

WPS 1569

POLICY RESEARCH WORKING PAPER

1569

Improving Water Resource Management in Bangladesh

Rashid Faruque

Yusuf A. Choudhry

The management of water resources has become a critical need in Bangladesh because of growing demand for water and increasing conflict over its alternative uses.

The World Bank
South Asia
Country Department I
Agricultural and Natural Resources Division
January 1996



Summary findings

As populations expand and make various uses of water, its growing scarcity becomes a serious issue in developing countries such as Bangladesh. Water can no longer be considered a totally free resource, and plans must be developed for its efficient use through better management and rules that preserve everybody's access to it and interest in its development. Because it is a common resource, its development and management should involve all beneficiaries.

The government's role in this process is to establish the ground rules for water use and conservation through a policy and legal framework and a monitoring system that ensure its continued safety of supply to — and responsible use of water by — every sector and user in the economy. National water policy must set the ground

rules for allocation to different users, water rights, pricing, and environmental safety.

Bangladesh's water strategy should start with a national water policy that spells out key objectives such as priority of use by critical economic sectors, approaches to water pricing and cost recovery for development, and shared public- and private-sector water management. An apex public planning organization is needed to perform overall planning for water resources and to advise the National Water Counsel on policy and legislation. Also needed are agencies to implement public water plans for the development of infrastructure, the monitoring of water regimes, and the enforcement of regulations.

This paper — a product of the Agricultural and Natural Resources Division, South Asia, Country Department I — is part of a larger effort in the department to analyze the major issues in managing land and water resources and developing a strategy to improve the management of these vital resources of the economy. An earlier version of this paper was presented at the conference on Bangladesh Agriculture in the 21st Century held in Dhaka on November 6 and 8, 1995. Copies of this paper are available free from the World Bank, 1818 H Street NW, Washington, DC 20433. Please contact Clydina Anbiah, room T7-020, telephone 202-458-1275, fax 202-522-1778, Internet address canbiah@worldbank.org. January 1996. (42 pages)

The Policy Research Working Paper Series disseminates the findings of work in progress to encourage the exchange of ideas about development issues. An objective of the series is to get the findings out quickly, even if the presentations are less than fully polished. The papers carry the names of the authors and should be used and cited accordingly. The findings, interpretations, and conclusions are the authors' own and should not be attributed to the World Bank, its Executive Board of Directors, or any of its member countries.

IMPROVING WATER RESOURCE MANAGEMENT IN BANGLADESH

Rashid Faruque
&
Yusuf A. Choudhry

Agricultural and Natural Resources Division
South Asia - Department 1
The World Bank

Contents

Summary

Introduction	1
I. An Analytical Framework for An Improved Water Management System	3
<i>Guiding Principles</i>	3
<i>The Framework</i>	5
II. Elements of the Framework and the Current Situation in Bangladesh	5
<i>National Social, Economic and Environmental Objectives</i>	6
<i>Establishing Priorities for Provision of Water Services</i>	8
<i>Water Policy</i>	8
<i>Policies on Water Pricing and Cost Recovery</i>	9
<i>Private Sector Management and Investment Principles</i>	10
<i>Public Sector Management and Investment Principles</i>	11
<i>Legal and Regulatory Framework</i>	11
<i>Administrative Rules</i>	11
<i>Institutions</i>	12
III. The Strategy for Bangladesh	14
<i>Formulating the National Water Sector Policy</i>	14
<i>Formulating Policy on Water pricing & Cost Recovery</i>	15
<i>Public Sector Management and Investment Strategy</i>	16
<i>Laws and Regulatory Framework</i>	16
<i>Framing of Administrative Rules & Regulations</i>	17
<i>Institutions (Organizations)</i>	21
<i>Organizations for Policy & Regulation</i>	25
<i>Organizations for Planning and Information Management</i>	26
<i>Organizations for Investment and Real-Time Management</i>	30
IV. The Action Matrix	36
<i>Annex-I Bangladesh: Major Water Sector Organizations and Related Agencies - Current Functions and Deficiencies</i>	38

An earlier version of this paper was presented at the conference on Bangladesh Agriculture in the 21st Century held in Dhaka on November 6 and 8, 1995. The Authors acknowledge the comments and suggestions received from the discussants of the paper and participants of the conference.

LIST OF TABLES

Table 1	Principal Water management Functions and Gaps in Bangladesh	17
Table 2	Laws, Regulations and Administrative Procedures for Water Sector Management in Bangladesh	20
Table 3	Principal organizations for Enforcement of Water Regulations in Bangladesh	24
Table 4	Water sector Activities and Responsible Organizations	32

LIST OF FIGURES

Figure 1	A Framework for Water Resource Management in Bangladesh	7
Figure 2	Bangladesh: Current Set-Up of Organizations in the Water Sector	23
Figure 3	Proposed Institutional Set-Up for Water Resource Management in Bangladesh	25
Figure 4	Proposed Structure of WARPO	29

Summary

The management of water resources has become a critical need for Bangladesh due to growing demand and increasing conflict between alternative uses. Water is a unitary resource which means that controlling it in one location can have adverse impact on others. Structures built to control flooding in one area have exacerbated the problem in others, in addition to creating undesirable externalities on agriculture, fisheries, navigation, transportation, etc.

Water resource management generally implies management of both the supply and demand for water. Because it is a scarce commodity, its use should be determined by opportunity cost pricing. Water is both a public and a private good and the system that allocates it should take into account the needs of all the users, particularly the underprivileged class. Because it is a common resource, its development and management should involve all beneficiaries.

The government's role in the development of water resources is to provide a policy and legal framework which sets the conditions for its use. A national water policy is needed to set the ground rules for allocation to different users, setting rights, pricing, and environmentally safe utilization. Along with policy, the governments also needs to establish the regulatory and monitoring system to ensure safety of supply and responsible use of water.

The future water strategy of Bangladesh should start with a national water policy that explicates key objectives like priority of use by critical sectors of the economy, water pricing and cost recovery for development, and the public and private sector management domains. There is need for an apex public planning organization that could perform the macro planning functions for water resources and advise the National Water Council on policy and legislative matters. The other necessary public institutions are agencies to implement the public water plans for development of infrastructure, monitoring of the water regime and enforcement of regulations.

The Government of Bangladesh had created the Water Resource Planning Organization (WARPO) for overall water planning in the country. This organization could be made effective with a redirection of its mandate and simple restructuring to include the multi-disciplinary functions of technical and socio-economic planning, data monitoring and evaluation, and regulation. WARPO should also develop the national water plan incorporating the principles of equitable water rights and priority fixed by the policy makers.

The Water Development Board (BWDB), whose original mandate was to develop physical infrastructure like dams, embankments, canals, etc. is the best organization for design and implementation of major water projects under the overall water plan. It, however, needs a re-fixation of its mandate and considerable restructuring to strengthen

its project implementation capacity. The Local Government Engineering Department (LGED) has performed excellently in the past and should continue to be the principal agency for development of small water schemes in collaboration with local users.

The other important organizations are the research institutions, like the River Research Institute (RRI), the Surface Water Monitoring Cell (SWMC) and the Geographical Information System (GIS) unit. SWMC and GIS have developed as excellent centers for water modeling and mapping under the Flood Action program (FAP). They should be maintained, at least in their present form, for future assistance in water planning including development of the national water plan, either with WARPO or as independent units.

The overall management of the water resources in Bangladesh would therefore be shared between state water agencies, users of water including the public, NGOs, and other government agencies in agriculture, industry, commerce, water and sewage, public health, municipalities, inland water transport, roads and highway, fisheries, forestry, environment, etc.

IMPROVING WATER RESOURCE MANAGEMENT IN BANGLADESH

Introduction

The demand for water and the ability to control its location, timing, quality and quantity are becoming critical with the growing population of Bangladesh. Starting with simple agricultural needs the pace of development has been placing increasing demands for industrial and municipal use of fresh water. The changing characteristics and magnitude of flood in the country has also changed the ways in which people used to respond to it in the past. Traditional activities like inland fishing has been affected by many human efforts to contain flood. Increasing erosion of river banks have enhanced environmental problems and have assumed major importance due to land and settlement pressures. The harnessing of water upstream in the Ganges plain and associated changes in river morphology has added new dimensions to its availability, in time and location. With all these current problems and the high probability of further deterioration of the situation, it is imperative for the country to develop a strategy and a long-term plan for management of this critical resource.

The Bangladesh Water and Flood Management Strategy, prepared in October 1995, presents a strategic framework for the development of a national water management system for the country. [see Box 1]. The strategy outlined will require a sound system for managing and developing water resources in Bangladesh. This system has to serve the water sector goals, keeping in perspective the resource constraints and the need for dynamism to make it responsive to the changing times. In Bangladesh, where water is a prime economic resource for agriculture (contributing 30 percent to GDP), water transport (contributing 4 percent to GDP), energy, water and sanitary services (contributing 2 percent to GDP), its value as an economic good cannot be underrated and the need for efficient management overemphasized.

The management of water resources needs to focus on both supply and demand aspects. Investments in dams, reservoirs, wells, pumps and canals have in the past provided adequate access to fresh water supplies. But with the growing demand imposed by population and modern usage of water, the supply-side approach to water planning is meeting its limitation. The availability of surface water in Bangladesh has declined with greater upstream use by India, in parts of the years, and groundwater potentials are fast depleting with increasing usage, particularly agricultural. The option remaining is to look for improved demand management to bring water use into balance with supply. It has also been now recognized that the country has a better chance of combating seasonal flood (when excess supply occur) through better flood management rather than flood control measures.

Box 1. Bangladesh Water and Flood Management Strategy

The strategy formulated by the Government of Bangladesh calls for:

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

Undertaking Integrated Water and Land-Use Planning: This would involve: (i) drainage, irrigation, landuse, cropping pattern, environment, erosion/sedimentation control, fisheries, navigation and salinity management and provision of water supplies, (ii) protection against drought and tidal surge, and (iii) coordinated planning and construction of rural roads, highways and railway embankments with provision for unimpeded drainage.

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

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

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

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

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

Developing appropriate institutions: In the next 10-20 years, a strategic institutional framework has to evolve that supports the sector goals and objectives with optimal efficiency (e.g. harmonizing environmental and social objectives with production and distribution objectives balancing quantity and quality

In designing a sound system for water management in Bangladesh, one has to consider the analytical framework for sound management of water resources -- the framework that will consider the goals and objectives of water resource management, issues and constraints facing the sector and the policies, programs and institutions that the country has to develop to realize the objectives.

I. An Analytical Framework for an Improved Water Management System

The comprehensive framework, proposed in this paper, attempts to analyze Bangladesh's needs, resources, and capabilities for comprehensive water management. The framework is a tool for evaluating options for public water management within the guidelines of a national water strategy, incorporating the interdependency between land and water use.

Guiding Principles

The guiding principles for the analysis of water resources and evaluation of alternatives are:¹

Water should be treated as an economic good.

Besides being a social and environmental good, water is also an economic good that needs to be managed both quantitatively and qualitatively. In Bangladesh, particularly, where water is intricately linked with the economic lives of people, its value has increased with competing demand. Therefore, economic efficiency of water use is a major policy consideration.

Water use must increasingly rely on opportunity cost pricing.

When water becomes scarce, even for a short period (e.g. seasonal drought in Bangladesh), the quantitative limits and the unitary nature (intervention in one cycle causing impact on other cycles) results in growing conflicts among users. It thus become necessary to use opportunity cost to value water, although it may be more difficult when appropriate information is lacking. Water pricing and economic incentives for efficient water use are critical policy decisions under these circumstances.

Water planning should be comprehensive, taking into account all sectors and usage.

Because of water's special characteristics,² it cannot be left to the mercy of unregulated markets. Frequent floods and droughts in Bangladesh pose tremendous variability in the supply of water (rainfall, surface and groundwater). This extreme variability is difficult to manage using price and the market mechanism. The government of Bangladesh is facing

¹ These are consistent with the Dublin Statement (1992) from the International Conference on Water and Environment and with Agenda 21 of the 1992 United Nations Conference on Environment and Development.

