796.9	850.0
B	Contingency (10% of A)	1977.7	1176.8	432.9	743.8	164.1	1012.6	579.7	85.0
	Total (A+B)	21755.2	12944.4	4762.4	8182.0	1805.4	11138.9	6376.5	935.0

I US $=Taka 60.00

Note 1: Cost of WARPO in kind not included in project cost

Annual phasing of cost (in Lakh TK)

Year	Total cost in thousand US$	Total Cost in Lakh	F/E COST	TAKA COST	GoB COST	PROJECT AID	RPA	CD/VAT
FY 2009-2010	13486.2	8024.3	2366.4	5657.9	810.5	7213.8	4847.4	628.3
FY 2010-2011	3393.5	2019.1	1069.6	949.5	211.1	1808.0	738.4	28.4
FY 2011-2012	4875.5	2900.9	1326.4	1574.6	783.8	2117.1	790.7	278.3
Total	21755.2	12944.4	4762.4	8182.0	1805.4	11138.9	6376.5	935.0

ii) Nature of foreign assistance (loan/grant/others): Loan and grant both

10. Likely Source of Foreign Assistance

IDA, WB and Netherlands Government and other Development Partners may be approached for assistance.

11. Is there any proposal to undertake feasibility study for the project? If yes, what would be the estimated cost, nature and likely institutional arrangements for the study?

The project is a Planning exercise including several special studies. Relevant agencies will prepare feasibility studies of project within the framework of the updated NWMP which will be screened by WARPO during the project period The project does not need any feasibility study.

12. Any other relevant information

As suggested by the NWMP, the framework plan requires to be reviewed periodically (five-year interval). The five year periodic review is normally seen as a way to assist the update of Annual Development plan of the Government. In view of recent introduction of requirement for a fresh review of the priorities for the next rolling plan is also understood. However there are some emerging issues and challenges in the water sector that need to be reviewed and update the NWMP. The study would assist WARPO in the update of the NWMP.

Signature of the responsible officer of the Executing Agency	**Signature of the Head of the Executive Agency with seal and date**
Recommendation and signature of the Secretary of the Sponsoring Ministry/Division with Seal and date	

ANNEX F: DRAFT BANGLADESH WATER ACT

ANNEX F: DRAFT BANGLADESH WATER ACT

December, 2008

AN ACT TO GIVE EFFECT TO BANGLADESH WATER POLICY FOR INTEGRATED MANAGEMENT, DEVELOPMENT, UTILIZATION AND PROTECTION OF THE WATER RESOURCES.

WHEREAS it is expedient to make a law to consolidate and supplement the existing laws to regulate the water resources of Bangladesh in order to facilitate and ensure integrated, equitable and sustainable management, development, and utilization of water resources and their conservation and protection and matters connected therewith or incidental thereto,

IT IS HEREBY ENACTED as follows:

CHAPTER I
PRELIMINARY

1. Short Title and Commencement:

1) This Act may be called the Bangladesh Water Act, 2008.
2) It extends to the whole of Bangladesh and if the government so requires, it may apply to different areas on different dates.
3) It shall come into force on such date as the Government may, by notification in the Official Gazette, appoint and different dates may be appointed for different sections of this Act.
4) In this Act, unless the contrary intention appears, a reference to the Act includes any rules made under the Act.

2. Definitions:

1) In this Act unless the context otherwise requires:
   (a) "Act" means the Bangladesh Water Act, 2008;
   (b) "Appropriation of waters" is the acquisition of rights over the use of waters or the taking or diverting of waters from a natural source in any manner and for any purpose allowed by law;
   (c) "Aquifer" means an underground geological formation which has structures or textures that hold water which can be exploited;
   (d) ‘Baor” means oxbow shaped lakes left behind by changing water course which has gradually shifted its course over time;

(e) "Beneficial use" means the application of water without waste to a use that is socially valuable and consistent with sustainable development, including any economically productive use;

(f) “Beel” means natural depressions or saucer shaped areas subjected to flooding by rain or river water which may or may not hold water throughout the year;

(g) "Bore" means any bore, hole, well, excavation or other opening in the ground or any naturally existing or artificially constructed or improved underground cavity which could be used, is used or may be used, for the purpose of intercepting, collecting, obtaining or using groundwater or for the purpose of disposing of any water below the surface of the ground, or which extends to an aquifer;

(h) ``Catchment”, in relation to a watercourse or watercourses or part of a watercourse, means the area from which any rainfall will drain, through surface flow, into the watercourse or watercourses or part of a watercourse;

(i) ``Charge” includes a fee, price or tariff imposed under this Act;

(j) “Conservation” includes, but not limited to improved efficiency, recycling, reuse or reduction of wastage or losses, preservation, and protection;

(k) “Conservation Measures” refers to any measures adopted by a water right holder, or several water right holders acting in concert pursuant to an approved conservation agreement to reduce diversions or consumptive use or both associated with the exercise of a water right;

(l) “Consumptive Use” means any use that diminishes the quantity of water in a water source;

(m) "Designated authority" means a body or organization so designated by the Government or by the Ministry of Water Resources to perform a specific function, or duty under this Act;

(n) "ECNWRC" means the Executive Committee of the National Water Resources Council;

(o) “Estuary” means a partially or fully enclosed body of water which is open to the sea permanently or periodically; and within which the sea water can be diluted, to an extent that is measurable, with fresh water drained from land;

(p) “Haor” means large natural water bodies in the form of bowl shaped depressions between two different rivers;

(q) “Khal” means natural or man made water courses for inflow or out flow of water;

(r) “Non-consumptive Use” is a beneficial use of water, whether in stream or by diversion from the waters of the country in such a manner that the water returns to or remains in the waters of origin at or near the point of origin without substantial diminution in quality or quantity and without resulting in or exacerbating a low flow condition;

(s) "Pollution" in relation to a water resource means the direct or indirect alteration of the physical, chemical or biological properties of the water so as to make it:

(1) unsuitable for any beneficial purpose for which it is or may reasonably be expected to be used; or

(2) harmful or potentially harmful:

(i) to the welfare, health or safety of human beings;

(ii) to any aquatic or non-aquatic organism;

(iii) to the resource quality; or

(iv) to property;

(t) "Prescribe" means prescribed by rules under this Act;

"Protection", in relation to a water resource, means maintenance of the quality of the water resource to the extent that the water resource may be used in an ecologically sustainable way; prevention of the degradation of the water resource; and the rehabilitation of the water resource;

(v) "Safe yield" means the amount of water which may be abstracted from an aquifer at a rate that will not reduce the supply to such an extent as would render such abstraction harmful to the aquifer, quality of the water or environment;

(w) "Servitude of abutment" means the right to occupy, by means of a water work, the bed or bank of a stream or adjacent land belonging to another;

