

Development and Management Challenges of Integrated Planning for Sustainable Productivity of Water Resources*

Murshed Ahmed**

Abstract

This paper explores the actual and potential contribution that can be made for enhancing the sustainable productivity of water resources. There are immense possibilities of converting waters of the GBM region and other transboundary rivers into wealth. It is a great challenge to integrate water resources to work out an environmentally sound, socially responsible and economically productive water management paradigm in this region. The challenges of water management, lies in overcoming water scarcity, water quality deterioration, threat to regional and world peace and security. Water resources management in Bangladesh are degrading and reducing their ability for promoting essential goods and services to humankind. However, if the country is to achieve higher, sustainable, poverty-reducing growth, water resource system should be developed in an integrated and comprehensive manner taking into account the multiple functions it performs and the goods and services it produces. IWRM is closely interlinked with benefits sharing of transboundary rivers but this depends on strengthening international cooperation and partnership approach. Strong political commitments and partnerships will bring together all players in the development chain in making the most of its benefits and share them equitably.

1. INTRODUCTION

Water as a basic human right is the single-most important input and a crosscutting resource. In addition to the importance of water as a basic human right, water is crucial to socio-economic development and poverty alleviation. The Third World

* Presented at the 14th Biennial Conference of Bangladesh Economic Association held in September 2002, Dhaka.

** Director, Project Evaluation, BWDB, Dhaka. Views expressed herein are the author's own and do not necessarily reflect those of the BWDB. The author acknowledges with gratitude the assistance and advice received from Mr, Nityananda Chakravorty, Joint Chief, Planning BWDB, Dr. Afzal Hussain, Head, Water Resources Division, IWM and Mr. Dhali Abdul Quium, Principal Scientific Officer, WARPO. The institutional and support services have been received from BWDB & SADM of IUBAT.

Water Forum 2003 concluded calling water a “driving force for sustainable development” and a strategic tool to fight against poverty¹. But water resources management in Bangladesh are degrading ecosystems and reducing their ability for promoting essential goods and services to humankind. Reversing this threat and achieving sustainability requires an integrated approach to managing water, land and ecosystems, taking into account socio-economic and environmental needs. Water as a basic need and a human right is considered as the engine for economic growth for sustainable poverty reduction strategy. It is a vital resource for human survival, socio-economic development of the country and preservation of its natural environment. Water resources should be managed in a comprehensive, integrated and equitable manner. Water resources planning has to take into account a variety of geographic, morphologic, hydrologic, social, economic, ecological and environmental factors².

As water is a precious national resource its proper utilization is of utmost importance in achieving our long-term goals and objectives. Sound and balanced management of water resources is a pre-requisite to ensure quality of life and the sustainable socio-economic development of our societies. Development of agriculture, industries, forestry, environment, fisheries, navigation etc. has deep-rooted linkage with Integrated Water Resources Management (IWRM). Although agricultural sector that contributes 24% to the country's Gross Domestic Product (GDP) Bangladesh Water Development Board (BWDB), pursuant to National Water Policy (NWP) has gradually been adopting the IWRM strategy in place of traditional agricultural bias.

2. OBJECTIVE

This paper aims to explore the actual and potential contribution that can be made for enhancing the sustainable productivity of water resources. The main objective is to cater for IWRM to satisfy multi-sector water needs with limited resources for promoting socially acceptable, environmentally sustainable, economically productive and efficient water management rather than fragmented and uncoordinated management of water resources. The final objective is to attain sufficient coping capability of the society to meet the challenges of IWRM.

3. APPROACH AND METHODOLOGY

Development and management of water resource is engineering and science based. Water is not only an economic good but also a social and environmental good that needs to be managed quantitatively and qualitatively. The management

of water resources is quite complicated and a difficult task that needs to focus on both supply and demand aspects. The concept of IWRM is globally accepted as the optimal approach for future water resources development. The IWRM is based on the many past experiences in water management throughout the world and hence is viewed as a flexible methodology to be adapted for each individual country². It is also based on the perception of water as an integral part of the eco-system, a natural resource and social and economic good. IWRM is a well-coordinated and participatory approach of a multi-functional system of water, man, land and related resources. Its objective is to ensure sustainable utilization of the water resources and an equitable distribution of its benefits, which optimally contribute to the social and economic development of the society as a whole, without compromising the sustainability of the vital eco-system. Development of comprehensive systems analysis model is required for this approach that would enable the identification of development priorities by accounting for the trade-offs between conflicting objectives. These approaches focus on the multi-dimensional character of water resources and their uses. The quantity and quality of water must be seen as a global concern requiring a unified management approach.

Water resources planning and management concept is multidimensional and multifarious. A multidisciplinary and comprehensive approach is adopted to optimize the water needs of agriculture, environment, public health, fisheries, navigation and industries. An integrated view of the hydrologic cycle and the interactions of human interference's have been taken into consideration. The data base and support services has been necessarily drawn upon the available sources inside the country although regional data base is felt to be an urgent necessity to make the management system dependable on the long run basis. The study is based on both macro-level and micro-level data. As a support to the said methodology, the secondary sources at the macro level have also been used. BWDB, Water Resources Planning Organization (WARPO), Ministry of water Resources (MOWR), Institute of Water & Flood Management (IWFM), Institute of Water Modeling (IWM) and South Asian Disaster Management Centre (SADMC) of International University of Business, Agriculture and Technology (IUBAT) are the major sources of the secondary level data and information.

4. LIMITATIONS OF THE ANALYSIS

It would be pertinent to mention some of the limitations of presented in this paper. The limitations include the follows:

- a. Case study both for country and region could not be done. Limited discussions on transboundary issues for an integrated water resource

management and benefit sharing have been made. Legal issues regarding water rights, codes, laws, regulations and its uses could not be covered based on master plan or basin management.

- b. Financing mechanism and financial implication could not be addressed. Water to all in a sustainable way has a cost which should be recovered from all those who benefit has not been worked out. Participatory decision-making on investments, cost recovery and enforcement mechanisms that give voice and choice to users and societies have not been done.
- c. Integrated information, on institutions, monitoring system and planning of joint ventures and research programs have been highlighted on a limited scale.
- d. Sustained benefits of water for the poor is a major challenge which remains to be addressed.

5. ISSUES AND PROBLEMS OF THE WATER RESOURCES SECTOR

The importance of water resources, in overall context of Bangladesh, is unlimited. Water is central for human survival, socio-economic and environmental sustainability⁴. However, it is a limited and finite resource with problems of different dimensions and issues. Various conflicting and complementary uses of water like domestic, agriculture, navigation, fisheries, livestock, forestry, hydropower and above all, in maintaining environment for a healthy and prosperous society make this resource an economically critical one. Although Bangladesh has been historically a land of rivers with variety of hydrological, morphological and meteorological characteristics it has been facing a dual challenge: unlimited flood water during the wet season on the one hand and increasing scarcity of water during the dry season on the other (Box-1). The twin problems of water scarcity during winter and abundance of the same during monsoon is a unique feature of water resources of the country. Water resources management system consists of (i) components of the natural system (ii) human made infrastructure and also (iii) institutional arrangements to regulate and control the availability and access to these components by users. Such a system produces goods and services in response to the final demand from society.

6. CHALLENGES IN MANAGING WATER RESOURCES

The problems of abundance of water during the monsoon and its scarcity in the dry season are critical to the development and management of water resources in

Box I: Some Critical Factors Adversely Affecting Management and Development of Water Resources in Bangladesh	
➤	Floods
➤	Drainage congestion and water logging
➤	Reduced fresh water availability
➤	Disturbance of morphological processes
➤	Rise of river beds due to siltation
➤	Erosion of river banks
➤	Cyclone and storm surges
➤	Coastal dynamics and salinity intrusion
➤	Pollution of surface & ground water
➤	Arsenic contamination of groundwater
➤	Human intervention in the flood plains and in the water bodies
➤	Poor Institutional development
➤	Upstream interventions
➤	Storage reservoirs in the Himalayas
➤	Upstream river basin development beyond the border of the country
➤	Non-optimal regional water sharing arrangements
➤	Inter-basin water transfer project/International river-linking project
➤	Drought and desertification
➤	Non-establishment of water rights

Bangladesh. The problem of scarcity has been further compounded by human interventions beyond the borders. Perhaps, nowhere else in the world does water pose such challenge and at the same time offer such potential for development as it does in this riverine delta. It is thus imperative that this resource be developed and harnessed to its optimum for our very survival as a vibrant society in the 21st century. In the dry season optimum use of available water resources will have to be taken into consideration the multifarious demand for use of water in domestic, irrigation, navigation, fisheries livestock, forestry, environment etc. On the other hand, in the wet season, the main tasks, in addition to provision of supplementary irrigation, are controlling, regulating and managing of floods to protect human lives, properties, crops etc. Mitigation of impacts of global warming, sea level rise and climate change throws another challenge for Bangladesh, along with other countries of the region. Some of the suggested critical measures against water-related disaster issues are depicted in the following Table 1.