² Characteristics that set water apart from other economic goods are (i) lack of substitutes, (ii) unitary nature, (iii) high variability in location and time, and (iv) relative immobility due to cost, investment indivisibility and movement constraints, and complex social and institutional arrangements controlling ownership and use.

growing problems because it has failed to address water resources issues in a comprehensive manner.³ Separate ministries and departments are in charge of surface irrigation, groundwater irrigation, fisheries, public health, environment, municipal water supply, power, and navigation; each acting independently of the other. The interdependency among sub-sectors and uses should be recognized and comprehensive planning, taking the interest of all users into account, should be used to reduce the conflicts in the system.

Proper Emphasis on environmental protection.

Water is an essential component of the environment and preservation of its quality and availability in critical areas of need are vital for the well being of the society. Pollution control and maintaining water quality is not given enough emphasis in a poor country like Bangladesh. Polluted water is the main cause of many health problems such as diarrhea diseases. Inadequately treated sewage pollutes water-dependent food sources and limits access to safe drinking water.

Proper Focus on poverty alleviation

The adverse effect of low water availability and quality is more on the poor, and the latter are significant factors in the spread of diseases in crowded low-income areas. Emphasis should therefore be placed on meeting water needs of the poor. Policies on water rights, and in some cases cross-subsidy, could be utilized for this purpose.

Water management and delivery systems should be decentralized.

Decentralization is essential because the government on its own cannot adequately meet the cost of water resources development and distribution. Decentralization also makes the task efficient and easier for the government, because instead of micro-managing the smaller scale operations it could concentrate on providing private incentives for quality distribution at the lowest price. However, because of high fixed costs of conveyance, the tendency for growth of natural monopoly in water distribution is high and the government needs to regulate the system by creating opportunities for competition, pricing and quality control. Many countries in Asia (Indonesia, Pakistan, Philippines, Sri Lanka), Africa (Cote d'Ivoire, Morocco, Niger, Senegal), and South America (Argentina, Columbia, Mexico) are transferring government operated water systems to private firms, public utilities, and water user associations.⁴

Extensive participation by stakeholders should be ensured.

Significant benefits accrue from user participation in the planning, implementation, operation and maintenance of water works. Firstly, it achieves broad based support for the project in the community and command area, and generates active interest in its operation and maintenance. Secondly, it reduces the financial and managerial burden on the government as users take on responsibility of managing considerable part of the operations and pay for the services they consider their own.

³ Most of the problems have been highlighted in "Bangladesh Water and Flood Management Strategy", FPCO, Dhaka, March 1995.

⁴ See Water Resource Management, World Bank Policy Paper, 1993.

The Framework

Figure 1 shows a schematic framework for water policy and management that is relevant for a country like Bangladesh. Central to the entire process is the national water strategy (NWS), which lays down the long, medium and short-term programs for the sector.⁵ Essential inputs into the NWS are (i) the national social, economic and environmental objectives, (ii) priorities for provision of water services to different sectors and users, and (iii) an assessment of the country's net water resources based upon supply and demand projections (which in turn are based upon projected population growth, rate of economic growth, rainfall, surface water and ground water projections).

The National Water Strategy is also guided by the country's policy on water rights and water pricing and cost recovery. Its two main components are a public sector management and investment strategy and a private sector management and investment strategy. Public sector strategy includes:

- (i) Laws and regulatory Framework, which specify water rights, water pricing, and conservation and environmental standards.
- (ii) Administrative rules, which specify mechanism for water allocation, monitoring and control, and coordination of water use between sectors.
- (iii) Institutional arrangements for public organizations responsible for policy and regulations, enforcement of water laws and rules, monitoring and data collection, planning, investment, O&M and including public participation in all phases of water development and use.
- (iv) International agreements, including the joint sharing of water in the major rivers with neighboring countries, and environmental protection.
- (v) Investment programs, between short to long-term, for flood management, surface and ground water development, and environment management.

The private sector strategy is based on government's efforts and assistance to increase private participation in water development, including investment, operation and maintenance and cost sharing. It particularly specifies the role and facilities provided to autonomous agencies like the NGOs for increasing public awareness and participation in this development process.

II. Elements of the Framework and the Current Situation in Bangladesh

This section discusses the components of the framework (in Figure 1) and assesses the situation in Bangladesh in regard to these components.

⁵ The proposed programs were presented in the Bangladesh Water and Flood Management Strategy designed by the Flood Plan Coordination Organization, with assistance from the World Bank in March 1995.

National Social, Economic and Environmental Objectives

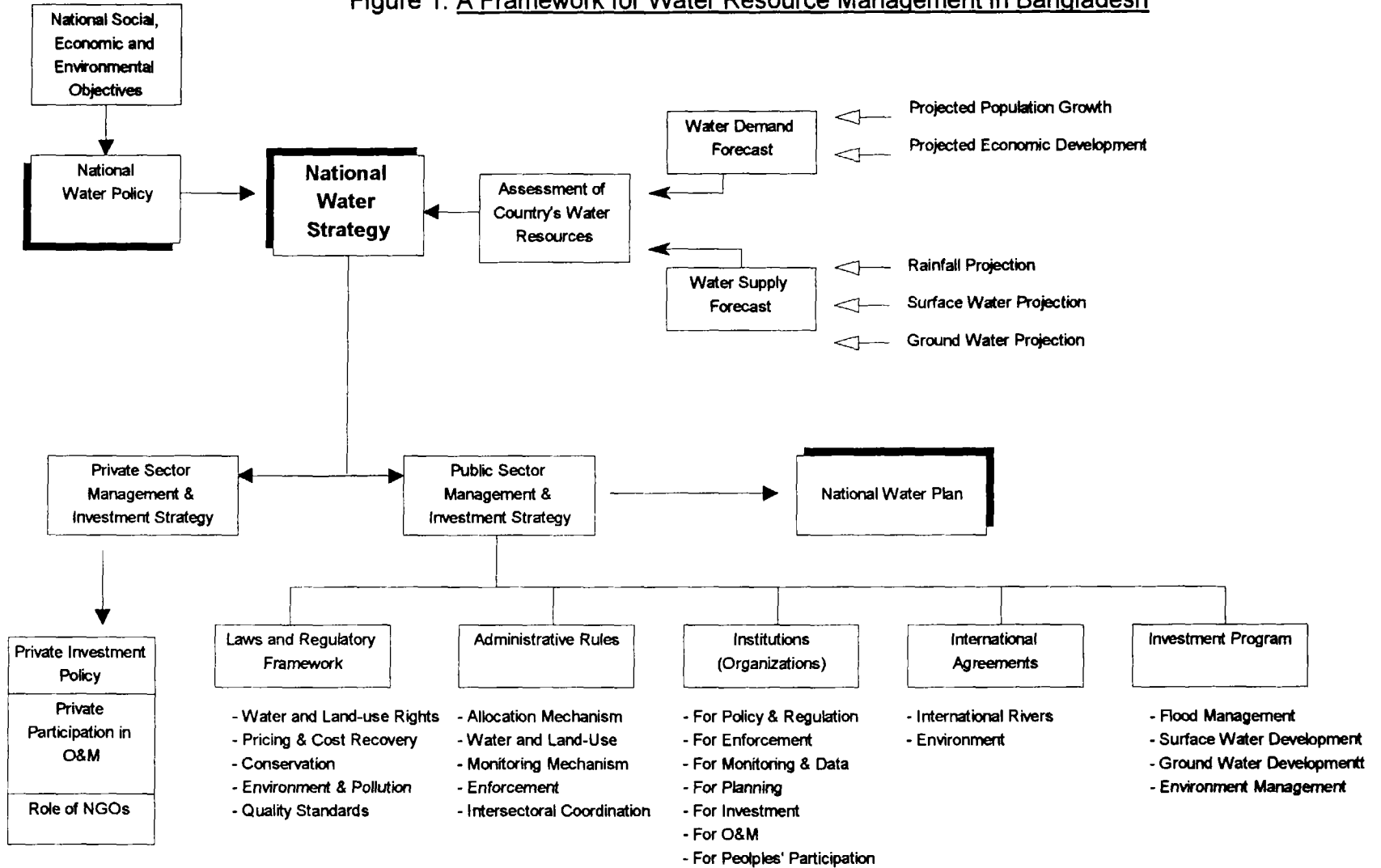
Development objectives that have significant bearing on utilization of water resources are:

1. Industrial objectives, particularly the provisions for industrial growth, type and location of industries. Water is an essential requirement for many industries, particularly for effluent discharge. It is also linked to industrial waste processing and maintenance of environmental standards. Although present consumption by industries in Bangladesh is small in absolute terms, the demand is projected to increase from 39 million cubic meters per month in 1995 to 64 cubic meters per month in 2005.⁶
2. Energy and power generation objectives. Presently, Kaptai Hydroelectric Plant is the only source of hydro power in Bangladesh. But there are plans for a number of other power projects in the Power System Master Plan, including extension of Kaptai, projects on Sengu and Teesta rivers, Matamuhuri Projects, etc.
3. Flood management objectives. Since Bangladesh lacks storage capacity for flood water, flood protection has centered on embankments, river closures, drainage control structures and drainage pumps. Storage of flood water in river channels and floodplain depressions are also prevalent. Static water bodies, such as river channels and ponds are often used for conserving flood and monsoon water for dry season irrigation.
4. Irrigation objectives, including major surface water irrigation and minor irrigation. The former consists of primary pumping plants and gravity diversion schemes in canal distribution systems and the latter consists of small manual and powered pumps to lift surface or ground water with earthen distribution systems constructed by farmers. Conjunctive use of both surface and groundwater is also a major objective to meet agricultural demand in the critical months, February-April, when surface water availability is low. Surface and groundwater are hydrologically interconnected, except for groundwater stored in confined aquifers. Concurrent planning for both are therefore essential.
5. Agriculture, fisheries, livestock and forestry objectives. Fisheries is an extremely important aspect of Bangladesh rural economics, nutrition and poverty alleviation measures. An estimated 73 percent of rural households take part in this activity.⁷ There are about 78,000 hectares of ponds where fish culture is practiced.
6. Environmental objectives. Specific objectives and guidelines for environmental impact assessment and research and training programs were developed under the Flood Action Program (FAP), which need to be implemented for sustainable development.

⁶ MPO estimate. See National Water Plan, GOB, 1986.

⁷ Source: Bangladesh Fisheries Resource Survey System, Directorate of Fisheries, GOB.

Figure 1: A Framework for Water Resource Management in Bangladesh



7. Economic stabilization, including macro-economic reforms, public sector rationalization, private sector development, poverty alleviation, health and human services, etc. Although Bangladesh has made significant advances in macroeconomic reforms, much remains to be accomplished in the restructuring of public enterprises and providing incentives for growth of the private sector such as liberalization of the financial markets, clarity and consistency in industrial and labor policies, etc.⁸ Poverty reduction objectives are intricately related to water policy since water is a major factor input in rural income generation.
8. Decentralization and shifting the point of control for development schemes, which will particularly assist in formulating plans for peoples' participation and involvement in managing water programs.

Establishing Priorities for Provision of Water Services

The government has to examine water needs of various sectors pursuing their respective goals and determine priorities of demand based on the national objectives. Although at present agriculture consumes the major part of water resources in the country, the demand from municipalities and industry are rising. Presently municipal water supplies are mostly obtained from groundwater sources, but overexploitation has denuded aquifers and there are critical shortage of groundwater specially in large metropolitan areas like Dhaka. The country's industrial concentration is also around Dhaka and rising industrial demand for water is likely to become a problem in the near future. It is possible that the constrained water supply for domestic and industrial usage will require cutback of groundwater irrigation in many areas. There is no consolidated policy for this yet, but this has to be developed in the immediate future.