(x) "Servitude of aqueduct" means the right to occupy land belonging to another by means of a water work for abstracting or transferring water;

(y) Servitude of submersion" means the right to occupy land belonging to another by submerging it under water;

(z) "Stream flow reduction" means reducing the availability of water in a watercourse to meet the need of other water users;

(aa) "Surface water" is water occurring on the land surface including in ponds, lakes, brackish water, streams and rivers;

(ab) "Sustainable Development" in this Act means the integrated management of water resources to assure the efficient use and equitable access for the benefit of current and future generations, optimizing the use of non-renewable resources, and averting the deterioration of renewable resources;

(ac) The "Sustainable Yield" of a water source is the amount of water available for diversion without impairing the long-term social utility of the water source, including the maintenance of the protected biological, chemical, and physical integrity of the source;

(ad) "Ground Water" means water found beneath the ground surface, regardless of whether the water flows through defined channels or percolates through the ground, and regardless whether the water results from natural or artificial recharge;

(ae) "Use" in relation to water, includes to withdraw, pump, extract, take, use or re-use or to divert for the purpose of using or re-using, that water;

(af) "Waste" includes any solid or liquid material or materials that is suspended, dissolved, or transported in water (including sediment) and which is spilled or deposited on land or into a water resource in such volume, composition or manner as to affect quality, or to be reasonably likely to affect the quality, of the water either during the whole year or part of a year;

(ag) The “Waters of Bangladesh” include all waters, on the surface, underground, and in the atmosphere, within or under the jurisdiction of the Republic;

(ah) "Water body" means an area submerged under water either during the whole year or part of a year;

(ai) "Water course" means a river or spring, a natural or man made channel in which water flows regularly or intermittently, a wetland, lake or dam into which or from which water flows;

(aj) "Water Management institution" means a basin management agency, a water user association, a body responsible for water management, or a water management utility responsible for protecting, maintaining, improving, allocating, and planning regarding the waters of Bangladesh pursuant to this Act;

(ak) "Water resource" designates different forms of accumulation of water including surface water, groundwater, rainwater, watercourse, estuary, aquifer, wetland, water body, or any other collection of water including the extent of coastal water that is necessary to be taken into account for conservation of other forms of accumulation of water;

(al) “Water Stress areas” are areas where the demand for water are approaching or exceed the available supply or where existing or potential water quality problem is serious;

(am) "Water use right" is a property right to use a certain portion of the waters of Bangladesh in conformity with the provisions of this Act, whether subject to a permit or otherwise;

(an) "Wetland" means land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is periodically covered with shallow water, and in normal circumstances, support or would support vegetation typically adapted to life in saturated soil.

2) Words and expressions used in this Act, but not defined herein shall have the meaning assigned to them in the relevant Acts.

CHAPTER II
ADMINISTRATION AND ENFORCEMENT

3. General Administration and Enforcement:

1) The general administration and enforcement of the provisions of this Act, including setting standards for granting of licenses, resolution of inter-agency disputes and the imposition of penalties for administrative violations hereof, are hereby vested in the Ministry of Water Resources except in regard to those functions which under this Act are specifically conferred upon other agencies of the government.
2) The Ministry of Water Resources may delegate its authority for resolution of inter-agency disputes to any of its agency or office or provide for the establishment of a water tribunal by promulgating Rules in this behalf.
3) Unless otherwise stated, the Executive Committee of the National Water Resources Council (ECNWRC) on behalf of the government will be the coordinating body for the enforcement of this Act. It shall provide directives on all matters relating to planning, management and coordination of water resources across all sectors and hear and dispose of appeals from decisions of the Ministry of Water Resources in disputes between various agencies of the government.
4) The Water Resources Planning organization (WARPO) will act as the secretariat of the ECNWRC and shall perform all other functions as are expressly provided in this act or rules made under this Act.

4. Delegation of Power by the Government

Subject to sub-sections (2) the government may delegate its power, function or duty vested under this Act to -

(a) Any body or organization assigning a specific power, function, or duty by the government;
(b) A water management institution.

5. Power of agencies authorized to enforce the Act

Agencies authorized by the government to enforce this Act are empowered to make requisition of any data, report, maps, document or any other materials from any public or private agency and to enter upon private lands, with previous notice to the owner, for the purpose of conducting surveys and hydrological investigations, and to perform such other acts as are necessary in carrying out their functions.

6. Directives to a water management institution

The Government may give directives to a water management institution in relation to the exercise of any of the institution's powers or the performance of any of the institution's functions or duties including any power, function or duty assigned or delegated to that institution.

7. Jurisdiction of Ministry of Water Resources over disputes

1) Unless anything otherwise expressively mentioned in any existing laws, The Ministry of Water Resources shall have original jurisdiction over all disputes relating to appropriation, utilization, exploitation, development, control, conservation and protection of waters within the meaning and context of the provisions of this Act.
2) The decisions of the Ministry of Water Resources on water rights controversies shall be immediately executed and enforcement thereof may be suspended only when a bond, of an amount fixed by the government to make amends for damages occasioned by the suspension or stay of execution, shall have been filed by the party preferring the appeal, unless the suspension is by virtue of an order of a competent court.
3) All disputes shall be decided within sixty (60) days after the parties submit the same for decision or resolution.
4) For the purpose of exercising any power or performing any functions under this Act, the Ministry of Water Resources or any authority designated by the Ministry may request any law enforcing authority or any other government or statutory authority to render necessary assistance, and upon such request that agency or authority shall render such assistance.

8. Concurrence of the ECNWRC for water programs and projects

1) No program or project involving the appropriation, utilization, exploitation, development, control, conservation, or protection of water resources may be undertaken without prior concurrence of the ECNWRC except those which the government may, in its discretion, exempt. The ECNWRC may designate WARPO or any other agency to review the plans and specifications and accord government's clearance.
2) The ECNWRC may require consultation with the public prior to the implementation of certain water resources development projects.

9. Appeal to the ECNWRC

A person who is a party to a matter dealt with under section 3 by the Ministry of Water Resources or under any other section of this Act by any other water management institution may appeal to the ECNWRC against a decision of that Ministry or such institution.

10. Penalties for Infringement of the Act

For the implementation of the provisions of this Act, the government shall promulgate the necessary rules which may provide for penalties consisting of a fine, imprisonment, suspension or revocation of the water license or other right to the use of water or any of the aforesaid penalties.