Table 1 : Development Objectives and Water Disaster Reduction		
Development Objectives	Water-related Disaster Reduction Option	Suggested Measures and Modeling Needs
Economic Development	<ul style="list-style-type: none"> ➤ Reduction of damages due to floods, storm surges etc. ➤ Reinforcement of flood plains management 	<ul style="list-style-type: none"> ➤ Flood management modeling ➤ Shared vision modeling ➤ Basin wide management ➤ River basin planning ➤ River basin management on the basis of participatory approach ➤ Flood forecasting & warning system
Poverty Reduction	<ul style="list-style-type: none"> ➤ Erosion control ➤ Land accretion ➤ Char development 	<ul style="list-style-type: none"> ➤ River erosion mitigation project ➤ Resettlement action planing ➤ Water management improvement project ➤ Irrigation & drainage management modeling under command area development ➤ Morphological assessment & modeling
Food Security	<ul style="list-style-type: none"> ➤ Irrigation ➤ Drought management ➤ Improve fish habitat 	<ul style="list-style-type: none"> ➤ Assessment & management of dry season water shortage ➤ Crop damage assessment modeling ➤ Integrated water resources management at level of river basins
Public Health & Safety	<ul style="list-style-type: none"> ➤ Safe drinking water ➤ Sanitation ➤ Drainage ➤ Cyclone /storm surges etc. 	<ul style="list-style-type: none"> ➤ Water quality monitoring ➤ Managing surface and ground water quality for mainstreaming the environment in the water sector ➤ Urban drainage management
Decent standard of living for the people	<ul style="list-style-type: none"> ➤ Access to fresh water resources and making water flows for production, health & hygiene ➤ Fresh water availability for multipurpose and multiple economic use 	<ul style="list-style-type: none"> ➤ Striking a balance between use of surface & groundwater ➤ Integrated planning for sustainable water management ➤ Urban flood control & drainage improvement
Protection of the Natural Environment and bio-diversity	<ul style="list-style-type: none"> ➤ Improve water quality ➤ Strongly enforce existing legislation related to water ➤ Environmental impact assessment and social impact assessment ➤ Preservation of the aquatic Eco-system 	<ul style="list-style-type: none"> ➤ Balancing supply and future demand ➤ Water quality modeling ➤ Capacity building for integrated management ➤ Developing partnerships & regional co-operation

In the Ganges-Brahmaputra-Meghna (GBM) region, particularly in Bangladesh, much of water is distributed unevenly in space and time. It is a great challenge to integrate water resources to work out an environmentally sound, socially responsible and economically productive water management paradigm in this region. The challenges of water management, therefore, lies in overcoming water scarcity, lack of accessibility of many to safe water for drinking and sanitation, water quality deterioration, threat to regional and world peace and security, lack of adequate awareness in decision makers, decline of financial resources and finally, fragmented water management. Thus, the management of water resources has been one of biggest challenges facing this sub-region. The 2nd and 3rd World Water Forum held in the Hague and Kyoto underscored the importance of IWRM to respond to the challenges of global water management. An 'Intent' was declared by five countries (Argentina, Bangladesh, China, the Netherlands and Vietnam) concerning cooperation in the field of integrated flood management in deltas and lowland river regions⁵.

7. DIMENSIONS OF INTEGRATED WATER RESOURCES MANAGEMENT

IWRM takes into account of all natural aspects of the water resources, of all sectoral interests and stakeholders, relevant policy frameworks, and all institutional levels. It has three main dimensions after Savenije, 1970 with modification and a number of crosscutting issues⁶. This is to note that water resources come in different forms and have multiple uses. Water is available in surface stocks and flows, as ground water in aquifers or as soil moisture. All forms of occurrence of water including surface and ground can be used for diverse purposes and all are important to the viability of ecosystems. As mentioned earlier, water resources also move and vary over both space and time, with the variability operating at different temporal and spatial scales. The movement of water, flowing over the surface and through aquifers, means that water resource issues can never be purely local. These multiple sources and multiple uses of water resources mean that there are likely to be various stakeholders with competing interests, especially since water use often involves externalities whereby secondary costs or benefits do not accrue to the water user. The multiple nature of water resources and their uses is reflected in a move away from traditional sector approaches to what has become known as IWRM⁷.

7.1 Dimension I: Kinds of Water Resources

Water resources of Bangladesh can be classified based on hydrological context and land type concept⁷. Water resources can take several forms of occurrence

including salt water and fossil ground water. An interesting distinction, which can be made, is between blue and green water. Blue water consists of both open inland waters and closed waters. The open inland waters are in the rivers, estuarine area, beels and haors, inundable floodplains and lakes while closed waters are in the ponds, baors (oxbow lakes), brackish water farms and shallow aquifers⁸. Both the kinds of water have received all the attention from water resources planners and engineers. Green water, the water available in the unsaturated soil responsible for production of bio-mass has been largely neglected but it is the green water that is responsible for 60% of the world food production and all of the bio-mass produced in forests and pasture. Fossil water, the deep aquifers that contain non-renewable water, should be considered a mineral resource, which can only be used at the cost of foregoing future use. In this definition, underground water distributed over blue, green and fossil water. Figure 1 provides a basis for identifying the nature and use of water resources.

7.2 Dimension II : Water Users

The various water users, which can be categorized into, are domestic, agricultural, industrial, power, livestock, fisheries, forestry and transport. Water users consists of consumptive use and non-consumptive (often in-stream) uses. It includes all uses of water resources (including fishing, navigation, besides direct use of water), and also includes ecosystems as “users” or stakeholders whose ‘interests’ need to be central to water resources management decisions. Besides quantity, the users also depend on the quality of the resource. An integrated approach to using water will be necessary to avoid conflicts that have been experienced in other countries. The fundamental basis of the approach should emphasize integrated river basins management including environmental protection in the use of shared water resources.

7.3 Dimension III: Spatial Scales

Water resources issues are apparent at different levels: the international level, the national level, the regional level, the local level and the household and intra-household levels. Parallel to these administration levels are hydrological system boundaries such as river basins, sub-catchment and watersheds. Hydrological boundaries seldom concur with administrative boundaries. River basins⁹ are very appropriate units for operation management but present problems for institutions, which have a different spatial logic. Defining the most appropriate spatial boundaries is a key challenge in many countries of the worlds. However, the management of resources and other aspect of life is undergoing a process of decentralization¹⁰. Dimension of integrated water resources management after

Savenije, 1970 with modification is shown in figure-1 where three dimensions: (i) Production/ water function aspects, (ii) Users' aspects (Preferences), (iii) Hydro-morphological aspects have been considered.

8. GLOBAL PERSPECTIVE

Over the past few decades, demand for water is constantly rising throughout the Globe. Water quality and quantity have deteriorated at local, regional, national and international level. Concomitantly the water for the environment has degraded and the cost of developing new water resources have risen alarmingly. This, combined with population growth and fragmented water management, has created an unsustainable environmental situation in many parts of the world. Bangladesh is faced with full range of global water-related problems which the entire world is now scared about. If a quick "blue accounting" on global perspective is made, it reveals that as much as 97.5 percent of world's water is salty, 1.67 percent is locked up in ice caps and glaciers, 0.17 percent lies too remote for human access, 0.53 percent comes at the wrong time and place (eg. in Bangladesh, only 3710 million cubic meters is available in February while as much as 111,250 cubic meters in August) and the remainder i.e. 0.13 percent of total water, is only available for human needs¹¹. Water is, therefore, really scarce. But it is still observed that actions of human mankind are continuing to pollute water in rivers all around the country. These problems need to be addressed to have a meaningful basis for water management.

9. DIVERSE APPROACHES TO WATER RESOURCES MANAGEMENT

With an expanding agro-based economy and manufacturing sector the demand for water of good quality and sufficient quantity is increasing dramatically. The scenario is exacerbated by rapid population growth and urbanization in most developing countries. As demand for water for human, industrial, agricultural, navigational, environmental and other uses has escalated, so have the different uses been under severe competition. In Bangladesh, despite the unique dimension of water as a resource, its variation in temporal and spatial occurrence is a major impediment to water development for marking contributions to the national economy. The important of this scarce resource management, therefore, lies in optimizing the use of water in each deserving sub-sector under short, medium and long-term perspectives. Conflicts and complementarities among them through careful project planning and design have to be minimized. Balanced set of policies and institutional reforms in water resources sector have to be obtained to manage water resources more effectively. These will harness efficiency of market forces

and strengthen the capacity of Bangladesh economy. In order to meet the water demand for the various and often conflicting use', available water resources have to be properly managed in a sustainable manner.

Identification of Problems of Managing Water Resources

The traditional benefit cost analysis does not reflect the consequences of water sector investments upon other sectors. It is important to develop a planning methodology that relates water sector plans to macro-economic decisions which would help to guide the investment policies for the overall development of a country. The management of water resources has, however, suffered from weaknesses that include : (i) fragmented and poor institutional approach to water management; (ii) over-emphasis on new investment programs combined with limited attention to ensuring effective operation and maintenance (O&M); (iii) low priority of environmental considerations and (iv) allocation of resources in Annual Development Program (ADP) and revenue budget on an ad hoc basis rather than on needs and priorities.

In general, the following three types of maladies are observed in water management:

- a. Fragmented public sector management that neglect inter-sectoral implication of water development in a particular sector or agency.
- b. Overextended public agencies neglecting financial accountability, user participation and efficiency of delivery services; and
- c. Public investments neglecting water quality, health and environmental impacts in the long run.