Preservation of natural fisheries must be weighed against irrigation development and flood control and drainage, as the latter has already affected river and open area capture fisheries in many places in Bangladesh.⁹ Dams and diversions for irrigation also affect inland navigation and their respective importance have to be determined by policy makers. Similarly, provisions for environmental use of water has to be made to combat salinity and deforestation.

Water Policy

Many countries in Asia, like India and Thailand, have published statements on national water policy.¹⁰ Others, like China, Philippines and Indonesia, have embedded water policies in legal codes. Bangladesh does not have an approved national water policy.

⁸ See Bangladesh: From Stabilization to Growth, World Bank Country Study, Washington D.C. 1995.

⁹ See Bangladesh Water and Flood Management Strategy, FPCO, Dhaka, September 1995; Water Resource Management in Asia, by Herald Frederiksen, et al. Volume 1, World Bank Technical paper No. 212, Washington D.C. 1993.

¹⁰ See Water Resource Management in Asia, by Harold Frederiksen, et al. World Bank, *ibid*.

Although the National Water Plan (NWP) did suggest a set of water sector policies, they were not comprehensive and never formalized. Consequently, planners and managers of water resources have no guidelines for actions, which may prove detrimental to the national interest. Disjointed policies also create conflicts between sub-sectors and different aspects of water use. Flood mitigation policies, (through FCDI projects), have had negative impact on fisheries and navigation. Uncontrolled groundwater extraction have lowered the water table in many areas, adversely affecting drinking water supplies. To deal with such inconsistencies, gaps and overlaps in water management, a coherent and consistent water policy is essential for Bangladesh.

Policies on Water Pricing and Cost Recovery: Given the value of water to life and livelihood, governments allocate it on the basis of political and social considerations rather than purely economic criteria. Pricing water below its economic value is prevalent throughout the world.¹¹ In many countries this has created tremendous strain on the water dependent eco-system. Farmers who pay little for their publicly supplied water often misuse it by growing water-intensive crop (as for example sugarcane in Pakistan and Maharashtra in India where an estimated 10 percent area used for sugarcane growing uses 50 percent of irrigation water¹²). City dwellers fail to conserve water when it is cheap, as for example in many cities of South Asia.

For preserving the financial viability of a public water supply institution and for establishing a water market for private sector activities, it is essential to price water according to some reasonable standard. Because demand is responsive to price, it is worthwhile to measure, monitor and price water carefully to cut back on waste without cutting back on needed service. Determining the opportunity cost could be a important step in guiding policies for pricing of water and to establish the magnitude of penalties to be imposed on polluters. Experience has shown that the poor are willing to pay for good water services (as high as 8 percent of their income in Kenya)¹³ and that cost recovery is feasible with good management. For instance, water charges could be applied on a graduated scale such that beyond a set standard, the user has to pay increasingly higher amounts. Water pricing policies of the government has to take into account the various factors that affect the growth of an efficient water market, with an active private sector.

Besides setting the right prices, government policy also has to address the issue of cost recovery. Nonpayment and non-collection of water dues are sadly common in many parts of the world, including Bangladesh. Two reasons for this failure are fairly obvious, low incentive to collect and low willingness to pay for lack of adequate service quality. The former is mostly for political reasons and the latter is almost a consequence of the former.

¹¹ See Water Resource Management, World Bank, op cit. A recent review of municipal water supply projects by the World Bank found that the price charged for water covered only 35 percent of the cost, and charges in many irrigation system are much less.

¹² See India Irrigation Sector Review, Agriculture Operation Division, India Country Department, World Bank, Washington D.C. December 1991.

¹³ See World Development Report, The World Bank, 1992.

Failure to recover cost results in low financial outlays and reduced services which again leads to non-payment of dues by beneficiaries.

Private Sector Management and Investment Principles

An important step to counter the persistent sluggishness in public investment is to boost private investment. In the water sector, private agencies can provide investment and management resources that could increase its efficiency many fold. Under ideal conditions, the government should assume responsibility for overall management of the resources for the benefit of society, undertake major development programs and provide public services of purely public good nature. The private sector should invest in developing the commercial aspects of water system production and delivery.

Private sector participation in providing water services can take many forms. A typical arrangement is private leasing or concession where a facility is given in long-term lease through competitive bidding to a private operator. The lessee provides investment for improvement of the facility and for operating and maintaining it. Such arrangements are found in Cote d'Ivoire, Guinea, Macao, Portugal, Spain and Argentina.¹⁴ Many countries in Latin America are adopting similar approaches. Bangladesh's success with private sector participation in the sale, operation and maintenance of tubewells is particularly notable. Other types of privatization include transfer of facilities to beneficiary groups like water user associations. This arrangement exists in many countries, such as Argentina, Mexico, Philippines, Indonesia, Nepal, Sri Lanka, Pakistan, etc.

There are a number of private firms in Bangladesh capable of providing consultancy, design, construction, O&M and other services in the water sector. Following government's willingness to encourage the private sector to take over as much commercial functions as possible from the state agencies it may benefit the sector to have well conceived policies to create appropriate opportunities private operations. Operational contracts have been awarded to private companies in agricultural services by major public organizations in the past and the same could be tried for decentralizing water services.

No matter what type of privatization measures are adopted, it is essential to provide proper policies for their success. These include legislation for establishing water property rights, trading rights, quality standards, dispute resolution mechanism, etc.¹⁵ Clear policy enunciation by the government and enforcement principles will facilitate the development of an efficient water market.

A large number of NGOs are active in Bangladesh with various aspects of social development, including employment generation, poverty reduction, health, sanitation, etc. These organizations could have important roles to play in the development of private water markets and policy measures should facilitate this. Particularly, NGO could assist in

¹⁴ See Water Resource Management, The World Bank, op cit.

¹⁵ See "Water Markets: Opportunities and Concerns", by K. William Easter, in Water Policy and Water Markets, World Bank Technical Paper No. 249, Washington D.C. 1994.

formation of user groups, facilitate information exchange and even provide capital assistance to small entrepreneurs. NGOs could also contribute significantly to environmental activities including educating the public, monitoring environmental hazards and mobilizing the people to undertake protection measures for water resources.

Public Sector Management and Investment Principles

Legal and Regulatory Framework: Legislation provides the basis for action by government or non-government entities and individuals. The state owns all natural resources and the government tacitly authorizes the use of water. But priorities are not clearly indicated and in some areas altogether ignored such as the environmental aspects of water use. As indicated before, the social value of water, externalities in water use and the tendency towards natural monopoly require effective regulatory measures. Regulatory systems monitor and enforce established laws, agreements, rules and standards. The principal areas covered by regulations are water rights and allocation, standards of service, water quality and environmental protection, watershed management, soil and water conservation, prices charged by regulated utilities, ease of entry to water services industries, etc. In Bangladesh, there are but few regulations in the books for covering the areas listed above, and more alarmingly they are badly administered. This is partly due to the multiplicity of agencies administering water rules, each following its own agenda without regard to the effect it has on the others. For example, the Agriculture Ministry's plans for groundwater irrigation may conflict with the Public Health Engineering Department's plans for use of groundwater for drinking. Pricing policies are also inconsistent, as for example irrigation water is priced well below municipal water price. Under these conditions, the need for centralized policies for water resources becomes indisputable.

Administrative Rules: Water rights legislation must be backed by appropriate rules for their administration. Clear administrative procedures for determining priority of use, allocation mechanism, timing, duration and the quantity and quality of supply are important for protecting both government and private sector investments and assuring fair water allocation in the market. In countries with efficient water administration, the source of water, geographical restrictions on its use (including linkages to land use), limitation on class of use, quality restrictions on source and return flows, and rules for any transfer of rights by the holder, are well defined.

Many countries still treat water and land-use separate issues. Public sector plans for committing these resources are made by different agencies and are not well coordinated. It is efficient to integrate land use and water use issues both in planning and operation. Appropriate rules and procedures should guide the administration of a system of rights/licenses and the working of an efficient water market. There should be a clear mechanism for assuring consistency and timeliness of implementing water rights and inter-linked land rights. In Bangladesh, project delays are common due to ineffectiveness of procedures for land acquisition.

The formulation of rules to administer water standards entail a wide range of action, from clarifying legislation to preparing manuals and guidelines. To assure practicality of objective and approach, local entities like NGOs and the public should actively participate in this task. What constitutes a violation and the associated penalties must be clearly stated, widely disseminated, and enforced promptly and uniformly.

Well administered service standards and regulations are as essential to sustaining good water services as the physical facilities themselves. Where comprehensive standards are prepared and enforced, service quality is high and the beneficiaries are more able and willing to pay. Furthermore, the system developed must be capable of providing an acceptable service under reasonable O&M costs.

Administrative rules must also cover institutional arrangements for coordinating mutually agreed upon priorities and policies of different water-related agencies. In many countries, river basin authorities are established to manage individual river basins. Other alternatives used are appointment of coordinating committees, with representatives from major public water agencies.¹⁶ Such committees have responsibility for reviewing and recommending investment and management principles to promote the overall water resource strategy and achieve consistency within the sector.

Institutions (Organizations): There are three main participants in water resources development and management: government, non-government entities and the private sector. The appropriate role of the government is to control overall exploitation and management of the resources for the benefit of society (through appropriate laws and regulations), undertake investment programs of a public good nature, and fill-in the gaps caused by market failure. Non-government entities should develop and manage resources for their members' benefits within bounds established by the government. Private sector activities parallel those of the non-governmental entities except for scale and profitability motive.

The implementation of water resource management policies in Bangladesh have many implications for public institutions dealing with water resources. Institutional structure at the national and local level are necessary for formulation and implementation of policies for improved water management and public investment programs. Many countries have utilized river basin management authorities to coordinate all water management functions within a basin. The system prevailing in some of them is described in Box 2.

Bangladesh has the National Water Council, with representations from all water-related ministries, for policy formulation at the highest level of government. It also has the Water Resource Planning Organization (WARPO) for overall planning of water resources and ensuring its optimum utilization among various users such as agriculture, fisheries, navigation, public health, industry etc.¹⁷ WARPO is also supposed to consolidate data on water collected by various agencies. The organization, however, has not operated

¹⁶ See Water Resource Management, The World Bank, op cit.

¹⁷ See FAP 26: Institutional Development Program, Report No.2, Dhaka, February 1995.

satisfactorily for various constrains and very little has been accomplished in sectoral planning or coordination. Individual line ministries have their own planning departments, which operate in more or less complete isolation of one another.

The River Research Institute (RRI), which includes the Surface Water Modeling Control (SWMC) unit, is a research and data generation unit for hydraulic and river studies. It has limited function for collecting broad water resource data.

Major investments in the water sector are made by the Ministry of Water through the Water Development Board (BWDB) and by the Ministry of Local Government and Rural Development through its Local Government Engineering Department (LGED). Besides other water related ministries have their own investment programs. There is very little coordination of activities between all these agencies.

Box 2: Water Management Institutions in Different Countries

In China, seven commissions cover the six major international river basins and one lake basin. They are centralized agencies under the Ministry of Water with important planning and regulatory functions.¹⁸ The Yellow River Conservancy Commission also has specific responsibility for flood management in the lower Yellow River. In India the Damodar Valley Corporation has the responsibility of developing water and managing flood protection, irrigation and power. There are some other agencies in India like the Narmada Control Authority, Bhakra-Beas Management Board, Ganges Flood Control Commission with limited functions. In Sri Lanka, the Mahaweli Authority has been a fairly powerful authority for both development and management of land and water resources. Malaysia has the area-based authorities for Muda and Kemubu irrigation projects.

Some of the basin authorities, like the Tennessee Valley Authority (TVA) in the United States, have very broad charter to develop multiple resources including water, power, navigation, etc. Others have more narrowly focused functions such as operation and maintenance of main-stream facilities for water supply and power generation. Another common use of basin authority is to simply coordinate basin planning, operation and regulatory activities. In France, river basin committees have operated successfully for over twenty-five years doing long-term planning for developing water resources. Regulation and enforcement over there are conducted by various national ministries, while operation and maintenance of different components of the water system are left primarily to regulated private sector entities and public utilities.