11. Offences

Subject to the provisions of existing laws, the following acts shall be penalized by the Government under section 10:

(a) Use of water for purposes other than those permitted under this Act;

(b) Failure to provide access to any books accounts, documents or assets when required to do so under this Act;

(c) Failure to comply with any condition attached to an authorized water use under this Act;

(d) Failure to comply with a directive issued under this Act;

(e) Unlawfully and intentionally or negligently tamper or interfere with any water work or any seal or measuring device attached to a water work;

(f) Failure or refusal to give data or information or give false or misleading information when required to give information under this Act;

(g) Fail to register an existing lawful water use when required by a designated authority;

(h) Intentional/deliberate refusal to exercise an obligation or obstruct any other person from exercising any of that person's rights or obligations under this Act;

(i) Unlawful commission or omission, whether by design or by default, of any act which detrimentally affects or could affect a water resource or coastal marine waters;

(j) Failure to comply with a temporary restriction to use water.

(k) Non-observance of any standard specified for the use of water.

(l) Unauthorized sale, lease, or transfer of water and/or water rights.

(m) Failure to provide adequate facilities to prevent or control diseases when required by the Government in the construction of any work for the storage, diversion distribution and utilization of water.

(n) Utilization of an existing well or ponding or spreading of water for recharging subterranean or ground water supplies without permission of the relevant authority.

(o) Violation of or non-compliance with any order, rule, or regulation of the Government.

(p) Illegal taking or diversion of water in an open canal, aqueduct or reservoir.

(q) Interruption of navigation in a natural water body.

(r) Encroachment on or pollution of any water resource

(s) Any other act or omission which the government thinks proper to be penalized.

12. Offences by companies or firms

Where an offence under this Act has been committed by a company, every person whoever at the time the offence was committed was in charge of, and was responsible to the company for the conduct of, the business of the company, as well as the company, shall be deemed to be guilty of the offences.

Provided that nothing contained in this section shall render any such person liable if he proves that the offence was committed without his knowledge or that he or she exercised all due diligence to prevent the commission of such offence.

13. Offences by government departments

Where an offence under this Act has been committed by any Department or Division of Government, the Head of the Department or Division shall be deemed to be guilty

of the offence and shall be liable to be proceeded against and punished accordingly:

Provided that nothing contained in this section shall render such Head of the Department or Division liable to any punishment if he or she shall prove that the offence was committed without his or her knowledge or that he or she exercised all due diligence to prevent the commission of such offence.

CHAPTER III
OWNERSHIP, APPROPRIATION AND WATER USE RIGHT

14. Ownership

The State has sole ownership of all water and water resources including:

a) All categories of surface water such as rivers and their natural beds, khals, beels, haors and baors; and other water bodies;
b) Continuous or intermittent waters of springs and natural water channels;
c) Subterranean or ground waters; and
d) Seawater.

15. Ownership of waters on private land

Unless otherwise excluded by law, the following waters found on private lands also belong to the State:

a) Continuous or intermittent waters naturally flowing through such lands;
b) Naturally occurring lakes and water bodies that are connected to a river, stream or a water body in public domain;
c) Waters in swamps and marshes located on such lands, and
d) Subterranean or ground waters.

Provided that the owner of the land where the water is found may, subject to any zoning regulation, use the same for domestic, agricultural and industrial purpose.

Provided further that The Government, however, may regulate such use when there is wastage, abuse or misuse in times of emergency.

16. Appropriation of water

Appropriation will be guided by the availabilities of both surface and ground water resources and based on demand and priority responding to the national and community interest.

17. Purpose of appropriation

Water may not be appropriated for any purpose other than the followings:

(a) Domestic: Use of water for domestic purposes is the utilization of water for drinking, washing, bathing, cooking or other household needs, home gardens, and watering of lawns or domestic animals.

(b) Municipal: Use of water for municipal purposes is the utilization of water for supplying the water requirements of the urban community including public offices.

(c) Fisheries: Use of water for fisheries is the utilization of water for development and management of fishery resources as a domestic and commercial enterprise.

(d) Wildlife: Use of water for wildlife is the utilization of water for preserving and conserving the natural habitat of wildlife located at various locations in the country.

(e) Irrigation: Use of water for irrigation is the utilization of water for all kinds of agricultural purposes.

(f) Power generation: Use of water for power generation is the utilization of water for producing electrical or mechanical power.

(g) Industry: Use of water for industrial purposes is the utilization of water in factories, industrial plants and mines, including the use of water as an ingredient of a finished product.

(h) Environment: Use of water for environmental purpose means the utilization of water for preserving, maintaining and conserving the natural environment and the eco-system

(i) Navigation: Use of water for navigation purpose means utilization of water for inland and coastal water transportation and oceanic transportation.

(J) Sustenance of the river regime: Use of water for sustenance of the river regime means the allowing of minimum stream flows for maintaining the essential morphological characteristics of the river and the aquatic biodiversity.

(K) Salinity control: Use of water for salinity control means the utilization of water for checking saline intrusion in the coastal areas.

(l) Recreation: Use of water for recreational purposes is the utilization of water for swimming, boating, water skiing, golf courses and other similar facilities in resorts and other places of recreation.

(m) Others: Any other beneficial or customary use for the people of the Republic

18. Exemption from appropriation

The Government, for reasons of public policy or public interest, may declare waters not previously appropriated, in whole or in part, exempt from appropriation for any or all purposes and, thereupon, such waters may not be appropriated for those purposes.

19. Water Use Right

Except as otherwise provided herein, no person or community, including government institutions or government owned or controlled corporations, shall appropriate water without a water use right.

20. Natural Water Use Right

Subject to the provisions of this Act, water use right is naturally conferred on any person for the use of natural bodies of water for the following purposes:

(a) Domestic use of water carried by means of hand carried receptacles; and,

(b) Bathing or washing, watering or dipping of domestic or farm animals, and navigation of boats and small watercrafts.

21. Water use right acquired through other means

Outside of the natural right of water use, water rights may not be acquired by any means except the following:

(a) Through an existing lawful water use rights as defined in section 31.
(b) Through a general authorization as defined in Section 34.
(c) By means of license, for specific purposes as may be determined by Rules, under this Act, to provide secure, defensible and enforceable ownership/ usufructary rights to ground water and surface water.

22. Acquiring of easement

No right of easements may be acquired by a holder of a water license for the construction and maintenance of works and facilities needed for the use of water, except when it is subject to the requirements of just compensation and the following conditions:

(a) That he is the owner, lessee, mortgagee or one having legal right over the land upon which he proposes to use water; and
(b) That the proposed easement is the most convenient and the least onerous to the servient estate.

Provided that easements relating to the appropriation and use of waters may be modified by agreements of the contracting parties, provided the same is not contrary to law or prejudicial to third persons.

23. Easement on river banks

The banks of rivers and streams and the shores of the seas and lakes throughout their entire length and within a zone to be prescribed by the Government are subject to the easement of public use in the interest of recreation, navigation, and fishing. No person shall be allowed to stay in this zone longer than what is necessary for recreation, navigation, and fishing or to build structures of any kind.