As water is largely a public good; its integrated management has to be based on the perception of water as an integral part of ecosystem, a natural resource and social and economic good. And management of this scarce resource has been a challenge for the Governments concerned. Proper development of water resources sector requires multi-objective planning, integrated land and water resources management, risk-based decision making, fostering citizen's involvement in planning decision making, social equity and environmental preservation, feedback from beneficiaries and project evaluation and many other elements.

The planning process should address the interactions between people, water, land and floodplain environment in a river basin. It should also take an integrated view of floods, droughts, river erosion, sedimentation, dry season flow, groundwater,

agriculture, crop diversity, soil fertility, fish habitats, wetlands, charlands, salinity, water quality, non-point source of pollution etc. However, Fig-1 illustrates emerging conflicts in land use and water use. Population growth, urbanization, agricultural expansion and industrial development are a great challenge to water resources management. This has resulted in widespread shortages in water availability and deterioration in water quality.

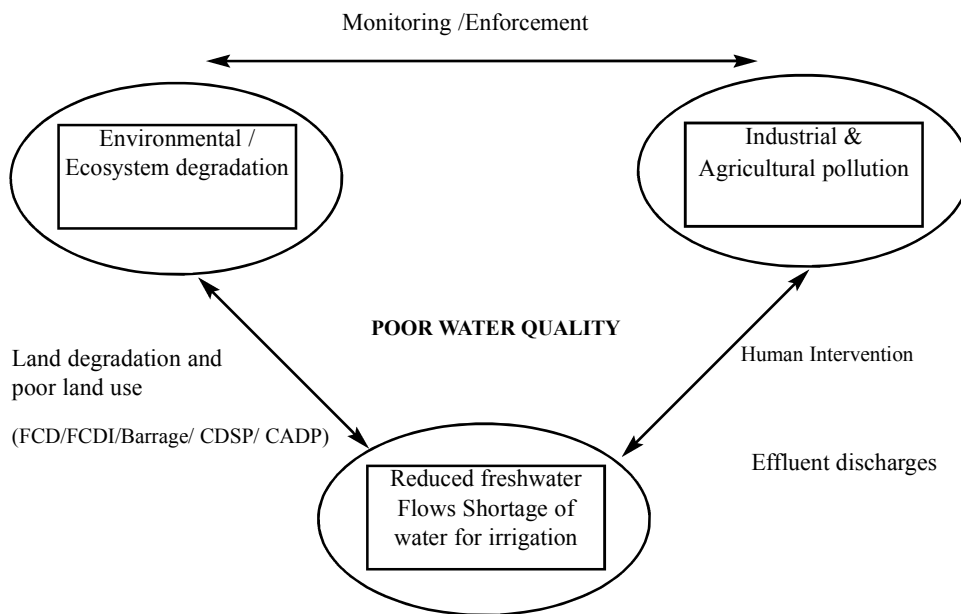


Figure 2: Poor Management of Water Resources

The consequences of the above mentioned problems shown in Figure 2 affect all the sectors of the economy in a given geographical area. Water infrastructure has also affected social, economic and environmental aspects adversely. Pollution, over consumption, growing sectoral demands and poor management of water resources are causing degradation of both quantity and quality of freshwater. Here three issues need elaboration, which are analysed below:

Water-Related Disaster: Water is the source of life, but it is also a threat and disaster. Water is closely linked to the socio-economic development of mankind. It is critical for long-term economic development for social welfare and for ensuring environmental sustainability. Water is identified as a big hazard only when it is “too much” or “too little”. Water-related disaster such as repeated

floods, storms cyclones, tidal surges, erosion of river banks and upstream withdrawal create a threat to the human environment and lead to socio-economic losses and deprivation. The effects of water-related hazards are thus social, economic and environmental shown in Figure 3. The over-exploitation of natural resources is accelerating depletion of important resources such as water, soils, forests and fisheries. The texture of causes and consequences of over exploitation brings about a myriad of socio-economic, technological, physical and governance problem. Indicative measures against the problems are shown in the Figure 4. In some areas of the northern region, use of deep tubewells along with the effects of the Farakka barrage on the Ganges river have lowered the water table. Similarly, withdrawal of Ganges water combined with siltation at the Gorai river off-take are

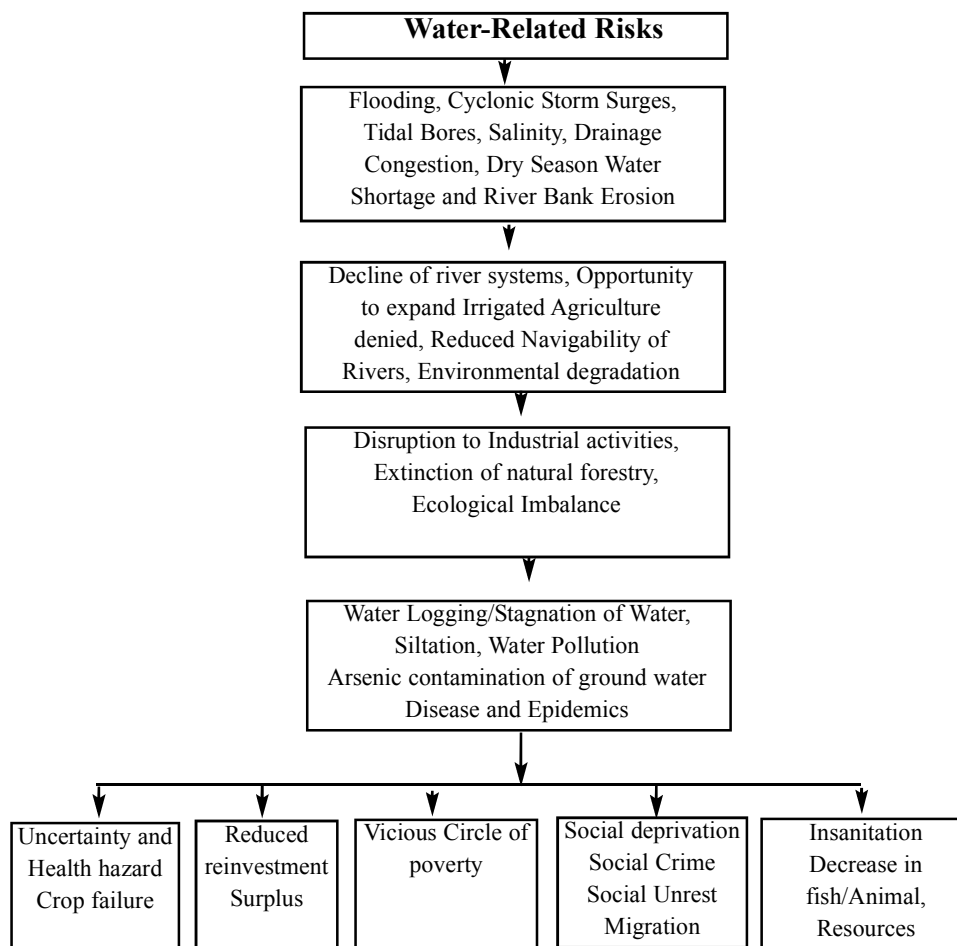


Figure 3: Schematic Representation of the Problems and consequences of Water-Related Hazards

greatly increasing the salinity in the South-Western Region. This is a major problem in over 25,900 sq. km. of the Ganges dependent area and is causing both short and long-term problems in crop production, fishery, forestry, power generation, industrial development, health care and domestic water supply. Although the situation seems to be improving following the Ganges water sharing treaty signed on December 12, 1996, nevertheless the desired improvement will not take place till the proposed Ganges barrage is constructed and water flowing down the Gorai and other relevant distributaries is augmented.

Water and Poverty: Poverty is also identified as a hazard. The major causes of poverty in Bangladesh are low economic growth, inequitable distribution of income, unequal distribution of productive assets, unemployment and under employment, high rate of population growth, low level of human resources development and limited access to public services. The poor class has increased due to crop failure by water-related disasters. As there are very little agricultural reinvestable surplus, low saving, low investment and low productivity make a case for below-poverty level equilibrium trap and perpetual poverty as shown in Figure 3. Salinity resulted in the scarcity of drinking water, change in vegetation affecting the livestock resources due to the scarcity of animal fodder and decline of the Sundarbans.

International Water Issues: The water management problem has another important dimension that is, the management of international water courses. More than 200 river basins are shared by two or more countries, occupying about 60% of earth's surface. More than 300 treaties have been signed by countries to deal with specific use of international water resources and more than 200 treaties signed by co-riparian to deal with water related issues, but co-ordinated management has still been a far-cry, resulting in economic, environmental and even political crisis among nations. Inefficiency caused by interdependent water uses cannot be resolved through a single Government policies. Without enforceable international rights established through treaties, upstream countries withdraw at the cost of downstream ones and the consequence is fatal for the lower riparians. On the other hand, her flat terrain prevents construction of storage dams to conserve the monsoon flood for use during the dry season.