People's participation in water resource planning, execution, operation and maintenance, monitoring and evaluation have been limited in Bangladesh, although there is good scope for this. For example, in Mirzapur a community based program for installing handpumps and latrines has worked very well. Moreover, women (a disadvantaged group) were

¹⁸ See Water Resource Management in Asia, by Frederiksen et al, World Bank Technical paper No. 212, Washington D.C. 1993.

involved from the very beginning in selecting sites, building structures, and maintaining them.¹⁹

In many countries of the world, peoples' participation has transformed the yields of water projects. In Sri Lanka, the Integrated Management of Major Irrigation Settlements (INMAS) scheme has worked fairly well. The program was based on participatory management, using project managers, farmers organizations, institutional organizers, and a system of committees to make decisions on scheduling of cultivation, maintenance, etc.²⁰ Peoples' participation has to be institutionalized for effective benefit. In many countries, beneficiaries serve on agency boards, outside government experts serve on technical committees, and public figures serve on policy and oversight commissions.²¹

III. The Strategy for Bangladesh

The principal elements of a water sector management system, presented in the previous sections, could be used to propose a strategic approach for Bangladesh to improve its water management. Some of the elements (shown in Figure 1) are already present in the system, and for these specific improvements to increase efficiency will be examined in the following sections. Others, which are currently missing, will have to be developed.

Formulating the National Water Policy

This is the first step towards a comprehensive water management program. There have been many ad-hoc directives from the government in the past, but these are disjointed and often conflicting. The initial task will be to review all the existing policies in conjunction with:

- i. Development objectives and strategies for the agricultural, industrial, energy and power, fisheries, livestock, forestry, navigation, and public health sub-sectors.
- ii. Flood and drought management objectives and strategies.
- iii. Environmental protection objectives and strategies.
- iv. Poverty alleviation and women-in-development objectives and strategies.
- v. Decentralization objectives and strategies.
- vi. Private use of water

The review should reveal any inconsistency between existing water policies and the needs of the different sectors and targeted development areas. It should also identify need for new policies to integrate and harmonize the objectives of different development agencies and the private sector.

¹⁹ See Water Resource Management, World Bank, op cit.

²⁰ See Comprehensive Water Resources Management in Sri Lanka, Asian Development Bank, January 1994.

²¹ See Water Resource Management in Asia, World Bank, op cit.

Formulation of a comprehensive water policy is a critical need for the country. Development of this policy will be expedited by allocating responsibility to an apex organization, like the National Water Policy Council whose members are from the cabinet, which makes decision on major water issues and approves regulatory measures. The institutional aspects are discussed further in the section on institutions and organizations.

Formulating Policy on Water Pricing and Cost Recovery: Policy on water pricing is a sensitive issue for any country. However, as discussed earlier, rationalization of water pricing is essential for ensuring efficient use of water, eliminating waste, allowing development of an efficient water market with private participation, and reducing the strain on government budget.

A number of options may be considered by policy makers, such as (i) allocation of water by government decree, (b) setting price high enough such that low-value users release it for higher-value users, and (iii) enabling active trading among users. Each of these measures create third-part effects where groups that do not get direct allocation suffer, as for example recipients at the lower reaches of a water channel. This may be of particular concern, particularly when the people adversely affected are the poor. Some kind of a balance needs to be reached between the three, although option three provides the best economic solution. There are other concerns on water prices, including the necessity of checking environmental degradation, that may have to be addressed.

Cost recovery is a critical issue for sustainability of water supply. If the private sector cannot recover cost, it will not invest in the sector. If state agencies cannot recover cost, the public will have to bear the financial burden and be content with inadequate level of services. This entails both economic and social costs.

Water pricing and cost recovery in urban and industrial supply are functionally easier, because metering is simple, and appropriate government policy and administrative mechanism could ensure cost recovery based on opportunity cost. Again, if the concern is to make water price non-prohibitive for the urban poor, the government may adopt a policy of graduated volumetric pricing where the heavy users pay more for consumption above a certain level.

Pricing of water for agricultural purposes is more difficult. Farmers in different areas (e.g. upper reaches and lower reaches of an irrigation canal) may not be receiving the same level of service and metering is difficult. Besides, farmers whose land adjoin natural water bodies (water tracts) and conveyance facilities (rivers) may feel it in their inherent right to have free access to the water. These and other political consideration may make recovery difficult. There are alternative methods for overcoming these problems to some extent, such as instituting cost recovery through user groups, and levying water charges on the basis of cultivated hectare of land and the type of crop (a rough indication of the volume of water consumed).

Water pricing policies may also be used to promote water conservation technology. Water fee and fiscal incentives could encourage urban and industrial consumers adopt water saving technologies, including water re-use systems. Similarly, water fee could persuade farmers to switch to alternative crops consuming less water. This would help accomplish crop diversification objectives as well. Fiscal incentives could promote private sector investment in small scale water processing technology for community based water and sewage systems.

Public Sector Management and Investment Strategy

A. Laws and Regulatory Framework

Water codes generally specify four important things, (i) the rights, powers and duties of individual users and government over natural water, (ii) ancillary power over land, (iii) registration and licensing of rights to water, and (iv) creation of the administrative structure to implement the code (UNECAFE 1973). The first three involve legislation and the fourth involves regulation.

Some countries in Asia (e.g. China, Indonesia, Philippines) have comprehensive water codes. Others have sector specific legislation, for example the irrigation legislation in India (the North India Act, the Bengal Act) and Pakistan (Canal and Drainage Act), etc. The latter system presents the usual problems of ambiguity in water rights of different users, overlapping and contradictory responsibility in administration, and failure to deal with the overall situation adequately. In Asia, China is the only country that has enacted comprehensive water laws (in 1989). Malaysia and Sri Lanka have also proposed comprehensive legislation, but they have been delayed for political reasons.²² Bangladesh should enact comprehensive legislation which could clarify principles of water usage (water and land-use rights, pricing, conservation, environmental protection and water quality), overcoming deficiencies in existing laws and enabling administrative efficiency.

Bangladesh could study the licensing system for surface water, common in developed countries, which are awarded on principles of riparian rights, or first-in-time and first-in-use, or legal authorization. These licenses could be permanent, temporary or periodic. They could be based on category of use (agriculture, industry, municipal); class of use (consumptive, non-consumptive, polluting); quantity and quality restriction; time and duration of use; with stated priority under conditions of scarcity. In addition, specification of the source of water, nature of return flow, geographical restrictions (including linkage to land-use) and rules governing transfer by the holder could become matters for legislative and regulatory consideration. The experience of Philippines, which has a comprehensive licensing system, could be studied along with that of India which has faced many problems with ambiguities of water rights. The merits of a licensing system is that it could be used for (i) allocating and controlling water use and quality, (ii) charging for

²² See *Water Resource Management in Asia*, World Bank, op cit. and *Comprehensive Water Resource Management in Sri Lanka*, Asian Development Bank, op cit.

water services, (iii) protecting investments and other user interests, and (iv) transferring rights through legal mechanism.

Land-use rights also needs to be examined along with water-use rights. Issues like land zoning in major urban areas for meeting environmental objectives; settlement on floodplains; uptake of land for flood control, detention basin and flood proofing facilities; siting restriction on industries to control pollution; restricting high water users' access at times of shortage; etc. should receive proper attention.

Environment and water quality regulations should receive high priority in Bangladesh because of the high density of population and the general lack of public sensitivity to these issues. Most countries in the world have adopted the World Health Organization recommendation on water quality standards for domestic supply. But standards for instream flows, effluent control and groundwater contamination are lacking and will need to be developed. Also issues related to use of fertilizers, pesticides and other non-point sources of pollution have to be addressed.

B. Framing of Administrative Rules and Regulations

Rules and procedures for administration of water legislation and regulation must be kept simple and easily implementable. Allocation mechanism should be flexible and adaptable. The first priority is usually given to domestic use, followed by industry and agriculture, subject to limits imposed on instream flows for navigation, fisheries or environmental protection. However, long-term priorities may need to be changed in favor of short-term necessities. The decision to change allocation priority may be political, but even then the decision makers have to evaluate the efficiency, equity and environmental consequences of their decisions.

Allocation mechanism for water resources may vary. If licensing is used, the receiver obtains a legal right. But if no legal title is given, or it is difficult to enforce the title, public control is the alternative instrument for enforcement of water rights. Administrative rules may also facilitate market mechanism for exchange and sale of water rights. For example, groundwater extraction rules may allow or restrict sale of tubewell water by private individuals.

In managing the water resources in Bangladesh, the principal functions that would be involved are shown in Table 1, along with the current situation and the gaps in the process.

Table 1
Principal Water Management Functions and Gaps in Bangladesh

Function	Current Situation	Gaps
Setting National Water Goals and Objectives	Loosely defined	Formal water goals and objectives

Function	Current Situation	Gaps
Framing the National Water Policy	Loosely defined	Formal National Water Policy
(a) Sectoral Objectives	Isolated and unrelated	Interrelated water objectives of different sectors
(b) Flood and drought management policy	Ambiguous and lacking intersectoral considerations	Incorporation of flood and drought management in the national water policy.
(c) Water and the Environment	EIA guidelines prepared	Formal EIA policy on water development.
(d) Policy on public and private water undertakings and participation	None defined	Clear definition of public and private sector domains in water management.
(e) Water rights and allocation policies	None defined	Clear definition of private water rights.
(f) Water pricing policy	Loosely defined	Clear policy on water pricing and cost recovery.
Laws, regulations and administrative rules concerning land-water usage	Scattered and conflicting	An omnibus water law (National Water Act), uniform regulations and administrative rules for all sectors.
National water planning	Stagnant	A comprehensive water development, use and flood management plan.
Public sector water investment planning	Ad-hoc and disjointed across sectors	Public investment program consistent with national objectives and intersectoral issues.
O&M planning and implementation	Ad-hoc and ineffective	Implementable public and private supported O&M plan.
Water resource data and information collection and processing	Scattered, insufficient and uncoordinated	Comprehensive water data for use of all agencies and interested individuals.

Setting national water goals and objectives: This is the first step towards the development of a national water plan. Key elements of the objectives have been discussed earlier in this paper.

Framing the National Water Policy: This is a necessary first step towards developing a strategy for realizing the broad water objectives. Key elements of the policy involving multisectoral consolidation, flood and drought management, water and the environment, public and private undertakings and participation, water rights and allocation principles, and water pricing and cost recovery have been discussed earlier in the paper.

Laws, Regulations and Administrative Rules: The three basic principles recognized by most countries in regard to natural water rights are:

- Declaration of state title
- Declaration of water being subject to administrative control
- Declaration concerning private rights

The first principle relates to the French doctrine of public domain. Under this doctrine, certain resources cannot be owned and managed by private persons because of their overwhelming public significance.

The second principle flows from English Common Law traditions. It recognizes neither total state ownership of water resources nor total private ownership. It reserves powers to the state to control water for specific purposes. The Northern Indian Canal and Drainage Act, 1873 and the Bengal Irrigation Act, 1876 are examples of this principle.

The third principle relates to private rights over water resources. This principle is in effect a mixture of both public and private rights. The Philippines constitutional provision read with the provision of its Civil Code, and the South Korean laws illustrate the application of this principle.

The water laws designed in colonial British India established the right of government to control and regulate water for specific purposes. They also limit the extent of private control over water resources through such legislation as the Indian Easement Act of 1882. With the passing of the East Bengal State Acquisition and Tenancy Act, 1950, the common law treatment of the issue officially ceased and state rights over the subsoil was formally established. But this was never enforced and the controlled and regulated use of water have continued on the traditions set during British India.