24. Application of the Civil Procedure Code on easement

The establishment, extent, forms, and conditions of easements of water not expressly determined by the provisions of this Act shall be governed by the provisions of the Civil Procedure Code.

25. Transfer of water use rights

In addition to the obligations under existing laws, water use rights may not be leased or transferred in whole or in part to another person or group without prior approval of the Ministry of Water Resources, and without due notice and hearing.

26. Protection of the rights of others

A water use right shall not be exercised in such a manner that the rights of third persons or of other appropriators are unduly prejudiced.

27. Right and duty of a lower riparian

1) Unless otherwise agreed upon between the concerned riparian users in conformity with this Act, the right of a lower riparian to receive water, which naturally flows from the higher estates or land without the human intervention, shall not be violated.
2) The owner of the lower estate or land cannot construct works which will impede the natural flow, unless he provides an alternative method of drainage.

28. Superior rights

Between two or more appropriators of water from the same source of supply, superior right shall be judged from the priority of use determined by Rules made under this Act.

Provided that, priorities may be altered on grounds of greater beneficial use, mufti-purpose use, and other similar grounds after due notice and hearing, subject to payment of compensation in proper cases.

CHATER IV
EXISTING LAWFUL USE OF WATER

29. Permissible water use

1) Water may not be used unless:
   (a) that water use is permissible under Schedule 1;
   (b) that water use is permissible as a continuation of an existing lawful water use defined under section 30.
   (c) that water use is permissible under a general authorization issued under Section 34.
   (d) that water use is authorized by a license issued under Section 35
   (e) A designated authority has dispensed with the license requirement.

2) A person or any agency who uses water under subsection (1):
   (a) must not use the water in violation of any condition of the relevant authorization for that use;
   (b) can not be outside any limitation, restriction or prohibition under this Act or any other applicable law;
   (c) in the case of discharge or disposal of waste or water containing waste, must comply with any applicable waste standards or management practices prescribed by relevant authorities unless the conditions of the relevant authorization provides otherwise;
   (d) shall not waste water; and
   (e) must return any seepage, run-off or water containing waste which emanates from that use to the water source from which the water was taken unless the responsible authority directs otherwise or the relevant authorization provides otherwise.

3) No authority outside that designated by the government may dispense with the requirement for a license for water use and only after it is satisfied that the purpose of this Act would be met with the grant of a license, permit or other authorization under any other law.

30. Existing lawful use of water

1) An existing lawful water use, with any conditions attached, is recognized but may continue only to the extent that it is not limited, prohibited or terminated by this Act. No license is required to continue with an existing water use until a responsible authority requires a person claiming such an entitlement to apply for a license. If a license is issued it becomes the source of authority for the water use. If a license is not granted the use is no longer permissible.

2) Subject to sub-section (2) an existing water use means a water use which took place at any time during a period of two years immediately before this Act commences, and which:
   (a) was permissible by custom or under any other law which was in force immediately before this Act commences;

(b) is declared by licenses an existing lawful water use under section 31
(c) is identified as controlled activity described in section 54 and in Schedule II.

3) In the case of a controlled activity, existing lawful water use means a water use which took place at any time during a period of two years immediately before the date of the declaration of its legality.

31. Declaration of a lawful water use

1) A person may apply to an authority designated by the government to have a water use, which does not fall under section 19 declared to be an existing lawful water use.
2) The designated authority may also, on its own initiative declare a water use which does not fall under Article 3.5 to be an existing lawful water use.
3) The designated authority may only make a declaration under sub-sections (1) and (2) if, upon verifications, it is satisfied that the water use:
   (a) took place at a time more than two years before the commencement of this Act and was discontinued for good reasons, or
   (b) had not yet taken place at any time before the commencement of this Act, but would have been lawful had it taken place and steps towards effecting the use had been taken in good faith before this Act commenced..

32. Appeal against denial of lawful use

Any person, who is aggrieved by the decision of denial of any existing lawful use, may prefer an appeal to the designated authority within 60 days of the denial whereupon the decision shall be reviewed by offering him an opportunity of personal hearing.

33. Continuance of existing lawful water use

A person or his successor-in-title may continue with an existing lawful water use subject to:

(a) any existing conditions or obligations attached to that use;
(b) its replacement by a license under this Act;
(c) any other limitation or prohibition under this Act.

CHAPTER V
GENERAL AUTHORIZATION AND LICENCE FOR WATER USE

34. General authorization

(1) The Ministry of Water Resources in concurrence with the ECNWRC, may, after public consultation, permit the use of water through a general authorization. A general authorization may be restricted to a particular water resource, a particular category of persons, a defined geographical area, a period of time, and would require conformity to other relevant laws. The use of water under general authorization would not require a license.

(2) No general authorization under sub-section (1) can be issued without the publication of due notice in the news paper:

(i) setting out the proposed general authorization, and

(ii) inviting written comments to be submitted on the proposed general authorization, specifying an address and a date before which the comments are to be submitted, which may not be earlier than 30 days after publication of the notice, and without considering all comments received.

35. License for water use

(1) As and when declared by the government, water use must be licensed by the authorities empowered under existing laws and in accordance with the standards set by the Ministry of Water Resources unless it is a permissible use listed in Schedule 1, is an existing lawful use, is permissible under a general authorization, or if a lawful authority waives the need for a license.

(2) Such licenses shall specify the maximum amount of water which may be diverted or withdrawn, the maximum rate of diversion or withdrawal, the time or times during the year when water may be diverted or withdrawn, the point or points of diversion or location of wells, the place of use, the purposes for which water may be used, the environmental conditionality's, and such other requirements as may be deemed necessary.

36. Consideration for the issue of general authorizations and licenses

In exercising its power to issue a general authorization or set standards for granting licenses, the Ministry of Water Resources may take into account all relevant factors including:

(i) existing lawful water use;

(ii) efficient and beneficial use of water in public interest;

(iii) the socio-economic impact of the water use to be authorized;

(iv) any catchment management strategy applicable to the relevant resource;

(v) the effect of the water use on the water resource and on other water users;

(vi) water quality objectives;

(vii) investment made by a water user in respect of the water use to be authorized.

37. Conditions to general authorization and license

The Ministry of Water Resources may apply conditions or standards to every general authorization or issuance of license.

(a) relating to the protection of:
  (i) the water resource concerned;
  (i) the stream flow regime; and
  (ii) other existing and potential water users.

(b) relating to water management by:
  (i) specifying management practices and general requirements for any water use, including water conservation measures;
  (ii) requiring the monitoring, analysis and reporting on every water use and specifying measuring and recording devices, and imposing a duty to measure and record aspects of water use;
  (iii) requiring the preparation/approval of and adherence to a water management plan;
  (iv) requiring the payment of charges for water use;

(c) relating to return flow and discharge or disposal of waste by:
  (i) specifying a water source to which it must be returned or other manner in which it must be disposed off;
  (ii) specifying permissible levels for some or all of its chemical and physical components;
  (iii) specifying treatment to which it must be subjected, before it is discharged.