With regard to water resources, the issue of concern is how to implement an integrated river basin management system, specified in the NWP (1999) in order to achieve the sustainable use of rivers and water bodies for present and future generations. This management system seeks to balance of interests of different sector users (hydropower, water supply and sanitation, irrigation, navigation etc). In order to meet with ever increasing and diversified demands, water resources management should be organized in an integrated manner at both national and

Dynamic and Complex Interrelationship Between Causes of Disaster And Impact on Natural Resource Base

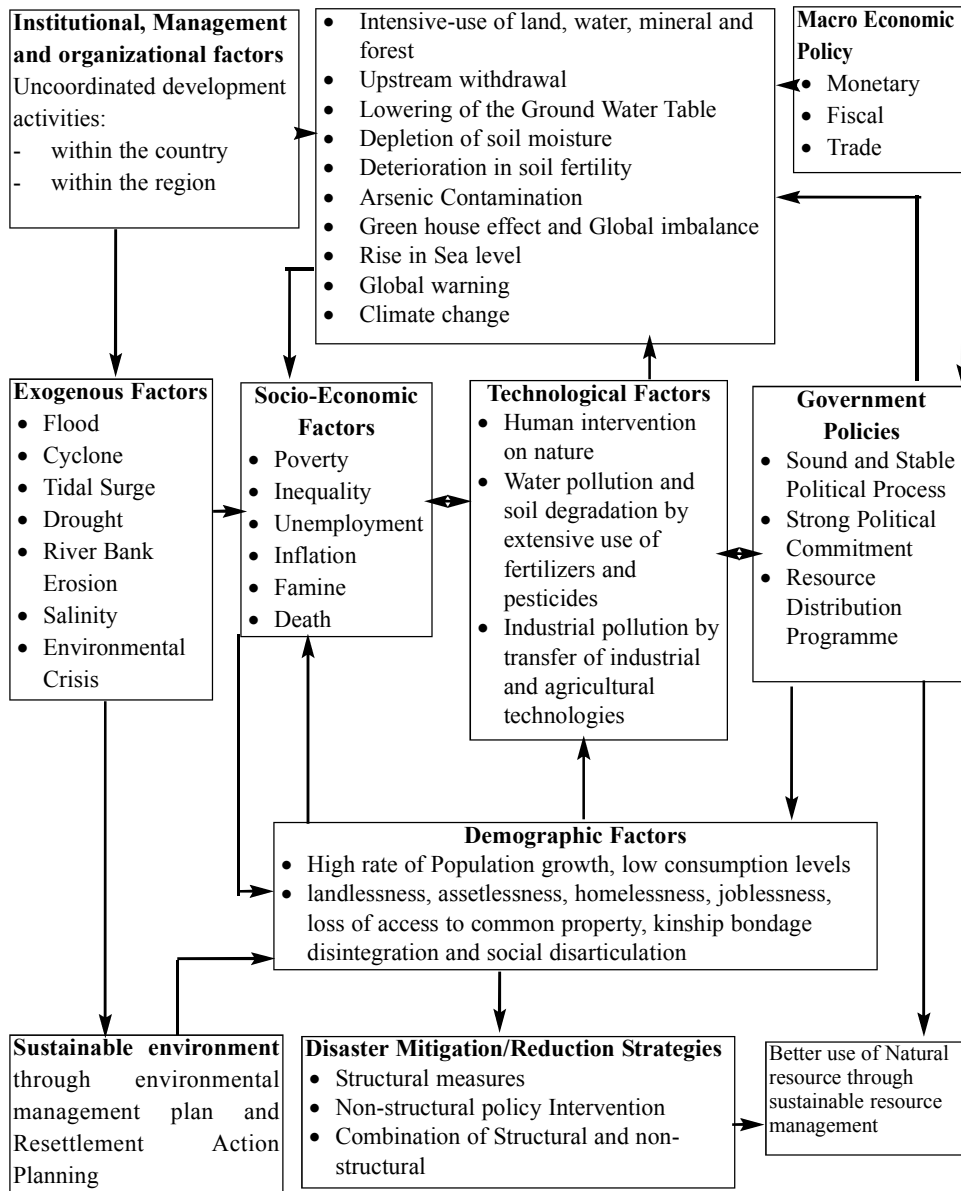


Figure 4: Interlinkages between causes of Disaster and Impact on natural resource Base

international watershed levels. Rational management of water resources is essential for ensuring the quality of growth and the sustainable development of the region.

10. INVESTMENT OPPORTUNITY IN WATER MANAGEMENT

Planning and management for water resources in the fragile ecology and changing environmental of Bangladesh is a complex and exceedingly difficult task involving hydrology, water management, forest and fishery resources, people, government policies and institutions. Planned utilization and efficient management of land and water resources in Bangladesh should be with a strategy of sustainability and exploited within their optimum sustainable capacity for achieving desired changes in agricultural growth and productivity. Investment is an economic activity. Water management activities need structural and non-structural components together for better and more comprehensive solutions. Water being basically a public good, as said earlier, return to investment on it may indicate its relative strength or weakness for the potential investors – both public or private as may be the case. But among few sectors of economy, water management in terms of irrigation, flood control and drainage, sanitation, water supply and sewerage turns up the financial rates of return as shown in Table 2.

Table 2: Average Economic Rates of Return on Project in different Sectors (1974-1992)

Sector 1978-82	1983-92	
1. Irrigation and Drainage	17	13
2. Water and Sanitation	7	9
3. Sewerage	12	8
4. Water Supply	4	6
5. Infrastructure Projects	18	16
6. Telecommunications	20	19
7. Transport :		
– Airport	17	13
– Highways	20	29
– ports	19	20
– Railways	16	12
8. Power	12	11

Source: World Development Report 1994, Infrastructure for Development, The World Bank, June 1994

Relative worthiness of investment in water management sector range, as per the World Bank's analysis above, between 6%-13% while other sectors have relatively higher values of return. Given water's special characteristics, it is difficult to use unregulated markets to deliver water efficiently or to allocate it among sectors. Even more important, as a cause of low realized returns, water moves through an intricate hydrological cycle of rainfall, absorption, runoff and evapotranspiration that makes water activities highly interdependent and result in numerous externalities from various uses of surface and groundwater. Market forces, e.g. taxes regulations, enhancement of competitive pressure etc. and inadequate or highly monopolistic private investment in water sector give rise to problems. IWRM principles can eliminate these problems by optimizing the benefits and minimizing the costs of competing sub-sectors in water management sector.

It is necessary to carry out lending operations for water project where assessment of the complications for involving other water-using sub-sectors within the relevant regional setting, most likely a river basin, is accomplished. Relevant pricing issues, cost recovery, financial autonomy and sustainability and community participation including Non-Governmental Agencies should receive particular attention. It will also be needed to carry out priority reforms and activities such as: public investment priorities, environmental restoration and protection, water resources assessment and data collection, comprehensive analytical framework, legislation, institutional structure and capacity improvement.

Investment Needs in Water Sector: Although the over-all returns on water infrastructure has to a great extent been disappointing nevertheless reasonable investment is required to meet the welfare needs of the society for which economic returns need not be competing with fast growing modern sectors. The Investments in water resources are investments not only in the water sector, but also socio-economic development and poverty alleviation. When compared with investments in other sectors like telecommunications and highways, these investments may appear to produce low returns. But when viewed from a national or regional angles, they can be considered very productive.

Investment levels in water institutions and infrastructure are far too low. Funding in this sector is declining. Water rates and collections are too low to cover costs, putting them at risk the financial and physical non-sustainability of water systems. Governments have to be prepared to meet the challenge of meeting financial resources in the water sector for investment as well as O&M.

New Issues and Approaches: The new and diverse approaches to managing water resources should build on the lessons of experience in different countries of

the world. Water is a unitary resource, and that surface and ground water are an interconnected system, which must be addressed with comprehensive planning. Water is both a public and a private good. Water is also economic and environmental good, as within each hydrological unit renewable fresh water is limited. A comprehensive policy framework is required for decentralized management and delivery structures, greater reliance on pricing and fuller participation by stakeholders¹². Degradation of the water for the environment of its quantity and quality are the result of poor and fragmented water management. In order to correct the situation new and diverse approaches to water resource management should move beyond traditional water management that will promote economically viable, environmentally sustainable and socially equitable management of water resources. The most important of these water resources issues are:

1. Quantity and quality concerns through an integrated approach.
2. Land use management with sustainable water management.
3. Freshwater flows for environmental management.
4. Water as an economic good that promotes cost-effective solutions.
5. Balance water management for different water users.
6. Supports innovative framework for stakeholders participation.
7. Effective legislative framework and enforcement capability.
8. Sustainable rural livelihoods and the quality of their environment.

To address some of these issues, it is suggested that the following can be considered:

1. Water should be considered as an economic good since it has a value in all its competing uses.
2. Water conservation should be an integral activity of the environmental management plan.
3. River basin studies should be taken up as a tool for integrated management.
4. Environmental Impact Assessment (EIA) should be undertaken for all major projects.
5. The water users should be encouraged to participate in water management activities.
6. Data and statistics on national and international water resources should be disseminated to the public.

Following international conferences, particularly in Dublin and Rio de Janeiro, the World Bank published a Water Resources Management Policy paper in

September 1993 to address the growing global water resources management challenges. To support the implementation of the Water Resources Management Policy, the Economic Development Institute (EDI) of the World Bank developed a special initiative, the “Water Policy Reform Program,” in collaboration with national and international organizations. The overall objective of the EDI Water Policy Reform Program is to assist countries in preparing and implementing reforms leading to sustainable water resources management.