The current laws, regulations and administrative rules for water management in Bangladesh, framed in response to the needs of individual sectors and specific demands of situations, are briefly listed in Table 2, below.

Table 2
Laws, Regulations and Administrative Procedures for Water Sector Management in Bangladesh

Title	Status	Purpose
The Bengal Irrigation Act, 1876.	Act	Levy of Water Rates.
Bangladesh Irrigation Water Rate Ordinance, 1983.	Act	Levy of Water Rates.
East Bengal Embankment and Drainage Act, 1952.	Act	Construction, Operation and Maintenance of Embankment and Drainage Structure.
Groundwater Management Ordinance, 1985.	Ordinance	Siting installation and spacing of Minor Irrigation equipment.
Acquisition and Requisition of Immovable Properties Ordinance, 1982.	Act	Acquisition of land in public interest.
State Acquisition and Tenancy Act, 1950.	Act	Regulates land ownership and declares subsoil resources belonging to the State.
Transfer of Properties Act, 1882.	Act	Provides for disposal of immovable properties by gift, sale, mortgage, lease, etc.
Registration Act, 1908.	Act	Deals with registration of properties and agreement between contracting parties.
Local Government Ordinance, 1983.	Act	Deals with the structure, composition and function of Local Government institutions.

The principal inadequacy in the above body of laws is the lack of updating and harmonization for internal consistency which obstruct enforcement. Many of the existing laws, such as the Embankment and Drainage Act, are outdated and need revision to suit present day conditions and requirements. This task has to be undertaken after framing the national water policy. The policy would reflect the principles of water rights and the extent of state and private ownership. As it stands now, only groundwater has been declared under the State Acquisition Act to be a subsoil resource belonging to the state. But the Groundwater Management Ordinance framed to regulate the use of groundwater for irrigation is dead. There are also multiple laws governing particular aspects of water use such as water rates levy, which need to be consolidated.

National Water Planning: The National Water Plan should follow the Water and Flood Management Strategy for future public sector investment and management programs in the water sector. This plan should draw heavily from the lessons of the FAP studies, other country experiences, and past experience of planning in Bangladesh.

Public Investment Program: The National Water Plan should lay down the basis of public water investment program in Bangladesh to be implemented by BWDB.

Implementation and O&M Program: Specific projects will have to be designed by the line ministries of the government in conformity with the public investment program. The O&M program, likewise prepared by the line ministries, should reflect joint public and private participation as specified in the National Water Plan.

Data and Information Management: The collection of hydrological data, its processing and dissemination to project designers, beneficiaries and the general public will have to be streamlined. Considerable improvement of the data and information management process has been accomplished under FAP. These have to be properly institutionalized and developed further.

C. Institutions (Organizations)

The institutional aspects of water management in the public sector, besides laws and regulation, are organizations, enforcement, monitoring and data collection, planning, investment, and O&M. It is important to incorporate public participation in as many aspect of these activities as possible.

The major organizations in the water sector are shown in Figure 2. The principal public organizations, under the Ministry of Water Resources, are the Water Resource Planning Organization (WARPO), Bangladesh Water Development Board (BWDB), River Research Institute (RRI) and Surface Water Monitoring Center (SWMC) under it. Organizations in other sectors that have interlinkages with this sector are the Public Health Engineering Department (PHE), Local Government Engineering Department (LGED), Water and Sewerage authority (WASA), Department of Fisheries (DOF), Inland Water Transport Authority (BIWTA), Roads and Highways Department (R&H), Department of Environment (DOE), and respective municipal corporations. The National Water Council presides over all these institutions in matters of water policy and legislation.

The National Water Council, with representations from all water-related ministries, approves policy for presentation to the Cabinet. WARPO is supposed to evolve national policies and plans for water resources, ensuring optimum utilization among various users such as agriculture, fisheries, navigation, public health, industry etc.²³ WARPO is also supposed to consolidate data on water collected by various agencies. The organization, however, has not operated satisfactorily for various constrains and very little has been

²³ See FAP 26: Institutional Development Program, Report No.2, Dhaka, February 1995.

accomplished in sectoral planning or coordination. Individual line ministries have their own planning departments, which operate in more or less complete isolation of one another.

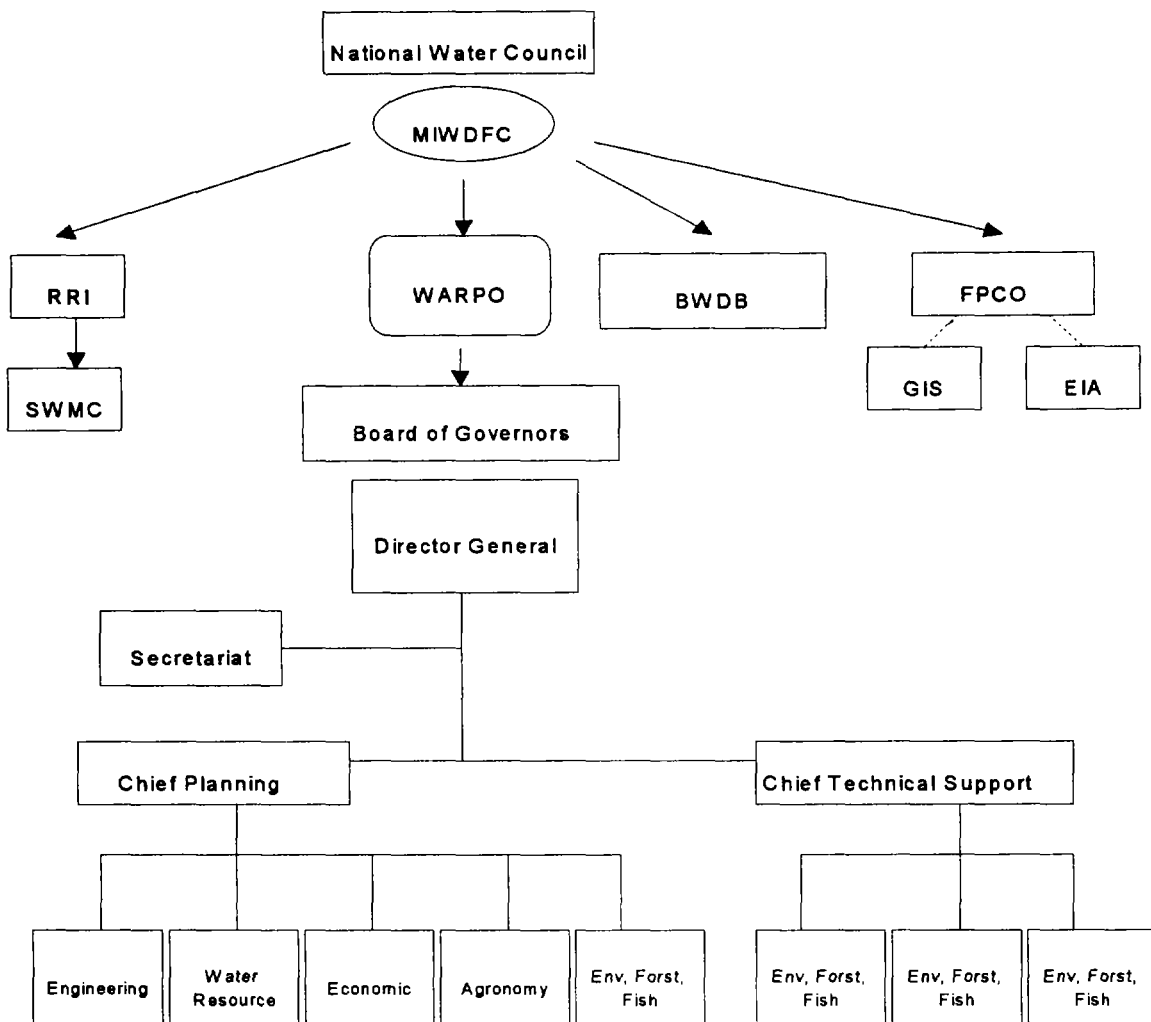
The River Research Institute (RRI), which includes the Surface Water Modeling Center (SWMC), is a research and data generation unit for hydraulic and river studies. It has limited function for collecting broad water resource data. Major investments in the water sector are made by the Ministry of Water through the Water Development Board (BWDB) and by the Ministry of Local Government and Rural Development through its Local Government Engineering Department (LGED). Besides other water related ministries have their own investment programs. There is very little coordination of activities between all these agencies.

A better management of water resource would require improved correction between these institutes. In particular, co-ordination with Roads and Highways Department (RHD), Local Government Engineering Department (LGED) and Bangladesh Inland Water Transport Authority (BIWTA) is important for two reasons. Firstly, activities of these organizations, such as construction of highways and rural roads, digging of canals, and dredging of channels for navigation have a direct impact on the hydrological regime. For example, narrowing of channels while constructing bridges/culverts reduces the carrying capacity of rivers and streams, an important factor causing floods. Road alignments cutting across the terrain gradient (north to south in case of Bangladesh) also contribute to and aggravate the impact of floods. Unplanned digging of canals and construction of embankments, while alleviating localized problems, can disturb the overall hydrologic balance in a region and eventually cause serious problems for large areas. Any intervention in the hydrological regime should keep the overall situation in view. Secondly, large investments are currently being made in flood control and irrigation (BWDB), highways (RHI), rural roads, embankments and canal-digging (LGED) and channel maintenance and improvement (BIWTA). Co-ordination of activities of these organizations, from planning through implementation stage, will result in (i) better designed projects, and (ii) large economies in investment where structural components can be combined.

Annex-1 provides a summary of the function of the various organizations, and identifies critical areas of deficiency. A review of these functions and the problems encountered reveal the following:

1. The policy making institutions have not been effective for lack of resources and support from key line agencies.
2. The legal and regulatory institutions have not performed satisfactorily for lack of specific mandate and necessary emphasis from top management.
3. The planning institutions have not been effective for lack of a strategic vision, shortage of human and material resources, clear mandate, and the inability to interface with other related water institutions.

Figure 2
 Bangladesh: Current Set-Up of Organizations in the Water Sector



4. The implementing institutions have not been effective for lack of appropriate plans and programs, shortage of human and material resources and lack of supervision and accountability.
5. The data and information management agencies have been constrained by lack of firm support and resources.
6. Institutions have operated more or less in isolation, both in planning and implementation of schemes.
7. The regulatory functions required of many of the related institutions were not performed adequately for lack of direction and coordination with the main water sector institutions.

The organizations that have responsibility for enforcement of water legislation and their specific responsibilities are shown in Table 3.