Such specifications shall, in appropriate cases, be done in accordance with existing environmental laws.

(d) In the case of a controlled activity by
  (i) specifying the waste treatment, pollution control and monitoring equipment to be installed, maintained and operated; and
  (ii) specifying the management practices to be followed to prevent the pollution of any water resource.

Such specifications shall, in appropriate cases, be done in accordance with existing environmental laws.

(e) In the case of withdrawal or storing water by:
  (i) Setting out the specific quantity of water or percentage of flow which may be taken;
  (ii) Setting out the rate of abstraction;
  (iii) Specifying the construction of a borehole and the method of abstraction from the bore hole;
  (iv) Specifying the place from where the water may be taken;
  (v) Specifying the periods when water may be taken;
  (vi) Identifying or limiting the area of land on which any water taken from a source may be used;
  (vii) Limiting the quantity of water which may be stored;
  (viii) Specifying the location where water may be stored;
  (ix) In the case of stream flow reduction activity:

(x) Specifying practices to be followed to limit stream flow reduction and other detrimental impact on water resources; and

(xi) Setting or applying a methodology for determining the extent of the stream flow reduction caused by the licensed activity.

38. Failure to comply with authorizations

(1) The Ministry of Water Resources may, by notice in writing to a person who contravenes any provision of the authorization, direct that person, or owner of the property in relation to which the contravention occurs, to take any action specified in the notice to remedy the contravention, within the time (being not less than two working days) that is specified in the notice or any other longer time allowed by the Ministry.

(2) If a contravention is not rectified within the time specified in the notice, or any longer time allowed, the Ministry may carry out any works and take any other action it decides is necessary to remedy the contravention and recover its reasonable costs from the person on whom the notice was served.

39. Essential requirement of license

The essential requirements of license, the procedure for its review, amendment, suspension and cancellation shall be regulated by Rules made by the Ministry of Water Resources.

40. Revocation of license or general authorization

Water license or authorization may be revoked by the Ministry of Water Resources after due notice and hearing on grounds of non-use for a certain period to be determined by the Ministry; gross violation of the conditions imposed in the license; unauthorized sale of water; willful failure or refusal to comply with rules and regulations or any lawful order; pollution, public nuisance or acts detrimental to public health and safety; when the appropriator is found to be disqualified under the law to exploit and develop natural resources of Bangladesh; when, in the case of irrigation, the land is converted to non-agricultural purposes; and other similar grounds.

41. Modification and cancellation of license or authorization

All water licenses and authorization are subject to modification or cancellation by the government, after due notice and hearing, in favor of a project of greater beneficial use or for mufti-purpose development, and a water license holder who suffers thereby shall be duly compensated by the entity or person in whose favor the cancellation was made.

42. Curtailment of license or authorization during water shortage

At times of water shortage, the use of the water under a license or an authorization may, in the interest of equitable distribution of benefits among legal appropriators, be reduced by the government after due notice and hearing.

43. Identifications of water stress areas

WAPRO shall identify and declare the water stress areas in the country and water extraction and utilization in the identified scarcity zones will be regulated, amongst other things, for sustaining rechargeable shallow groundwater aquifers.

44. Water allocation in water stress areas

1) Unless special circumstances demands otherwise, water allocation schedules will be framed by local governments or any authority designated by the ECNWRC in specified water stress areas in general with the following priority - domestic and municipal uses, fisheries and wild-life, sustenance of the river regime, irrigation, industry, environment, salinity management, navigation, and recreation and by taking account of the specific users' existing rights and all the applications received and also in accordance with procedures to be determined by Rules.
2) With due regard to the standards set by the Ministry of Water Resources, the authority designated under subsection (1) may establish a procedure for licensing in respect of any aspect of water use in the water stress areas.
3) License issued under this section replace all previous entitlement to any existing lawful water use.

CHAPTER VI
CONTROL OVER WATER

45. Declaration of flood control area

1) To promote the coordinated protection of flood plains, the ECNWRC may designate flood risk zones and establish flood control areas in those zones.
2) In respect of declared flood control areas rules may be promulgated to prohibit or control activities including cultivation of sand bars and tidal flats and erection of private embankments or revetments, that may damage or cause deterioration of water catchments and embankments, impede drainage, obstruct the flow of water, change the natural flow of river, increase flood losses or aggravate flood problems and to protect in particular the regions of economic importance such as metropolitan areas, sea and air ports and export processing zones.

46. Storage of Water

1) Water of a stream may not be stored in a reservoir by an individual in such amounts that may prejudice the right of any other user. Whosoever operates the reservoir with necessary authorization shall, when required, release water for minimum of stream flow.
2) No reservoir operations shall be outside the rules and regulations issued by the governments or any designated government agency.

47. Control and protection of ground water

1) While the concerned authorities empowered under the existing laws shall authorize the use of ground water, the Ministry of Water Resources may determine the procedures and standards for using ground water, the requirements for the registration of every boring or alteration to existing borings as well as other control measures for the exploitation of ground water resources.
2) A person may not drill, construct, enlarge or otherwise alter a borehole, engage in a borehole drilling program, for the purpose of exploring for ground water, except in accordance with the standards set by the Ministry of Water Resources.
3) A person may not cause or allow any ground water to run to waste from any borehole, except for the purposes of testing the extent or quality of supply, or cleaning, sterilizing, examining or repairing the bore hole.
4) No project for use of ground water shall draw down the water table below a critical limit to be determined by the Ministry of Water Resources.
5) The Ministry of Water Resources has power –
    (a) To determine the safe yield of any aquifer for the purpose of guiding determinations concerning the abstraction and use of water from the aquifer;

(b) To require that an aquifer be used on a sustainable basis, including restricting abstractions so that they do not, individually or collectively, exceed the safe yield of the aquifer;
(c) To impose special requirements and restrictions with respect to artesian wells, for the purpose of preventing wastage or contamination of water, or loss of artesian pressure and
(d) To carry out programs for the recharge of aquifers.

48. Standards for Minimum stream flows

After due notice and hearing, minimum stream flows for rivers and streams and minimum water levels for lakes shall be established by the WARPO for the protection of the environment, control of pollution, navigation, salinity control, and general public use.

49. Declaration of Certain Protected areas

1) Any watershed or any area of land adjacent to any surface water or overlying any ground water may be declared by the Government as a protected area.
2) Rules and regulations may be promulgated to prohibit or control such activities within the protected area which may damage or cause the deterioration of the surface water or ground water or interfere with the investigation, use, control, protection, management or administration of such waters.