The international Conference on Water and the Environment: Development Issues for the 21st Century, held in Dublin (January 1992), called for new approaches to the assessment, development and management of freshwater resources. The conference report sets out recommendations for action at the local, national and international levels, based on four guiding principles. First, the effective management of water resources demands a holistic approach linking social and economic development with protection of natural ecosystems, including land and water linkages across catchment areas or groundwater aquifers. Second, water development and management should be based on a participatory approach involving users, planners and policymakers at all levels. Third, women play a central part in providing, managing and safeguarding water. Fourth, water has an economic value in all its competing uses and should be recognized as an economic good.

The United Nations Conference on Environment and Development (June 1992) in Rio de Janeiro, Brazil, confirmed the widespread consensus that the management of water resources needs to be reformed. The conference stated that, the holistic management of fresh water as a finite and vulnerable resource and the integration of sectoral water plans and programs within the framework of national economic and social policy are of paramount importance for actions in the 1990s and beyond. The conferences stressed the implementation of allocation decisions through demand management, pricing mechanisms and regulatory measures.

The World Water Forum 2000: The World Water Forum, ended with Ministerial Declaration of the Hague made on the 21st of March, 2000 confirms the commitment of the world to achieve water security in the 21st century. The call can well be traced to the declaration of NWP of Bangladesh made in January, 1999 - more than a year before the recent Hague Declaration. The main challenges of the Hague Declaration can well be seen textured nearly in the said policy which reads, “The policies enunciated here in are designed to ensure continued progress towards fulfilling the national goals of economic development, poverty alleviation, food security, public health and safety, decent standard of living for the people and protection of the natural environment.” Water pricing and regulatory principles are also laid down in the Policy sections 4, 5 and 6 to cover the good governance of water.

To ensure proper development and management of the water resources various policies and strategies have been implemented in Bangladesh. The Government in 1999 approved a NWP to integrate water resources potential into development. The NWP has been formulated to meet the growing demand for water and the main directives include the following: provide the rationale for comprehensive water management planning; define the government’s thinking and direction on water management issues; point to the strategic direction for accomplishment of water management objectives; indicate legal measures and institutional support for the system.

The Third World Water Forum 2003: The main theme of the Kyoto Water Forum was “Addressing: Water issues through ownership and partnership for “Sustainable Development”. The theme included ‘Encouraging Governance and Ownership of Water Management’, which is a key to sustainable development and a better quality of life, enabling developing countries to stand on their own feet (Box-2). The themes were outlined to enhance for water strategies for individual countries or for river basins where appropriate: participation in water activities reinforced by role sharing with civil society and stakeholders: and water networking within the international community.

The Third World Water Forum prioritized water actions as an urgent global agenda and suggested certain policy actions to help tide over the global water crises. The Forum urged better co-operation among nations sharing common water sources and suggested to spur the United Nations into taking a leading role

Box 2 : The identified actions of the basic concept of sustainable water development and Management	
Encouraging Governance and Ownership of Water Management :	Fostering Partnerships to Support Ownership
Positive Actions ➤ Identify problem ➤ Raise awareness ➤ Build capacity ➤ Mobilize financial resources ➤ Formulate strategies ➤ Integrated Water Resources Management ➤ River basin management on the basis of participatory approach	Positive Actions ➤ Stakeholder involvement ➤ Sector-wide approach ➤ Development assistance ➤ Technology transfer ➤ International networking ➤ Developing partnerships & regional co-operation ➤ Basin wide planning

Based on discussion and interview with BWDB officials who attended the Third World Water Forum, 2003

in liaising, mediating and co-operating with other organizations involved in water sector. The Forum concluded calling water a “driving force for sustainable development” and a strategic tool to fight against poverty.

11. A FRAMEWORK FOR SUSTAINABLE PRODUCTIVITY OF WATER RESOURCES

Since development and management of water resources activities in Bangladesh are multidimensional and multifarious, the dynamics involved in the process may have to be pursued under the framework of certain guidelines. The four key issues can be considered as a follow-up of the Hague Declaration (World Water Forum 2000) for enhancing the sustainable productivity of water resources. The goals of the Declaration are inspiring but difficult to achieve. They imply viable technology, workable institutions, incentives, behavioral changes and investments for bringing the vision to reality. The essence of the *four key issues* is as follow:

Issue 1-Approach: It is an integrated approach to water resources management. IWRM provides a holistic and participatory approach in which decision making would recognize three areas for integration: (i) the relations between water and land use, (ii) the trade-off between social and economic development (different sectors) and the environment, and the interaction between management at international, national and local levels. To strengthen and reinforce these management approaches, the GOB recently prepared the NWP (1999) and has currently formulated the draft National Water Management Plan (NWMP). It is an integrated water resources management. Here, a framework at the catchment, basin and aquifer level operates, where nature manages water. Actors are the base-level water users who decide in a participatory way, enriched with adequate scientific and technical information.

Issue 2-Technology: It is less wasteful, more environmentally and socially friendly. The technology is drawn basically on traditional wisdom, but harnesses as much revolutionary changes as stimulation and incentives of society can afford. Several models are used in water resources planning (i) water balance model (ii) groundwater model and (iii) investment analysis model. These models are now being used in the planning processes of water sector. But some of them needs improvement and some new models are also required.

Issue 3-Institutions: Appropriate legal and institutional framework for the management of the environment including water resources have to be established when approaching water resources management from an integrated perspective. Water management is everybody’s responsibility. Role of the government is primarily legislative and regulatory even through introduction of private sector as

a service-provider, accompanied by demand from consumers, is in the offing in water sector in Bangladesh, a true public-private partnership is still to grow where government must ensure clear and sustained rules for accountability and transparency for each actor. The communities and users have to have a water management culture. They will be the guardians of sound water management practices, by enforcing principles and flagging violations. Local community empowerment and their participation should act as the basic building blocks and women should provide the glue to hold the communities together. Private sector can come up as catalysts, but basin management rules and water rights must be well defined. Government role remaining as the pivot for providing an enabling environment, alliance of local people NGOs - agencies may go for water-asset creation.

Issue 4—Funds: Public sector funding in water sector has a definite role to invest in cost-effective services in accountable and transparent way. To bring about changes of the magnitude needed as per the vision, provisions of funds will have to be almost trebled, up to 2025. In Bangladesh context, the present level of public sector allocation (say, Tk. 10.00 billion a year) will have to be increased to about Tk. 30 billion a year which can be foreseen as very difficult for the government to provide. Moreover, the bilateral and multilateral sources are also getting scarcer. Domestic and foreign private investment is, therefore, considered to be the next best approach to address the funding problem.

The public sector initiatives through MOWR, BWDB, WARPO, DOF, LGED etc are now being convergent towards an integrated water resources management. BUET, IUCN, IWM and CEGIS are also contributing to the integrated approach by providing analytical tools, models and guidelines. But the basic fact remains: the vision approach of catchment, basin and aquifer level planning, design and implementation cannot be materialized without establishing a high speed Internet link through data providers. For example, flood monitoring and forecasting in Bangladesh requires compressed or full resolution imagery for mapping flooding time, extent, duration etc based on remote sensing, GIS and hydrological data. High priority processing and delivery mode of the data providers in each of the co-basin countries (say, Nepal, India in our case) have, therefore, to be ensured.

In this pursuit, the framework of action outlined in the recent World Water Forum in the Hague has clearly underscored the importance of regional and sub-regional cooperation in data exchange and management. Before any Apex Body for such regional cooperation in water sector can be created for coordination, exchange of data and information at professional levels in different public and private water agencies can break the ice and pave the way for preparing the ground for integrated water system. If participation of local stakeholders is the key to micro-

level water resources management, it is more so for international stakeholders at the macro-level to make micro-management sustainable. Absence of the later preempts the efficacy of the former.

The Forum has opened the global eye that those who look at political and administrative boundaries as the basis of decision making in water, are only ignoring a crystal truth that those boundaries seldom conform to the catchment and basin characteristics¹³.

Guidelines for a Rational Management of Water Resources: Improvements in the management of water resources must strike a balance both in the supply and demand for water. It will have to examine the supply of water in the context of international rivers and groundwater, and the demand from irrigation, fisheries, navigation, drinking and municipal needs, and other important areas¹⁴. Therefore, one of the most difficult strategic issues will be deciding how to allocate limited supplies of water in the long run among its uses for agriculture, industrialization, salinity control, fisheries, navigation and a growing urban population. The following are the vital issues involved in the IWRM for enhancing the sustainable productivity of water resources:

Balancing demand and supply—The ever rising demand for water use and uneven distribution of water resources in both time and space make balancing water demand and supply quite a challenge. Severe imbalances of water availability in different part of the year and in different part of the country make the issue of water resources management more complex. So quantification and minimizing of impacts is vital for any planning or management problem, which is a complex exercise requiring sufficient data, knowledge and appropriate tools. Competition for the available water by the various water user sectors is stiff and is expected to get stiffer in the future unless comprehensive guidelines are put in place to dictate the allocation of the available water resources. Balance water management addresses all the issues of water users to provide adequate water in time, minimizing the adverse impact and maximizing the benefits. The issue of balancing water supply and demand during the dry season is a critical one. Water resource planning must achieve a balance among sectors as well as among users at the regional or hydrological unit level. Different water management approaches are needed during wet and dry seasons for creation of the best balance between the different needs of all water users in area, where these resources are scarce that have neglected water quality, health and environmental concern.