Table 3
Principal Organizations for Enforcement of Water Regulations
In Bangladesh

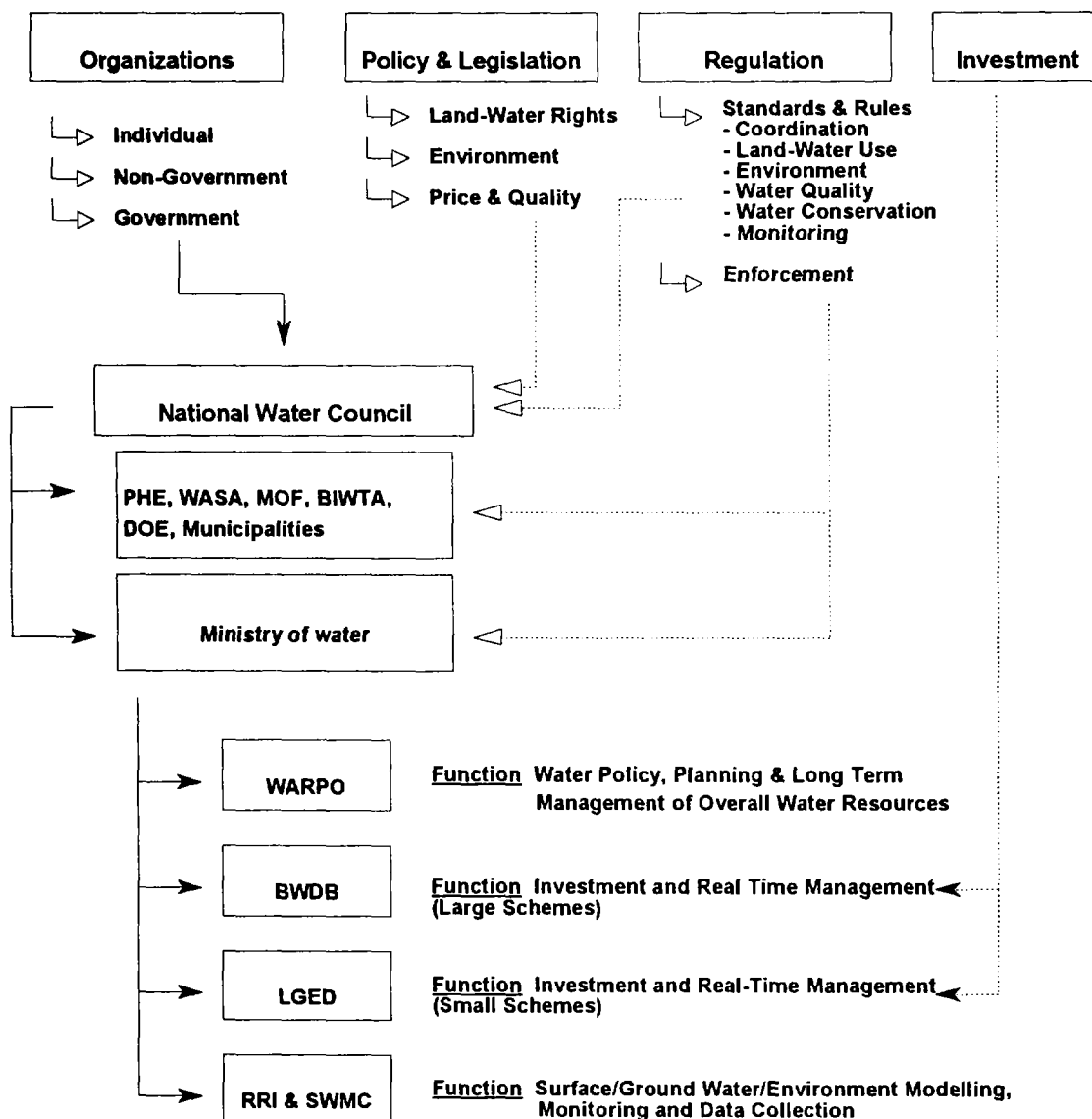
<u>Organization</u>	<u>Responsibility</u>
BWDB	Flood control, drainage and irrigation.
BIWTA	Maintenance of river channels for navigation.
Ministry of Land	Lease of open water and closed water fisheries. Regulated use of subsoil resources.
WASA	Supply of drinking water to cities.
Zila Parisad (District Council)	Optional function of construction and repair of embankments, supply, storage and control of water for agricultural purposes.
Municipalities	Supply of drinking water to small towns.

Appropriate regulation of water resources is critically needed because of the importance of water allocation to meet competing (and often conflicting) demands, including the need for conservation. There are major gaps in institutional responsibilities and absence of a coordinating system with sufficient peoples' participation.

The proposed organizational framework for carrying out functions noted above is shown in Figure 3.

Figure 3

Proposed Institutional Setup for Water Resource Management in Bangladesh



Organizations for Policy and Regulation

The National Water Council: The highest body, today in Bangladesh, for formulation of water policy including intersectoral coordination is the National Water Council. This body

is constituted of ministers from respective ministries and it makes recommendations to the cabinet on all water policy issues. This high-powered council has not functioned well in the past because of lack of support. There is no effective organization for examining water issues in a holistic manner and presenting them to the Council. The task has been partially performed by the Ministry of Water, which lacks appropriate resources to do this job efficiently. The situation in Bangladesh, however, is not as complicated as in countries with a federal structure, like India,²⁴ where in spite of the presence of a National Water Resources Council and a National Water Policy mandating coordinated water development across States and alternative uses, very little has been accomplished due to lack of institutional mechanism to plan, coordinate and implement programs across state boundaries and among users.²⁵ The Water Resource Planning Organization (WARPO) provides a logical support base for the National Water Council. The mandate of WARPO covers this aspect, by requiring it to “determine national policies and strategies for the scientific utilization and conservation of water resources.” As suggested later on the framing of a national water policy and associated water legislation could be undertaken by WARPO, for approval of the National Water Council. WARPO should also provide research and information support to the NWC.

Organizations for Planning and Information Management

In many Asian countries, there are organizations for planning and coordinating water management activities at the highest level, like the National Water Resource Board in Thailand and the National Water Resource Board in the Philippines. The latter not only advises the government on water matters but is a permanent organization with broad powers for coordinating and integrating water resources development; administering rights; formulating criteria, rules and regulation; undertaking river basin planning; surveys and studies; and reviewing and approving water resource projects within the context of overall national, regional and river basin plans.²⁶ In Bangladesh, there is need for such an organization and this could very well be WARPO, given its broad mandate for this type of function.

The Water Resources Planning organization (WARPO): With some modifications, WARPO could be made to perform the task of a national water resource management organization in Bangladesh. However, one of the problems encountered with this type of organizations is the difficulty of ensuring that other agencies of the government accept its leadership and abide by its instructions. In India, for instance, the Ministry of Water Resources has essentially remained the old Ministry of Irrigation and its origin reflects upon its preoccupation with irrigation and flood protection. It has no direct authority over

²⁴ See India Irrigation Sector Review, op cit.

²⁵ The situation in Sri Lanka is slightly different. Although there is no high level policy body there as yet, a recent ADB and USAID study (Comprehensive water Resources Management in Sri Lanka, op cit.) has recommended the establishment of a National Water Commission, serviced by all related ministries, but with one prime ministry responsible for ensuring that water-related issues are considered in policy proposals.

²⁶ See Water Resource Management in Asia, op cit.

other related ministries. In China, the Ministry of Water Resources has great powers, but also has an irrigation and flood control focus and experiences difficulty in managing relationship with other ministries and the provinces. Such difficulty, however, are related to the power and control over water planning and implementation conferred upon the organization by the government. If WARPO is given the mandate and legally empowered to examine and approve water related activities of all government and private organizations, it would have the necessary impact that is currently not there. The design of the organization could be further enhanced by bringing into it the element of participative management from all subsectors which will provide further legitimacy to its actions.

In the management of overall water resources in Bangladesh WARPO's four major functions would be:

1. **Planning:** National, regional and basin planning with overall assessment of water supply and demand in the country.
2. **Overall Management of Water Resources:** This would involve management of both supply and demand. Supply management necessitates medium and long-term planning for new development and replenishment of fresh water resources. Demand management would include direct measures of controlling water use, to indirect measures that affect voluntary behavior (market mechanism, financial incentives, public awareness programs).
3. **Monitoring, Evaluation and Data Collection:** Water resources data, in particular hydrological and hydrogeological data, are essential for planning and designing water programs. In Bangladesh, there are specialized government agencies that collect, process and transmit some of these data, but the latter is too disjointed, poorly recorded and inadequate for comprehensive planning.
4. **Regulations:** The regulatory aspects of water resource management often get lost in the bureaucratic maze of government agencies. Without one central body, systematically looking through various regulatory requirements and working like a watch dog to measure compliance by various entities, it would be very difficult to bring discipline in the sector's management. The National Water Policy Council sets the agenda for water use, conservation, and environmental renewal. However, it needs a mechanism for constant evaluation and updating of policies, something that should become the mandate of WARPO as the advisory body for the National Water Council. Rules for administering water rights, land-use rights, environmental quality standards, quality of service standards (e.g. for urban water quality) must be framed and administered by WARPO.

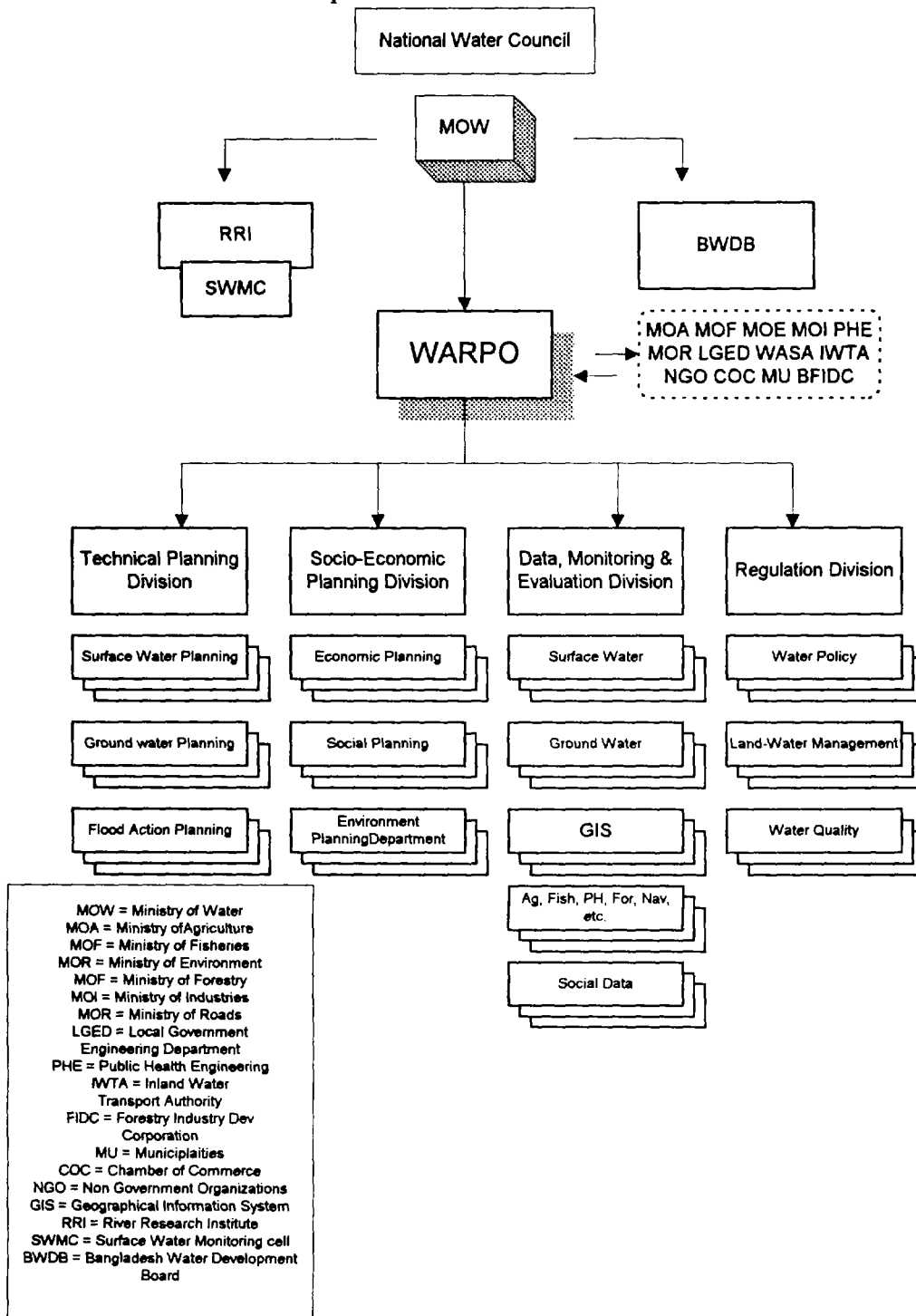
WARPO's mandate could be restated to cover the specific activities mentioned above. This could easily be done with minimal dislocation, through reformulation and addition of a few specific mandates.