50. Preservation of water bodies

No one shall fill up natural depressions and water bodies that are to be preserved for recharge of aquifers and rainwater management in major urban and rural areas..

51. Recreational use of water

No person shall develop a public stream, lake, or a water body for recreational purposes without securing prior permission of WARPO. Such use of water bodies will be allowed if it does not damage the environment.

52. Drainage and sanitation

The ECNWRC shall direct any public water and sewage authority to take appropriate measures for drainage and sanitation, including treatment of domestic waste water and sewage, construction of sewage treatment plants, and the replacement of open drains in the interest of public health.

53. Clearance for the construction of dams, bridges and other structures

No construction of road, dams, bridges and other structures which may seriously interfere with the flow of navigable waterways shall take place without having an approved plan and Planning Proforma approved by Planning Commission after a clearance from WARPO.

54. Other controlled activities

1) The government may regulate all other activities having detrimental impact on water resources that are identified as controlled activities in Schedule II or which have been declared by Rules to be a controlled activity or stream flow reduction activity or which are, in the opinion of the government, inconsistent with the principles of integrated water resource management.

2) The government may, at the request of the water management institution concerned, order an owner or occupier of land who has been convicted of an offence relating to a stream low reduction activity to remove, cease or terminate the cause of the stream flow reduction from that land within a period stated in the order.

CHAPTER VII
CONSERVATION AND PROTECTION

55. Zoning for Efficient land and water use

In coordination with the Ministry of Land, The ECNWRC shall develop appropriate zoning regulations including for industry, agriculture, brackish aquaculture, hatcheries, for efficient and sustainable use of water resources of the country.

56. Conjunctive use of water

All irrigation and urban water supply plans will consider the conjunctive use of all forms of surface and ground water including rain water for optimizing harvesting of sources, minimizing adverse impact and maximizing social, economical and environmental benefits.

57. Protecting flow of water from injurious substance It shall be the duty of any person in control of a well containing water with minerals or other substances injurious to man, animals, agriculture, and vegetation to prevent such waters from flowing on the surface of the land or into any surface water or into any other aquifer or porous stratum..

58. Preventing pollution of water resources

No person shall pollute any water resource in any manner except in accordance with pollution permit or waste disposal permit which shall be issued by designated authority with due regard to environmental standards under existing laws.

59. Preservation of haors and baors and wetlands

Natural water bodies like haors and baors, beels, swamps and marshes which are important for water flow propagation or migratory bird sanctuary will be preserved and protected and drainage schemes should, to the extent possible, avoid such areas

60. Water resource project and environment

No government agency shall take any water resource related project without due regard to the biodiversity, aquatic environment, fish habitat and natural drainage systems,

61. Mitigating adverse effect of water development projects

No water development activity or irrigation network should create serious environmental degradation and any adverse impact of water development and flood control projects shall be minimized through appropriate mitigation measures

62. Unauthorized encroachment on water resources

Any form of encroachment on water bodies including rivers and streams, if not authorized under rules, will be deemed illegal. The definition of encroachment or the purpose of this section shall be determined by the Ministry of Water Resources and notified in the Official gazette.

63. Dewatering of water bodies

Total dewatering of water bodies for agriculture, fisheries or grazing is not permissible and partial dewatering is allowed only where a substantial portion of the stored water or land area has traditionally been used for crop production or livestock grazing

64. Perennial links of water bodies with rivers

Perennial links of water bodies with rivers will not be disrupted by human action unless it is necessary in the greater interest of public projects.

CHAPTER VIII
FINANCIAL PROVISION

65. Water use charges

1) The government from time to time, by notification in the Gazette, establishes a pricing policy for charges for any water use.
2) Except for flood control and drainage projects for a period determined by the government, the pricing policy may set charges:
   (a) for funding water resource management including the related cost of:
      (i) Monitoring water resource and their use
      (ii) Water resource protection, including the discharge of waste and protection of the Reserve, and
      (iii) Water conservation;
   (b) for funding water delivery at actual cost including
      (i) the cost of investigation and planning
      (ii) The cost of design and construction
      (iii) The cost of operation and maintenance
      (iv) The cost of water distribution;
   (c) For achieving equitable and efficient allocation of water.
3) The pricing policy referred to in section (1) may -
   (a) differentiate on an equitable basis between:
      (i) different geographic areas, such as limited cost sharing in rural areas and full cost pricing, including overhead and depreciation costs, in urban areas
      (ii) Different categories of water use;
      (iii) Different categories of water users;
   (b) provide for a rebate for water returned to a water source, and
   (c) provide on an equitable basis for some element of the charges to be waived in respect of specific users for specified period of time.
4) The pricing policy may differentiate under section (3) -
   (a) In respect of different geographic area, on the basis of:
      (i) socio-economic aspect of the area concerned;
      (ii) the physical attribute of the area;
      (iii) the demographic attribute of the area;
   (b) In respect of different types of use and water users, on the basis of:
      (iv) The nature of consumption, with lower rate set for basic consummative uses and higher for commercial and industrial uses The extent of water use;
      (v) The quantity of water returned to a water source;
      (vi) The economic and financial status of water users.
5) The pricing policy may provide for a different rate for waste discharge, taking into account:
   (a) The characteristic of the waste discharged;

(b) The amount and quality of the waste discharged;
(c) The nature and extent of the impact on a water resource caused by the waste discharged;
(d) The extent of permitted deviation from prescribed water standards or management practice;
(e) The required extent and nature of monitoring of the water use.

6) In setting the pricing policy for water use charges, the government:
   (a) Shall consider the class and resource quality objectives for different water resources, and
   (b) May consider -
      (i) Incentives and disincentives to promote the efficient use and beneficial use of water;
      (ii) Incentives and disincentives to reduce detrimental impact on water resources, and
      (iii) Incentives and disincentives to prevent the waste of water.

7) Before setting a pricing policy for water use charges, the government shall -
   (a) Publish a notice in the Gazette:
      (i) Setting out the proposed pricing policy, and
      (ii) Inviting written comments from the stakeholders to be submitted on the proposed policy, specifying address and a date before which the comments are to be submitted, which date may not be earlier than 30 days after publication of the notice in the Gazette, and
   (b) Consider all comments received on or before the date specified.

66. Application of the pricing policy for water use charges

1) Water use charges:
   (a) May be levied within a specific water management area;
   (b) Shall be levied in accordance with the pricing policy for water use charges set under Section 65.
2) May be levied by and are payable to the water management institution concerned;
3) In the case of O&M charges, must be retained locally for the provision of services within the project area;

Provided that any person liable to pay water charges to a water service institution for water supply services or sanitation services will not be charged for those services under this Act.