Conserving resources—IWRM is a process, which should promote the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising with the sustainability of vital eco-systems.

Bangladesh must achieve a rational and integrated management of water resources by striking a balance between use of groundwater and surface water, This is to maximize benefits for all without jeopardizing the quality and sustainability of the resources themselves or the ecosystems they support.

Upstream and downstream—Policies for integrated water resources management should support sustainable development in such a way, which does not affect the quality or quantity of these resources available to other users the other places.

Dealing with variability—Bangladesh has a huge surplus of water in the wet season and a shortage of water in the dry season. The critical impact issue is minimizing the effects of the variable and uncertain character of water resources. Minimization of conflicts between in-stream and off-stream users of water and maximization of complementarities must be achieved through careful project planning & design, particularly in case of FCD and FCDI projects.

Appropriate management—Appropriate water management is a key to national development. Appropriate use of surface water and ground water must be complementary to each other instead of being competitive. Identifying the most appropriate management system and finding a better way of managing water are needed during wet and dry season for achieving intersectoral balance and integrated water resources management. Appropriate management is required to produce water and water related goods and services for the benefits of the society as whole. It can be considered a production function, which transforms the quantity, time and location characteristics of surface and groundwater resources into quantity, quality, time and location characteristics of the desired outputs.

For a sustainable development of the life and living condition of the people and environment a comprehensive National Water Management Plan is an absolute necessity. The **NWMP** by WARPO is expected to take care of the holistic approach to integrated water resources management in Bangladesh. Understanding between co-basin countries for cooperation is also on a positive move. Information superhighway is now a crying need for these nations to be transparent enough about their respective water use, availability, quality and hazard¹⁵.

The NWP focuses on the balanced use of water and also flood and drought management rather than only irrigation and flood control as in the past. The policy will provide guidelines for identification of future programs of government and non-government sectors for the optimum development and sound management of water resources. To operationalise the water policy, a dNWMP with a holistic and integrated approach is being developed which aims at optimal use of available water resource and distribution of benefits to all concerned.

Recent shift in water sector planning and cross-sectoral issues

With declaration of NWP and preparation of dNWMP, the planning approach of BWDB has taken an strategic shift from sectoral planning to multi-sectoral planning. Thus scope has been enlarged to involve all water related sectors in its planning process. The new planning outfit is getting multidisciplinary and viable in nature, according to the needs of water sector planning as per NWP. The signing of agreement with Global Water Partnership in March, 2000 in the Hague has opened a larger avenue for BWDB to extend its water resources planning from FCD/FCDI approach to holistic integrated water resources management approach for sustainable water management. A major background work of this integrated planning approach has been the preparation of guidelines for participatory water management for involving all the stakeholders into the stages of water resources project cycle.

The BWDB planning performs micro-level planning for water resources projects for increased productivities in agriculture and fisheries for socio-economic development and poverty reduction of the country¹⁴. Flood management, drainage and irrigation project planning for agricultural and fisheries development constitutes the mainstay of BWDB's planning activities¹⁶. Preparing and updating inventories of potential projects on the basis of feasibility studies accomplished by BWDB's in-house professional or outsource consultants are also one of the major functions of BWDB. In this connection appointment of consulting firm /individual consultants is one of the major task of planning offices. Recently, planning wing of BWDB takes care of the IWRM for agricultural, fisheries, forestry and navigation so that the project is sustainable form institutional and environmental viewpoint.

Conflicts regarding water needs and use can emerge between big farmers and small /land less farmers; high land farmers; farmers and boat man; and, not the least of our concern, development activities and environmental concerns. Apart from these conflicts, which are likely to occur within a project area, conflicts can also arise outside between protected and un-protected lands; upstream and downstream areas; local level and regional, or national levels. The basic purpose of planning is to optimize the interests of varying group so that each user can pursue his /her own livelihood in harmony with others. Planning, if done effectively, can prevent conflicts and minimize disruption to the environment and, thus, ensure sustained growth. Such a function is sometime referred to as planning for IWRM. Interest of cross-sectoral stakeholders can be best obtained if conflict can be resolved by institutional interference within the stakeholders themselves.

The coordinated development for IWRM can be achieved through proper integration of two basic systems, the natural system and the human system. In the

case of Bangladesh, this integration will have to contend with, among others, the issues of integration between land and water resources management; surface and ground water management; flood and drought management; upstream and downstream water management; water quantity and quality; scales; and human culture and IWRM philosophy.

The key issue for IWRM is to develop an appropriate human system that is responsive to people's needs and is generally capable of delivering the intended services without jeopardizing the sustainability of the natural resources.

12. POLICY INITIATIVES

Bangladesh has no control over the international water courses. There are six major adverse effects related to water resources development: (i) flooding and drainage congestion, (ii) drought, (iii) siltation, (iv) river bank erosion, (v) salinization, (vi) pollution of surface and groundwater. Water resources management in Bangladesh, as the lower riparian country, is closely interlinked with and largely dependent on 57 transboundary rivers having shared basins with the neighboring countries (Box-3).

Box 3 : The proposed program for fostering regional cooperation in water resources development

- Work with co-basin countries to establish a regional level network for unhindered flow of water related data and information on relevant aspects of hydrology, morphology, water pollution, ecology, changing watershed characteristics, cyclone, drought, flood warning etc., and to help each other understand the current and emerging problems in the management of shared water resources.
- Work with co-basin countries for regional cooperation for basin wide harnessing, development, sharing and management of common water resources.
- Work in close cooperation with co-basin countries to resolve international water issues related to floods, water scarcity and environmental degradation.
- Explore ways to augment the water available for all users and sectors in the basin.
- Work jointly with co-basin countries for the prevention of chemical and biological pollution of the rivers flowing through these countries, by managing the discharge of industrial, agricultural and domestic pollutants generated by human action.
- Seek international and regional cooperation for achieving the goals of joint management of transboundary rivers for mutual benefit of all.

NWMP by WARPO is under process of approval by the government. IWRM in Bangladesh needs a strong and sustainable WARPO which would be able, to implement and update a NWMP. NWP provides the directives and the guidelines for fundamental and wide-ranging reforms of the water sector and its two principal organizations, the WARPO and the BWDB. It declares clearly the intention of the government to pursue a policy of IWRM and further pledges to take all necessary measures to manage the water resources of the country in a comprehensive, integrated, equitable and environmentally, sustainable manner. The NWP provides a comprehensive policy framework for dealing with such issues as river basin planning, water rights and allocation, delineation of public and private domains, water supply and sanitation, preservation of the natural environment and the development concerns of fisheries, navigation and agriculture¹⁷. The policy also provides guidance on its disposition towards water as an economic good, water pricing, fuller participation by stakeholders, decentralized management and delivery structures. The policy also formulates views on regulations, incentives, public investment plans and environmental protection and on the inter-linkages among them.

The policy has successfully integrated internationally accepted water management principles, norms and standards, with the demanding social and economic needs of a developing country. The true strength of this policy, however, emanates from its decentralized and democratic nature that gives every user opportunity to vote for the use and sharing the water in an efficient, equitable and environmentally sustainable manner. A Guideline for people's participation (GPP) was prepared by MOWR and approved in 1995. The GPP was further elaborated jointly with other water related government agencies in 2001 as the Guideline for Participatory Water Management. Efforts are now underway to effectively operationalize the Guideline for application in practical field.

The recent adoption of Interim Poverty Reduction Strategy Paper (IPRSP) adopted by the government envisages a sustainable integrated water resources management system to enhance the livelihood opportunities of rural people which is an overarching objective of Water Management Improvement Project (WMIP)¹⁸. Finally, the policy enunciates the basic principles for reforming the WARPO and the BWDB to facilitate the emergence of an IWRM regime.

13. POLICY IMPLICATIONS

- Access to fresh water resources has been a global concern since the beginning of human civilizations. Driving forces for increasing fresh water supply are: rapid population growth, expanding urbanization

and fast growing needs for irrigation and power generation. Safe and sufficient water is needed to sustain life and for raising people's standard of living giving them the ability and opportunity to advance. Safe water is also an important tool for development. The importance of water security implies meeting the basic needs like food supply, health and sanitation, protection of ecosystem, sharing water resources, managing risk, capacity development and financing. No growth and poverty alleviation strategy for Bangladesh can succeed without a healthy water and agricultural sector.