Proposed Mandate of WARPO

1. To advise the Government on national policies and strategies for balanced utilization and conservation of water resources, with a perspective of the needs of all users in the system and particularly socio-economically disadvantaged groups.
2. To administer water legislation through issuance of standards, regulations and administrative rules for governing water rights, land-use rights for the purpose of water resource management, including location of industries and urban centers, pollution control, limiting flood damage risk, and managing regional supply shortages.
3. To issue environmental quality standards for water resources and regulation and rules for their administration, including comprehensive standards for measuring compliance with environmental objectives, public health and instream water quality and quantity conditions.
4. To issue rules and regulations for quality of water service standards, including community water supply, standards for irrigation delivery, etc. for government owned, user group owned and private utility operations.
5. To administer water rights including issuance of licenses, etc. on national scale and overseeing of performance of the system.
6. To prepare, revise and update a comprehensive water resource master plan including detailed projections of supply, demand, balancing needs of different users (including disadvantaged socio-economic groups), environmental safeguards, economic efficiency, and long term preservation of national interests, using a system of participatory planning at various stages of the plan development..
7. To interface with other public and private organizations for evaluating and approving the water resource utilization plans of all subsector's, and private and public user groups, in context of management of the scarce resources, environmental and water quality maintenance, priority needs of specific communities, municipalities, industry, agriculture, fisheries, navigation, and various instream users.
8. To advise water resource users on balanced development of their facilities and provide guidance for long-term water use.
9. To monitor, collect, consolidate and disseminate standardized water resource data needed for planning and regulating the water-use environment, including data on surface and ground water, draught, flood, salinity, water quality, erosion, land-use, etc.

The proposed WARPO's position vis-à-vis the existing water sector institutions is shown in Figure 4, and the structure of its main units in the revised form are discussed below.

Figure 4
Proposed Structure of WARPO



The Four Functional Divisions of WARPO

The organization would have to be reorganized under four functional divisions, as follows:

Technical Planning Division: This would be in charge of the technical aspects of planning, including surface water planning, groundwater planning and flood management.

Each of these planning units will have experts from agriculture, fisheries, navigation, industry, municipality and other relevant areas, respective to their needs.

Socio-Economic Planning Division: This division will have three units for economic planning, social planning and environmental planning, respectively. They will work jointly for preparing the national water plan. The Economic Planning unit will consolidate intersectoral demand for water with available supplies and carry out economic evaluation of alternative actions. The social planning unit will function as a conduit for participatory planning and for advancing vulnerable groups interest. The Environmental unit will evaluate all environmental impacts on water resource programs in the country.

Monitoring, data Collection and Evaluation Division: The function of this division would be to collect and consolidate data on water resources from all primary collection agencies in the country and to build a technical and management information base for all water users in the country. Its proposed components are surface water information unit; groundwater information unit; GIS unit; agriculture, fisheries, forestry, public health, and navigation information unit; environment data unit and social data unit.

Regulation Division: This division would propose policies, regulations and administrative rules in context of water policies of the government, and administer them through the line agencies. The three units of this division are the water policy unit, land-water use unit and water quality unit.

Although the overall planning for water resources should be the function of WARPO, individual sub-sector plans will still have to developed by line ministries. Irrigation and flood project planning will continue to be the responsibility of Bangladesh Water Development Board (BWDB). This is elaborated later in a discussion of that organization.

Organizations for Investment, and Real-Time Management

Infrastructural support projects in the water sector will have to be carried out by the traditional organizations e.g. the Bangladesh water Development Board and the Local Government Engineering Department. Under the new proposal, however, the mandate, role and function of BWDB will have to be modified and updated.

The Bangladesh Water Development Board: The mission, goal, mandate and institutional form of BWDB in the future could be conceived in view of three important aspects of efficient public sector institutions. The first is a clear recognition of the role of

public institutions in the water sector, which should be confined to creation of vital infrastructure. Everything else should be encouraged through private efforts and an enabling environment should be created for private enterprise development. An essential focus of the Bangladesh Water Resource Management Strategy is people's participation. To implement this strategy, it is necessary for BWDB to devote its attention to development of beneficiaries capability for undertaking minor water control structures and O&M of facilities. Only major upstream water development and management functions, where heavy engineering equipment and skills are necessary, should be retained by BWDB. Other activities, such as monitoring and regulation of water regime in various parts of the country should receive its strong attention.

The second aspect that needs reconsideration is the mandate of BWDB in relationship to WARPO. After sector strategy formulation, long-term planning, intersectoral coordination, and regulation of water usage activities is assumed by WARPO, BWDB's mandate will have to be redirected towards real-time management of water resources including project planning, construction of FCD-I structures, and operation and maintenance. The third factor for consideration is bringing a system of accountability and control in the organizational culture of BWDB which will ensure its efficiency.

Re-fixing BWDB's Mandate

There is now an urgent need for redefining the present mandate of BWDB, in view of separation of functions of WARPO, arising from different jurisdictional coverage as well as the need to develop specialized knowledge, and institutional strengthening of RRI and SWMC which later on may evolve into the Bangladesh Hydrological Institute (BHI). Macro data collection requires comprehensive procedures and coverage; macro planning requires interdisciplinary team work and the understanding of national and sectoral and intersectoral policies and programs, which are best undertaken by a central coordination and planning organization like WARPO. On the other hand, design requires advanced technical knowledge, construction must oversee field activities and assure quality, and O&M requires the expertise and discipline of sustaining a service to end-users. Moreover, quality assurance requires a clear separation of work so that units can be held accountable for performance. This is most evident in the design, construction and O&M phase of a project. For example, transfer of responsibility from construction to O&M should require a warranty to ensure that construction deficiencies are not passes on to the O&M agency.

The appropriate mission of BWDB should be to provide large scale engineering support for implementation of the national water sector strategy and plan for flood control, drainage and irrigation and real-time management of water resources. WARPO should provide the macro framework within which BWDB could design engineering schemes with due consideration of social and environmental parameters. The sequence of activities, from strategy to national planning to project planning, implementation and maintenance are conceptualized in Table 4 below to identify specific institutions and specific responsibility.

Table 4
Water Sector Activities and Responsible Institutions

<u>Activity</u>	<u>Institution</u>	<u>Responsibility</u>
Producing Sector Strategy and Plan, Monitoring and Regulation of the Water Regime	WARPO	Macro planning, intersectoral coordination, administration of water rights, regulation.
Pre-feasibility and Feasibility Studies at the Macro level	WARPO	National water Planning, regional planning, basin planning.
Review and Approval of Intersectoral Schemes	WARPO	Coordination of plans developed by different water use agencies, intersectoral balancing and prioritization of needs.
Project Planning and Feasibility Studies	BWDB/LGED/ DOF/ MOA/ BIWTA/ PHE/ Municipalities/ etc.	Development of projects and schemes within the context of the overall national water plan, agricultural, fisheries, industrial, municipal, and social demands, etc.
Detailed Design	BWDB and other line agencies	Design of large FCD/I schemes only should be undertaken by BWDB, with considerable outsourcing to the local consulting industry. Smaller schemes should be made the responsibility of other agencies like LGED, NGOs, etc.
Implementation of Schemes	BWDB/ LGED/ etc.	Implementation of large FCD/I schemes should be the responsibility of BWDB. Smaller schemes should, similarly, be undertaken by LGED.
Construction	BWDB/ Local Construction Industry.	BWDB should undertake major construction works on FCD/I projects, but in phases the local construction industry should be given increasing quantum of the construction work to help develop the private sector.

Table 4 (continued)
Water Sector Activities and Responsible Institutions

<u>Activity</u>	<u>Institution</u>	<u>Responsibility</u>
Commissioning	BWDB/ LGED	Bringing the schemes into operation, fixing and defects, and putting into use the operations and maintenance procedures on large scale FCD/I projects should be BWDB's responsibility. It should also be charged with development of local institutions for taking over as much of the O&M functions as possible after project completion.
Operation and Maintenance	BWDB/ LGED/ Farmer Organizations	O&M of the major structures should be the responsibility of BWDB. Intermediate facilities should be handed over to LGED, and very small facilities to farmer's organizations.

Under the above scheme of things, the role and structure of BWDB should be changed as follows: .

Planning and Feasibility Study

BWDB would be the principal public agency for project and program planning, and for undertaking feasibility studies of FCD/I schemes, working within the national water plan and guidance of WARPO.

Project Design

BWDB's responsibility should be limited to design of large scale schemes based on the national water plan. A considerable portion of the design work should be contracted out to the local consulting industry who have shown substantial competence for this. It should be mandatory to include necessary inputs into the design from intended beneficiaries and other affected people, which is not currently practiced. This would avoid problems of inappropriate or inadequate water control structures.

Implementation and M&E Plan

The detailed implementation and monitoring plan should be prepared by BWDB for which adequate strengthening of the organization through training of technical personnel and social scientists would be necessary. The organization should restructure itself to have a considerably downsized group of highly qualified technical experts, social scientists and economists and management personnel for some design work, strong supervision of

outside consultants, preparation of implementation and M&E plans, some construction and strong supervision of outside construction firms, and O&M.

Implementation of Schemes

Implementation of schemes should see significant changes from past practice. Sound implementation planning, with careful scheduling and pro-active measures like head start on land acquisition during late phases of negotiation with donors, pre-qualification of contractors early on, etc. should make the process much more efficient than it is now.

Real-Time Management of Water Resources

All planning and design should be done with appropriate resource management actions that would ensure operation and maintenance of facilities and defined provision of services over time. Sensitivity analysis should be done to show how facilities might perform under differing outcomes to assess risk and guide operations for varying conditions. Design flexibility should provide capability for subsequent response to change.

Planning for O&M needs to reflect the practical aspects of funding, equipment, regulation, administrative procedure and incentives to ensure proper delivery of services. Project level Plans of Operation and Maintenance (POM) should be prepared by BWDB for all its projects. The POM must respond to the legislative framework and be consistent with established policies, rules and regulations (water rights, environmental standards, safety requirements, administrative and financial rules, etc.). Real-time management, requires reliable and timely data which should be strengthened in BWDB. Effective administration of regulatory functions is a necessary complement to ensure that actions are carried out properly so that real-time water operations and physical maintenance of facilities can be most effective for meeting their objectives.

Real-time management is predominantly concerned with managing supply and demand at scheme levels to meet allocation objectives. Integral to such activities are also issues related to water conservation, rationing at times of scarcity and other techniques to ensure that water demands are moderated to correspond in a logical manner to water availability. These should be the functions of BWDB.

Agency Accountability

Clear assignment of responsibilities and accountability will be critical to the future operation of BWDB. A particular need is to clarify responsibilities for completeness of facilities and quality of works.

Proposed New Mandate for BWDB

1. Planning, feasibility study, designing and construction of large scale water structures (dams, barrages, reservoirs and other original works, irrigation embankment and drainage, bulk water supply to communities, water supply for needs of fisheries,

navigation, and recreational use of water resources), in accordance to the national water plan and WARPO guidelines.

2. Flood control, including water shed management.
3. Prevention of salinity, water congestion and reclamation of land.
4. Except within the limits of sea-ports, maintenance, improvement and extension of channels for inland water transport, including dredging of channels but excluding all such operations as may be assigned by the Government to other agencies.
5. Regulation of channels to concentrate river flow for more efficient movement of water, silt and sand, excluding all such operations as in the opinion of the Government may be carried out by any other agency.
6. Real-time management of water resources, as may be prescribed by WARPO for balancing the needs of different sectors, including water allocation, rationing, diversion, and O&M of major structures.