67. Recovery of water use charges by water management institutions

The government may direct any water management institution to recover any charges levied on behalf of the government from water users within its water management area or area of operation, as the case may be, and shall compensate the institution for its services.

68. Liability for a water user charge

1) Any person using water must pay all charges imposed under section 65 in respect of that water use.
2) On non-payment of water use charge the defaulter will be subject to suspension of water supply and made liable for interest payment during the period of default at a rate determined from time to time by the government, by notice in the gazette, and in further default will be liable for other penalties as set in the Rules.
3) A person must be given the opportunity to make representations within a reasonable period on the imposed penalty under section (2) 9b) to a designated authority.

69. Water use charges are charges on land

1) A charge under Section 68, including any interest, is a charge on the land to which the water use relates and is recoverable from the current owner of the land without recovering from any other person who may be liable for the charge.
2) The concerned authority or relevant water management institution must upon written application by any person, and within 30 days of the application, issue a certificate stating the amount of any unpaid water charges and any interest due in respect of the land.

70. Effect or restriction on suspension of water use

A person whose water use is for any reason restricted or suspended may not:

(a) later claim the water he or she would otherwise have been entitled during the period of restriction or suspension; or
(b) claim compensation for any damage resulting from the restriction or suspension.

71. Financial incentives

Financial incentives shall be provided for water re-use and conservation and for preventing over-exploitation and pollution.

72. Authority for water tariff

1) The government may empower different authorities for setting water, sewerage and drainage tariff and collection of charges from time to time
2) It may take measures for converting the public sector agencies into financial autonomous entities with effective authority to charge and collect water tariffs and fees.

CHAPTER IX
WATER USER ASSOCIATION

73. To secure efficient distribution of water, incite an awareness of water conservation, participatory management and adequate maintenance of a project or system and to protect environment, the Government may authorize any officer or organization or local authorities to form water users association by the water users of a particular project, subproject or hydrological or social unit of a project.

74. Procedure to establish water user association

1) The government may determine procedures from time to establish water user associations, and revise these procedures for equitable, efficient and participatory water resource management including by ensuring the adequate representation of women, landless, share croppers and other vulnerable groups in the association.

2) Until separate Rules are framed by the Government, the Associations shall be registered within the framework of Cooperative Societies Ordinance and the Rules made there under.

75. Functions of the Associations:

The broad tasks and responsibilities of the Association will, among other things, include the followings:

(a) Stakeholders' interactive activities through preliminary discussions, meetings, motivations etc.

(b) Formally represent the beneficiaries and project affected persons in all issues relating to water management

(c) Participate in all stage of project cycle

(d) Prepare annual crop/other production plan and O&M plans

(e) Mobilize local resources and collect beneficiary contribution towards schemes investment and operation and maintenance cost

(f) Frame the working procedure

(g) Keep books of account for record and auditing

(h) Work with implementing agencies, NGOs, Community level self-help groups and LGIs including in arranging relevant extension, training and other service for various stakeholder groups.

(i) Progressively take up full or shared water management responsibilities

(j) Resolve conflicts, elect/select office bearers, explore economic activities around water resource project, sub-project/scheme.

CHAPTER X
ACCESS TO AND RIGHTS OVER LAND

76. Persons authorized to enter and inspect properties

(1) A water management institution may in writing appoint any suitable person to enter any property to carry out the activities set out in Section 78

(2) The person appointed under section (1) must be provided with a certificate of appointment signed by the authorized representative of the institution.

77. Power of persons appointed to enter and inspect properties

A person appointed under Section 76 may, enter a property:

(a) After giving reasonable notice to the owner or occupier of the property;
(b) To enquire whether this Act, any condition attached to an authorized water use under this Act, notice or directive is not being complied with.

78. Power to summon and examine witness etc.-

1) Any person empowered under this Act to conduct an enquiry shall, while holding such enquiry have all the powers of a civil court, while trying a suit under the Code of Civil Procedure, 1908 (Central Act 5 of 1908) in respect of the following matters, namely:-
   (a) summoning and enforcing the attendance of any person and examining him on oath;
   (b) requiring the discovery and production of any document;
   (c) receiving evidence on affidavit; and
   (d) any other matter which may be prescribed.

2) Every enquiry under this Act shall be deemed to be a judicial proceeding for the purposes of relevant sections of the Penal Code, 1860.

79. Issue of Warrant

A warrant shall be issued by a court which has jurisdiction in the area where the property in question is situated, and must only be issued if it appears from information obtained on oath that:

(a) There are reasonable grounds for believing that this Act, any condition attached to any authorized water use under this Act, notice or directive, is not being complied with.
(b) There are reasonable grounds for believing that any information supplied in connection with the use of water is inaccurate, or
(c) Access to the property has been denied.

80. Mode of recovery of money

Any amount due from any person in pursuance of the provisions of this Act or the rules made there under may, if the amount is in arrear, be recovered, without

prejudice to any other mode of recovery, in the same manner as an arrear of public revenue due on land.

81. Acquisition of servitudes

1) A person who is authorized under this Act to use water may claim a servitude of Abutment or Aqueduct or Submission or obtain amendment of any such existing servitude.
2) The rights and duties of servitude holder and landowners shall be determined by Rules.

82. Ownership of waterworks placed in good faith

A water management institution:

(a) Retains ownership of a water work placed in good faith on land belonging to another;
(b) May transfer the rights held in respect of improvement on the land to another water management institution.

CHAPTER XI
GENERAL PROVISIONS

83. Power to make rules and regulations

The Government may make rules and regulations:

(a.) limiting or restricting the purpose, manner or extent of water use;

(b.) requiring that the use of water from a water course be monitored, measured and recorded;

(c.) requiring that any water use be registered with the responsible authority unless exempted by provisions of this Act;

(d.) prescribing norms and standards for the design, construction, installation, operation and maintenance of water works;

(e.) regulating the design, construction, installation, operation and maintenance of any water work, in order to protect a water source or coastal marine water;

(f.) regulating or prohibiting any activity in order to protect a water source, habitat or coastal marine water;

(g.) prescribing waste standards which specify the quantity, quality and temperature of waste which may be discharged or deposited into or allowed to enter a water source or coastal marine water;

(h.) prescribing management practices to be used to treat waste, or any class of waste, before it is discharged or deposited into or allowed to enter a water source or coastal marine water;

(i.) requiring that waste discharged or deposited into or allowed to enter a water source or coastal marine water be monitored and analyzed and prescribing methods for such monitoring and analysis;

(j.) prescribing methodology for making volumetric determination of water to be ascribed to a stream flow reduction activity for the purpose of water use allocation and the imposition of charges; and

(k.) prescribing procedures for the allocation of water.