- Water is termed as lifeline for survival and sustainable development in the 21st century. Water is not only a powerful tool in combating poverty rather water can elicit democracy and spark peace for human development¹⁹. Economic value of water has to do with encouraging governance and ownership of water management which is the key to sustainable development and better quality of life, enabling developing countries like Bangladesh to stand on their own feet. Governance of water resources is a crucial issue, involving ownership rights on water for various uses.
- At river basin level, water problems become water 'challenges' when they help countries to understand the effects of their actions on neighboring countries. The scarce water gives rise to complex international problems that share the waters of international drainage basin. International /shared rivers have become sources of conflict as well as catalysts for cooperation. Basin-wide water management approach is fundamental for efficient and sustainable water use for the countries with predominantly transboundary rivers. Transboundary waters bring together policy-makers from different countries, giving them the opportunity to discuss and understand each others' positions for decision-making. It is essential to encourage such talks before conflicts arise. The river basin approach also offers another platform on which interest groups of all sorts can gain from mutual consultation. The bottom-up process will enable people for taking responsibility of integrated water management.
- Partnerships can yield a wide range of benefits (i) solidarity among countries and the region. (ii) regional security and economic development. Cooperation should go beyond single purpose solution towards integrated water resources management including land, water, ecosystems and people for all transboundry water basins²⁰. Resolution of conflicts will help building joint water management

institutions with proper understanding and by using human and political processes. While so much could have been done, achievement in terms of sharing and management of water resources of the common rivers through mutual cooperation has not been encouraging. Without the active cooperation of the co-basin countries, the above policy objectives of Bangladesh can never be achieved. Bangladesh's sincere efforts to foster regional cooperation among the co-basin countries of the GBM regions has to be reciprocated equally by the co-riparian countries²¹. Closer cooperation can work out the most feasible policies and effective instruments to water resources management.

- Management of water resources effectively and in a sustainable manner is an intricate process which requires comprehensive and innovative approach keeping in view the policies adopted at the international level. No strategy can be successful unless the interests of all stakeholders are taken fully into consideration. The problem becomes complicated when it concerns shared water systems between neighboring countries. The strategy should also ensure all co-basin countries increased benefits taking into account their major demands for effective water management.
- A strategy for conjunctive and non-conjunctive use of water over short, medium and long term is an imperative for conservancy of environmental balance. Besides consumptive and non-consumptive use, stakeholders depend on certain management practices such as flood protection, drainage, water level control, water distribution etc. This is a key dimension of IWRM: different stakeholder's interests operate and these can vary in scale from intra-household differences to transboundary disputes between countries. They also vary temporally, as needs and resource availability changes with development, population growth, changing land-use and settlement patterns, ecological change and so on. This implies that water resources management is conflict management, for the capacity to take account of different stakeholder interests and resolve actual or potential conflicts between them which is central to an IWRM approach.
- Multi-objective water resource planning approach is required to optimize the water needs of agriculture, environment, public health, fisheries, navigation and industries. The framework for improving water resource management should take into account all sectors and

usage for achieving intersectoral balance. The environmental, technical, social, economical, and institutional factors are necessary for ensuring economically viable, environmentally sustainable and socially equitable water management structure.

- Water allocation policies should be based on the principle of integrated water resources planning and management, covering all types of interrelated freshwater bodies, and taking into consideration water quality and quantity. Governance of water resources is a crucial issue, involving ownership rights on water for various uses. Within the holistic framework, strategies should be aimed at (a) improving the efficiency of water utilization, (b) preventing the contamination of known resources and (c) ensuring that all potential water resources are identified and protected. These policies should also consider the inextricable link of social and economic development with the protection of natural ecosystems and land and water uses across a catchment area or a ground water aquifer.
- Financial and economic sustainability for economic efficiency of water use is a major policy consideration. Policymakers have been compelled to adopt a comprehensive framework for improving water resources management that reflects the nation's social, economic and environmental objectives. NWMP in Bangladesh aims at developing a comprehensive framework for promoting environmentally sound, economically efficient, socially desirable and productive management of water resources. Multiple and economic use of water will increase in future. Steps have to be taken now to make adequate arrangement for supply of safe and required volume of water for drinking, domestic use, agricultural, industrial and fish culture purposes, maintenance of navigation facilities and saving environment.
- Managing water resources and making best use of this precious resource for all is truly a global challenge. So, the imperative is for its appropriate management and augmentation of water flow for the benefit of agriculture, navigation, pisciculture and also for ensuring safe for drinking and domestic /municipal uses. Demand for water will rise very strongly in the coming decades. The question now arises how to get sufficient water to provide food security, health and livelihoods to a growing population in harmony with other water users and the environment²². Participatory planning and development of water supplies for agricultural, municipal and industrial

applications will help achieve the most efficient water use and allow for the best possible reuse²³.

- Allocating water in the most rational way to make the most of its benefits and share them equitably has become increasingly important as demand for food and water increases and as water scarcity becomes more acute. Reducing conflicts among water users and conflict management of water resources is thus a major challenge. Water has no administrative border: its only limits are the river basin. The challenges of integrated water resources management are not, therefore, confined within territorial limits. Integration of all national efforts for multi-purpose and multiple economic use of water resources into a regional framework is thus imperative. The ultimate goal is to establish mechanisms for joint management for achievement of IWRM with predominantly transboundary rivers for efficient and sustainable water use by all the co-basin countries like China, India, Nepal and Bhutan for mutual benefits.

14. FINDINGS AND LESSONS

- Fresh water availability has become a major constraint for development and social well being. An equitable and economically efficient water allocation policy should be developed to satisfy the water demands of various competing water-use sectors. Conflicts over water have become more common among such competing users as urban water supply, irrigation, power generation, flood control and inland navigation. Water resources management and development issues need to be addressed and treated in a systematic and comprehensive manner. Policy makers must develop a comprehensive framework for water resources management rather than fragmented management of water sectorally by its separate uses.
- Bangladesh as a lower riparian in the eastern waters basin makes it extremely vulnerable to flood or drought. The high water levels in the major rivers during monsoon cause drainage congestion and over-bank spillage of their tributaries and distributaries²⁴. Besides flooding or drought and inadequate drainage, salinization and river bank erosion is another major problem. These threats will have to be addressed which constitute hazards of different degrees to the economy and mankind.

- A number of studies have been undertaken on how best to address floods and manage water in the dry and wet seasons²⁵. Managing the supply of water has been addressed in piecemeal fashion in the past without protecting the interest of navigation and fisheries. Flood management has been a top priority for decades, but an environment-friendly mechanism for balanced and harmonious development of water resources is yet to be designed. Efficient water and flood management and assured shares of the dry season flows of the transboundary rivers have, therefore, become imperative for the survival of Bangladesh²⁶.
- The Ganges water-sharing treaty has created a favourable atmosphere for agreement on sharing of the water of 53 other common rivers. The Treaty is a manifestation that cooperation for mutual benefit can be attained through negotiation and strong political will on the part of the involved parties. Although the 1996 Treaty on Sharing of the Ganges Waters with India has brought some relief to the drought-prone areas of the southwest of Bangladesh, the water shortage problem during the dry season still persists and likely to aggravate in the Ganges and other basins with rising demands of the increasing economic activities.
- As the competition for water can only become more intense in the future, it is imperative that an equitable and well-administered water allocation and regulatory framework be formulated for countries in the region. The framework should be based on (i) sharing and exchanging information; (ii) information highlighting the strong features of water allocation policies; (iii) water conflicts that act as serious constraint to socio-economic development.
- Water is an ever scarcer commodity and is frequently contaminated. In some rivers, the quality of water has deteriorated to such an extent that the quantity of water available for drinking and domestic use has been significantly reduced. For such rivers, appropriate remedial measures should be undertaken to restore the quality of water to its natural condition so as to maintain sustained socio-economic growth²⁷. These are all intended to provide knowledge and experience in formulating water allocation policies and practices that will ensure optimum and equitable allocation of water resources, thus contributing towards sustainable development and poverty alleviation.

- Over the last three decades Join Rivers Commission (JRC) has always concentrated on the quantitative aspect of Common River during its deliberations. Increasing pollution of river waters by the rising population, industries and use of agro-chemicals and pesticides has now become a matter of great concern. JRC, therefore, should give proper emphasis on the quality aspects of water and formulate necessary management strategies.
- The comprehensive assessment will ensure increasing productivity of water in agriculture while the program through basin-wide water management approach will help to arrive at concrete solutions promoting the changes needed for efficient and sustainable water use. The Dialogue will help disseminate research findings and determine research priorities from a stakeholder perspective. The collaboration among the transboundary rivers and river basins will initiate self-help strategy for development of water resources.
- The construction of Ganges Barrage Project which needs 500-600 million US dollars would help check desertification in the southwestern and northern region of the country and rejuvenate the flow of around 20 rivers including the Padma that alone contributes 20 percent of total surface water during the lean period (CAS for Bangladesh, BUP, World Bank, 2003). The barrage project is the only remedy to Bangladesh to solve many water-related disasters like salinity, desertification and arsenic contamination. The barrage project would not only help increase food production, but also to meet demands of surface water for drinking and irrigation purposes. All the nine feasibility studies on the Ganges barrage have found the project viable and socially desirable with no adverse environmental impacts.
- Water is essential for broad-based agricultural and rural development in Bangladesh. It is unique to all ecosystems and all human activity and has no known substitute. The earth contains approximately 1.4 million cubic kilometers of water, but approximately 97.5 percent of the amount is brackish water. About three-quarters of remaining 2.5 percent is locked up in icecaps and glaciers, leaving humans only a fraction of percentage point of the total water on earth available for human use with increasing stress²⁸. Balancing the use and development of available water in a sustainable way is urgent. More in practical applications, water is the engine for economic growth for sustainable poverty reduction strategy. The poverty of a large percentage of population is both a symptom and a cause of water crisis.