IV. The Action Matrix

Issue	Current Status	Recommended Action	Responsible Institutions
National Water Policy	No formal policy	Establish NWP	WARPO, NWC
National Water Act	Many scattered and disassociated legislation	Prepare and enact NWA	WARPO, NWC, parliament
Water-land use Regulation and Rules	Many scattered and disassociated regulations and rules	Prepare comprehensive water regulation and rules	WARPO
Apex organization for water sector planning and coordination	WARPO	Reorganize and strengthen WARPO	WARPO, MW
Implementation of policies and regulations	Rudimentary and uncoordinated	Make line ministries responsible for individual actions and WARPO responsible for overseeing enforcement	Line ministries, WARPO
Water resource data and information	Scattered, insufficient and uncoordinated	Make WARPO responsible for consolidation of data from all sources	WARPO, MW
National Water Plan	Incomplete NWP of 1989, insufficient water shed planning	Prepare comprehensive NWP with intersectoral inputs and attention to water shed development	WARPO
Sub-sector plans	Uncoordinated and conflicting	Coordinate intersectoral planning through WARPO	WARPO
Institutional Capacity	Inadequate capacity of BWDB to plan and implement water projects and programs	Rationalize BWDB's organizational structure and strengthen capacity for project planning and implementation	BWDB, MW

Issue	Current Status	Recommended Action	Responsible Institutions
Institutional capacity	Possible over-extension of LGED's capacity	Review LGED's activities and build capacity	MLG

Annex - 1
**Bangladesh: Major Water Sector Organizations and Related Agencies - Current
 Functions and Deficiencies**

Organization	Current Function	Major Deficiencies/Problems
Planning Commission	<ul style="list-style-type: none"> • Establish multi-sector investment priorities. • Recommend allocation of resources. 	<ul style="list-style-type: none"> • Inadequate personnel resources.
National Water Council	<ul style="list-style-type: none"> • Approval of national water policies. 	<ul style="list-style-type: none"> • Low frequency of meeting and inadequate service support from the Water Ministry.
WARPO	<ul style="list-style-type: none"> • Collection and supply of hydrology, and other water data. • Preparation of reports on major water programs. 	<ul style="list-style-type: none"> • Water policy formulation. • National water planning. • Monitoring • Formulation of water legislation and regulations. • Intersectoral coordination of water plans. • Central data system.
RRI	<ul style="list-style-type: none"> • Surface water modeling. • River training studies 	<ul style="list-style-type: none"> • Mathematical modeling including environment and surface/ground water. • Inadequate Funding
SWMC	<ul style="list-style-type: none"> • Mathematical river modeling • Flood management modeling • Irrigation system modeling • National and regional modeling • Environmental modeling • Survey and data collection • Development of a national hydrological data base. 	<ul style="list-style-type: none"> • Continued existence after FAP.

Organization	Current Function	Major Deficiencies/Problems
FPCO	<ul style="list-style-type: none"> • Water resource management strategy development. • FAP coordination. 	<ul style="list-style-type: none"> • Continued existence after FAP.
The GIS Unit	<ul style="list-style-type: none"> • Collection of hydrologic, topographic, soil and flood regime data. 	<ul style="list-style-type: none"> • Continued existence after FAP.
The EIA Unit	<ul style="list-style-type: none"> • Development of EIA guidelines. • EIA study of projects. 	<ul style="list-style-type: none"> • Continued existence after FAP.
BWDB	<ul style="list-style-type: none"> • Water project planning and implementation. • Flood control and water shed management. • Salinity control. • Maintenance of water channels for transportation. • Regulation of water channels. 	<ul style="list-style-type: none"> • Weak planning capability. • Inadequate implementation capability. • Inadequate O&M capability. • Overgrown size.
Hydrology Directorate of BWDB	<ul style="list-style-type: none"> • Collection of ground and surface water data. 	<ul style="list-style-type: none"> • Lack of adequate linkage with national water planning.
Flood Forecasting and Warning Center of BWDB	<ul style="list-style-type: none"> • Collection and dissemination of information. 	<ul style="list-style-type: none"> • Proper coordination and linkage with the national DCMU unit.
LGED	<ul style="list-style-type: none"> • Planning, designing and implementation of rural Infrastructural development projects. • Thana/Union Drainage and Embankment planning, irrigation planning, land and water use planning. • Small scale water resource schemes. • Canal digging programs. • Town protection schemes. 	<ul style="list-style-type: none"> • Little or no coordination with BWDB and other water sector agencies. • Inadequate responsibility for enforcing water regulations.

Organization	Current Function	Major Deficiencies/Problems
R&H Department	<ul style="list-style-type: none"> • Construction and maintenance of primary and secondary roads. 	<ul style="list-style-type: none"> • Road networks have intervened with water courses and affected hydrological regime. • Little or no coordination with BWDB and other water sector agencies.
PHE Department.	<ul style="list-style-type: none"> • Rural and urban water supply and sanitation. 	<ul style="list-style-type: none"> • Little or no coordination with BWDB and other water sector agencies. • Inadequate enforcement of water regulations.
DAE	<ul style="list-style-type: none"> • Information dissemination on agricultural technology including water and land-use.. 	<ul style="list-style-type: none"> • Little or no coordination with BWDB and other water sector agencies.
BADC	<ul style="list-style-type: none"> • Operation of low lift pumps and tubewells. • Harnessing of hill streams. • Salinity control. Distribution of water for irrigation. 	<ul style="list-style-type: none"> • Little or no coordination with other water sector agencies. • Inadequate responsibility for enforcement of water regulations.
BIWTA	<ul style="list-style-type: none"> • River conservancy work, including river training for navigational purpose. • Disseminating navigational and meteorological information, including river charts. • Hydrographic survey. • Programming for dredging and revival of dead or dying rivers, channels, canals, etc. • Develop, maintain and operate inland river ports. Develop rural water transport. 	<ul style="list-style-type: none"> • Inadequate coordination with other water sector agencies. • Inadequate responsibility for enforcement of water regulations.

Organization	Current Function	Major Deficiencies/Problems
DOF	<ul style="list-style-type: none"> • Develop inland and offshore fisheries. • Development of rules and regulations for utilization of fisheries resources. • Planning for fish cultivation. 	<ul style="list-style-type: none"> • Inadequate coordination with other water sector agencies. • Inadequate responsibility for enforcement of water regulations.
DOE	<ul style="list-style-type: none"> • Monitoring pollution level of rivers, underground and drinking water. • Working with FAP agencies to develop environmental protection measures. • Collection and analysis of data concerning environment. • Monitoring and analysis of surface water for detection of pesticides and heavy metals. • Analyzing waste water samples for different agencies. • Assist in preparation of EIA for different agencies. 	<ul style="list-style-type: none"> • Insufficient coordination with other water sector agencies. • Inadequate enforcement of water regulations.
Dhaka City Corporation	<ul style="list-style-type: none"> • Providing sanitation services. • Manage underground sewage systems. • Supply water for public and private purposes. • Undertake schemes for provision, storage and distribution of water. • Regulate, control and inspect all private sources of water within the city. • Sanction new wells. 	<ul style="list-style-type: none"> • Insufficient coordination with other water sector agencies. • Inadequate enforcement of water regulations.

Organization	Current Function	Major Deficiencies/Problems
Dhaka City Corporation (continued)	<ul style="list-style-type: none"> • Sanction water pumps and other sources of drinking water in the city. • Provide a system of public drains within the city. • Control, regulate and inspect all private drains within the city. • Undertake drainage schemes within the city. • Regulate washing places such as “dhobi ghats”. • Manage public water-courses within the city. • Regulate public fisheries in public water courses. 	
WASA	<ul style="list-style-type: none"> • Construct, improve and operate water supply and sewerage works, and other facilities to improve environmental sanitation in the city. 	<ul style="list-style-type: none"> • Institutional inefficiency. • High level of water losses in the system • Poor maintenance of facilities. • Poor coordination with other water sector agencies. • Poor implementation of water laws and codes.
Engineering University Institute for Flood Control and Drainage Research and Environmental Engineering Division.	<ul style="list-style-type: none"> • Education and research on flood control and drainage. • Education and research on water quality and environmental management. 	<ul style="list-style-type: none"> • Inadequate linkage with other water sector agencies.

Policy Research Working Paper Series

Title	Author	Date	Contact for paper
WPS1545 International Commodity Control: Retrospect and Prospect	Christopher L. Gilbert	November 1995	G. Ilogon 33732
WPS1546 Concessions of Busways to the Private Sector: The São Paulo Metropolitan Region Experience	Jorge M. Rebelo Pedro P. Benvenuto	November 1995	A. Turner 30933
WPS1547 Testing the Induced Innovation Hypothesis in South African Agriculture (An Error Correction Approach)	Colin Thirtle Robert Townsend Johan van Zyl	November 1995	M. Williams 87297
WPS1548 The Relationship Between Farm Size and Efficiency in South African Agriculture	Johan van Zyl Hans Binswanger Colin Thirtle	November 1995	M. Williams 87297
WPS1549 The Forgotten Rationale for Policy Reform: The Productivity of Investment Projects	Jonathan Isham Daniel Kaufman	November 1995	S. Torres 39012
WPS1550 Governance and Returns on Investment: An Empirical Investigation	Jonathan Isham Daniel Kaufman Lant Pritchett	November 1995	S. Fallon 38009
WPS1551 Sequencing Social Security, Pension, and Insurance Reform	Dimitri Vittas	December 1995	P. Infante 37642
WPS1552 Unemployment Insurance and Duration of Unemployment: Evidence from Slovenia's Transition	Milan Vodopivec	December 1995	J. Walker 37466
WPS1553 Spatial Correlations in Panel Data	John Driscoll Aart Kraay	December 1995	R. Martin 39065
WPS1554 Rationing Can Backfire: The "Day without a Car" in Mexico City	Gunnar S. Eskeland Tarhan Feyzioglu	December 1995	C. Bernardo 37699
WPS1555 Capital Markets, Financial Intermediaries, and Corporate Governance: An Empirical Assessment of the Top Ten Voucher Funds in the Czech Republic	Roland Egerer	December 1995	D. Brown 33542
WPS1556 Workers in Transition	Michal Rutkowski	December 1995	WDR 31393
WPS1557 Electricity Demand in Asia and the Effects on Energy Supply and the Investment Environment	Masayasu Ishiguro Takamasa Akiyama	December 1995	G. Ilogon 33732

Policy Research Working Paper Series

Title	Author	Date	Contact for paper
WPS1558 In Search of Price Rigidities (Recent Sector Evidence from Argentina)	Jacques Morisset	December 1995	N. Cuellar 37892
WPS1559 Have Transport Costs Contributed to the Relative Decline of Sub-Saharan African Exports? Some Preliminary Empirical Evidence	Azita Amjadi Alexander J. Yeats	December 1995	S. Lipscomb 33718
WPS1560 Trade and Fluctuations	Aart Kraay Jaume Ventura	December 1995	R. Martin 39065
WPS1561 Income Inequality and Aggregate Saving: The Cross-Country Evidence	Klaus Schmidt-Hebbel Luis Servén	January 1996	E. Khine 37471
WPS1562 Catching Up with Eastern Europe? The European Union's Mediterranean Free Trade Initiative	Bernard Hoekman Simeon Djankov	January 1996	F. Hatab 35835
WPS1563 Equity and Growth in Developing Countries: Old and New Perspectives on the Policy Issues	Michael Bruno Martin Ravallion Lyn Squire	January 1996	P. Sader 33902
WPS1564 From Plan to Market: Patterns of Transition	Martha de Melo Cevdet Denizer Alan Gelb	January 1996	C. Rollison 84768
WPS1565 Housing Finance in Transition Economies: The Early Years in Eastern Europe and the Former Soviet Union	Bertrand M. Renaud	January 1996	R. Garner 37670
WPS1566 Liquidity, Banks, and Markets: Effects of Financial Development on Banks and the Maturity of Financial Claims	Douglas W. Diamond	January 1996	D. Evans 38526
WPS1567 Population Growth, Factor Accumulation, and Productivity	Lant Pritchett	January 1996	S. Fallon 38009
WPS1568 Determinants of Diarrheal Disease in Jakarta	Anna Alberini Gunnar S. Eskeland Alan Krupnick Gordon McGranahan	January 1996	C. Bernardo 37699
WPS1569 Improving Water Resource Management in Bangladesh	Rashid Faruquee Yusuf A. Choudhry	January 1996	C. Anbiah 81275