(l.) requiring concerned departments/organizations to establish effective systems to collect, process and disseminate data/information on water resources,

(m.) setting up of a mechanism that ensures that allocation of water between competing demands is compatible with sustainable use,

(n.) prescribing that water must not be obtained for speculation or be wasted,

(o.) requiring that end use must be socially acceptable,

(p.) clarifying the entitlement and responsibilities of users and providers and he role of the state vis-a-vis stakeholders, and

(q.) providing legal status for various water user groups.

84. Limitation of liability

Neither the state nor any other person is liable for any damage or loss caused by -

(a) the exercise of any power, or the performance of any function or duty under this Act;

(b) the failure to exercise any power, or perform any function or duty under this Act.

unless the exercise of or failure to exercise the power, or performance or failure to perform the function or duty was unlawful, negligent or in bad faith.

85. Amendment, substitution and withdrawal of instruments

1) A power to make an instrument under this Act, including any rule, regulation, license, directive or notice, unless the contrary intention appears in the relevant provision, includes a power to amend, substitute and withdraw that instrument.

2) A power to amend, substitute and withdraw an instrument under section must, subject to section (3), be exercised in the same manner and subject to the same conditions or limitations as the original power.

3) In the case of an amendment to an instrument which:

   (a) Does not significantly alter the rights and obligation of any person;

   (b) Corrects any clerical mistake, unintentional error or omission in an instrument;

The amendment may be made without following the procedure required for establishing or giving effect to the instrument, unless the contrary intention appears.

86. Overriding effect of the Act

1) Notwithstanding anything contained in any other law for the time being in force, the Act and rules made and order given under it shall prevail.

2) This Act overrides any provision in a prior law exempting a person from payment of a charge or limiting payment to a fixed charge for water use.

SCHEDULE - 1
PERMISSIBLE USE OF WATER

(1) A person may, without a water use permit issued under this Act -

(a) Take water for reasonable domestic use, small gardening and animal watering (excluding feedlots), by hand, hand-operated device (including portable containers) or small pump, directly from any water source including a stream, borehole and well to which that person has lawful access.

(b) Take water for reasonable domestic use, small gardening and animal watering (excluding feedlots) on land owned or occupied by that person, at a maximum rate of 5 liters per second not exceeding 5 cubic meters (5000 liters) per day directly from any water source to which that person has lawful access, and

(c) Store and use run-off water

(d) Construct any works thereon for rainwater harvesting or for recycling of used water otherwise than in a river or stream and abstract and use the water so conserved or recycled for domestic purposes

(e) May construct a shallow hand pump or dug-well and use the water for domestic purposes subject to any limitation on the depth of such wells in any area as may be prescribed in regulations made under this Act.

(f) In emergency situations, take water from any water source for beneficial use;

(g) For recreational purposes -

(i) Use the water or the water surface of a water resource to which that person has lawful access, or

(i) Portage any boat on any land adjacent to a watercourse in order to continue boating on that water course;

(2) An entitlement under this Schedule does not override any other law, ordinance, by-law or regulation, and is subject to any limitation or prohibition hereunder.

SCHEDULE II
CONTROLLED ACTIVITIES

The following activities are controlled activities for the purposes of Article 41 of this Act.

(a) Irrigation of any land with waste or water containing waste which is generated through any industrial activity or a water work;
(b) Intentional or attempted modification of atmospheric precipitation;
(c) Power generation activities which alter the flow regime of a water resource; and
(d) Intentional recharging of an aquifer with any waste or water containing waste.

SCHEDULE III

POWERS, FUNCTIONS AND DUTIES WHICH MAY BE EXERCISED BY A WATER MANAGEMENT INSTITUTION ON ASSIGNMENT OR DELAGATION

1. General

Subject to the provisions of this Act, a water management institution may exercise any of the powers and perform any of the functions and duties set out in this Schedule or any other powers, functions and duties which the government considers to be necessary or desirable in order to ensure compliance with this Act.

2. Powers to manage, monitor, conserve and protect water resources and to implement catchment management strategies

A water management institution may -

(a) manage and monitor permitted water use within its water management area;

(b) conserve and protect the water resources and resource quality within its water management area; and

(c) do anything necessary to implement catchment management strategies within its water management area.

3. Water management institutions may establish rules to regulate water use

A water management institution may establish rules to regulate water use.

1) The rules established under sub-paragraph (1) may relate to, amongst other things, the manner in which -

   (a) The times when;

   (b) The places where;

   (c) The manner in which; and

   (d) The waterworks through which; Water may be used.

2) A water user must adhere to the rules established under sub-paragraph (1) if those rules apply to the user.

3) A rule established under sub-paragraph (1) prevails over a distribution condition contained in any authorization.

4) Before establishing the rules under sub-paragraph (1), a water management institution must publish a notice inviting written comments to be submitted on the proposed rules, specifying an address and a date before which the comments are to be submitted, which date may not be earlier than 30 days after publication of the notice.

4. Water management institution may direct the termination of illegal water use

1) A water management institution may direct any person whom in the opinion of the institution, uses water -

   (a) In a manner which is not permissible under this Act; or

(b) In breach of any condition.

To terminate such illegal use within the period specified in the directive.

2) If a person to whom a directive was given under sub-paragraph (1) fails to comply with the terms of the directive within the period specified under sub-paragraph (1) the water management institution may -

(a) Suspend the authority to use the water for a period specified in the notice and /or

(b) Remove a water work used for the purpose.

5. Water management institution may temporarily control, limit or prohibit the use of water during periods of water shortage.

1) Despite anything to the contrary in an authorization, a water management institution may -

2) By written notice to the water user in the area, who, in the opinion of the institution may be affected;

If that authority on reasonable grounds believes that a water shortage exists or is anticipated within an area -

(i) Limit or prohibit the use of water;

(ii) Require any person to release stored water under that person's control;

(iii) Prohibit the use of any water work;

(iv) Require that specified water conservation measures be taken.

3) A notice given under sub-paragraph (1) must -

(a) Specify the geographical area or water resource to which the notice relates;

(b) Set out the reason for the notice; and

(c) Specify the dates of commencement of the measures.

4) In exercising the powers under sub-paragraph (1), the responsible authority must-

(a) Give preference to the maintenance of the reserve;

(b) Treat all water users on a basis that, in the opinion of the water management institution, is fair and reasonable; and

(c) Consider -

(d) The actual extent of the water shortage, and

(e) The likely effects of the shortage on the water users.

5) If the owner or person in control of a water work contravenes a notice issued under sub-paragraph (1), the water management institution may -

(a) Modify, or require the owner of the water work to modify the water work so that it cannot be used take more water than that allowed for in the notice, or

(b) Remove the water work or require the owner to remove the water work if the notice contains a prohibition on the use of that water work.

6) A water management institution may recover from the owner any reasonable costs incurred by it in acting under sub-paragraph (4).