- An IWRM program can only be launched when the necessary conditions are sufficiently met or are in the process of being met. These conditions are represented by the building blocks like enabling environment, sound basis for planning and prioritization, appropriate tools or technologies and effective institutional structures to carry forward the national goals of an IWRM.
- Guidelines for Participatory Water Management (GPWM) has been approved for management transfer of small and medium schemes. The recent reforms in water sector has created an enabling environment for taking concrete action. The WMIP has been conceived as an instrument for facilitating the emergence of integrated water resources management regime. A National Water Management Plan is also under process of approval by the Government.

15. VISION FOR THE FUTURE

A regional water management plan is required which will be based upon adequate hydrological and agro-socio-economic and ecological system. Bangladesh requirement for sustainable management of transboundary rivers and preservation of natural eco-system are to be identified. Cooperation from neighboring countries are sought through agreements and partnerships approaches. The sharing water with India can open up opportunities for regional, sub-regional, basin, sub-basin wide development of water resources for the benefit for all people of the region. Sharing the water of transboundary rivers is, however, a major challenge for all the countries of the region. Joint planning for integrated water resources management at the basin level should be carried out for increased water productivity²⁴. Regional cooperation should be pursued to increase food security and socio-economic growth in all fields of sustainable development and management of the river basin and its resources, including navigation, flood management, fisheries, agriculture, power production and environmental protection.

Water resources management is not only technical, it requires huge organizational resource including finance and institutional management. The main activities should include:

- Strengthening national water resources management by adjusting the regulatory framework to improve stakeholder participation in river basin management.

- Defining the water rights and fixing water code.
- Improving information gathering at national level.
- Developing a framework for national capacity building in water resources management.

All these activities need finalization of water management plan and a national water code to give effect to the NWP. What is needed is a vision for short, medium and long-term needs of the dimensions of integrated water resources management. With regard to water resources, the issue of concern is how to implement IWRM, specified in the NWP, in order to achieve the sustainable use of rivers for present and future generations. Appropriate course of national and international measures are, therefore, required to address water resources in an integrated manner. A long-run perspective study upto 2025 is, therefore, needed to provide the vision and option for the future management of water resources. The NWP of the government provides a broad outline for this. The historic Ganges Water Sharing Treaty between Bangladesh and India in 1996 opened up the opportunity for mitigating the severe adverse environmental effects in the southwest region as a consequence of the Farakka Barrage upstream. Gorai River Restoration Project (GRRP) was designed to restore the flow of Gorai river during the dry season and prevent environmental degradation in the south-west region by ensuring fresh water flow in the wet season, augmenting flow during the dry season and controlled disposal of dredged materials of the river. The pilot dredging has been completed, the rest is under consideration of GoB.

Report on the options for Ganges Depended Area (OGDA) has been completed for taking up construction of Ganges Barrage Project by BWDB for restoring the environment and improving the socio-economic status of GDA. As a start to implementing the Ganges Barrage Project, the action recommendations are as follows :

Review of GRRP to find out its overall complementarily with the Ganges Barrage Project to ensure optimal and wise investment of the scarce national resources by avoiding duplications.

Agree to the terms of reference and commission the feasibility study with emphasis on environment and detailed engineering of the Ganges Barrage Project for long-term multipurpose water resources management of the GDA on a priority basis.

Draw up terms of reference and commission a research project to investigate the relationships between Sundarbans ecological health and different water system parameters under different scenarios of climate change and sea-level rise.

These recommendations are, however, very general. These have to be translated into workable program and implementable terms. Since the policy-regime is favorable, complicated issues like harnessing internal and international river resources in an integrated way to achieve sustainable development of water sector should be taken up. The institutions for such integrated approach also should not be left in a low-key. The creation and strengthening of basin organizations for making it a basin-wide management to influence the policy makers of respective riparians has to be supported by the co-riparian countries. This vision would help to clarify the options available for India and Bangladesh for water-sharing agreements for harnessing and development of IWRM and disaster management in the region. Future efforts should emphasize resource planning rather than project planning. Such an approach would view water resource system in an integrated manner, taking into account the multiple functions it performs and the goods and services it produces to meet human demand and sustain the ecosystem. This would call for independent planning and prioritization for conflict management of water resources.

16. CONCLUDING OBSERVATIONS

Water management is an issue of politics, administration, finance and human relationships with a legal perspective. Strengthening regional co-operation and dialogue on water issue will yield the greatest benefits in the long run. There are immense possibilities of converting waters of the transboundary rivers into wealth. However, if the country is to achieve higher, sustainable, poverty-reducing growth, water resource management system should be developed in an integrated and comprehensive manner taking into account the multiple functions it performs and the goods and services it produces. IWRM is closely interlinked with benefits sharing of transboundary rivers but this depends on strengthening international cooperation and partnership approach. These cross-cut the artificial political boundaries of countries and enter into an estuary of multi-country water management regime for mutual consultation. Strong political commitments and partnerships will bring together all players in the development chain to expedite joint planning and management of transboundary water systems, allocating water in the most rational way to make the most of its benefits and share them equitably.

References

1. Ministry of Water Resources, The Third World Water Forum, Kyoto, Japan, April 2003, P. 17
2. World Bank, Water Resource Management in Bangladesh, March 1998, P.1
3. Anukularmphai, Apichart', Integration of Water Resources Management into Economic and Social Development, An Overview of Experiences in Thailand, Water Resources Journal, ESCAP, UN, December 1999, P.23
4. Ministry of Water Resources, Government of Bangladesh, National Water Policy, Dhaka 1999, P.2
5. Ministry of Water Resources, The Third World Water Forum, Kyoto, April 2003, P. 121
6. BWDB, Water Management Study Report, Polder 43/2A, Volume-1: Main Text, Final Report, August 2000, P.2-2
7. DFID, Sustainable Rural Livelihoods What contribution can we make? edited by Diana Carney, Water / Irrigation and Sustainable Rural Livelihoods by John Soussan, Papers presented at the Department for International Development's, Natural Resources Advisers' Conference, July 1998, P.181
8. Bangladesh's water resources consist of three general components, i.e. stream flow or surface water, rainfall and ground water storage. These components are closely related. For a detailed discussion see: GOB; Bangladesh towards 21st Century; M/O Information, External publicity wing, March, 1994, p.37; see also: Bangladesh Center for Advanced Studies & Nature Conservation Movement, Wetlands of Bangladesh, May 1994, p.12.
9. River basins provide a rational organizing framework for both developing and managing water resources in each basin. That river basin will be necessary as a tool for integrated management.
10. Decentralization has considerable promise in increasing information flows, enhancing transparency and accountability and promoting early warning of potential disasters. But decentralization does not estimate the risk of capture of resource allocation mechanisms by political and economic interest groups.
11. Of the total available water on this planet, around 2.5 to 3.5 percent is freshwater or 35 to 49 M km³. Some 95 percent of this volume is locked up in the cryosphere (as snow and ice in the polar regions and glaciers), and in deep-seated groundwater. The total water available for human

consumption is around 44000 km³. See, proceedings of the UNESCO/WMO/ICSU, International Conference of Hydrology, 22-26 March 1993 Paris.

12. World Bank, Water Resources Management, A World Bank Policy Paper, Washington D.C., Sep. 1993, p.27.
13. Based on interview and discussion with Chakravorty, Nityananda, Senior Research Fellow, Power and participatory Research Centre who attended the World Water Forum, 2000 held in the Hague.
14. FPCO, Bangladesh Water and Flood Management Strategy, September 1995.
15. Based on interview and discussion with Chakravorty, Nityananda, Joint Chief, Planning, BWDB.
16. Besides these three areas, the other important planning areas are related to planning for river bank protection in towns and important areas, hydrological and morphological data collection and updating, environmental management related to water, management of watershed, haors, and estuarine land reclamation and management.
17. Ministry of Water Resources, Government of Bangladesh, National Water Policy, Dhaka 1999, p. 4-7.
18. WARPO, Newsletter, A quarterly bulletin of WARPO, September 1999
19. BWDB, Water management Improvement Project: Preparation study, Vol.1, Main Report, June 2003, P. 17
20. Ministries of Agriculture, Nature Management & Fisheries, Land and Water International, The Netherlands, P.7
21. World Water Actions, Forum Edition, March 2003, P.47
22. Khan, Tauhidul Anwar, 'Bangladesh and the Transboundary Water Issues', JRC, Ministry of Water Resources, The Third World Water Forum, April 2003, P. 57
23. International Water Management Institute(IWMI), Improving Water and Land Resources Management, Annual Report 2000-2001, P-4
24. World Water Actions, Forum Edition, March 2003, P.33
25. Planning Commission, The Fifth Five Year Plan, 1997-2002, Ministry of Planning, GOB, March 1998, P- 271
26. World Bank, Water Resources Management in Bangladesh: Steps Towards a New National Water Plan, Report No. 17663-BD, Rural Development Sector Unit, South Asia Region, March 1998, P-1

27. FPCO, Bangladesh Water and Flood Management Strategy, September 1995
28. ESCAP, Confluence, News letter, ESCAP Water Information, No. 34, December 1999, P.11
29. Ministry of Water Resources, Third World Water Forum, 2003, P. 7.