

Regional Co-operation on Transboundary Water Resources Management: Opportunities and Challenges

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Abstract

This paper aims at developing an overall framework of regional cooperation among the co-riparian countries to set principles of transboundary water resources management on the basis of broad political and social consensus. A permanent solution and durable system to resolve conflict in sharing of water resources call for enhancing effective regional cooperation for integrated use of the water resources of the region. Integrated management of shared basins is arguably a promising option for the Ganges-Bhrammaputra-Meghna (GBM) region. It strongly argues for establishing River Basin Organization (RBO) as an apex body for coordination of watershed management and avoidance of conflicts in transboundary rivers. Sustainable river basin management through RBO will create a common platform and a joint forum for all expertise for promoting the concept of Multi purpose River Basin Development (MRD). It will seek a reasonable solution for water resources management shared by all and renewable energy schemes at river basin level. Major activities would include effective cooperation for disaster management, basin-wide development, ecosystem protection and regional institutional framework. These new arrangements would also reflect a shift from a static system to a dynamic system of integrated approach for water management and economic use of water calling for a stronger regional cooperation.

Keywords: apex body, water rights, water allocation, groundwater depletion, hydroelectricity and conflict reduction.

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1. Introduction

Bangladesh is one of the largest active delta of the world having a flat topography with very low elevations which is larger than 10 meters from mean sea level. Eighty percent of the country is deltaic floodplains criss-crossed by about 230 rivers, including 57 transboundary rivers of which 54 are shared with India and three with Myanmar. The river system that flows through Bangladesh is the third largest source of freshwater discharge to the world's ocean. Catchments area of the three major river systems of the Ganges-Brahmaputra-Meghna (GBM) region is about 1.72 million km², 93% of which lies outside the country. Bangladesh, being a lower riparian country, does not have any control on the flow of these rivers. This has deprived the country of any opportunity for effective water management. But the people of Bangladesh have developed their pattern of agricultural practices, food habits, social and cultural ceremonies and even the living style for centuries based on the dynamics of her river delta. Bangladesh has historically been a riverine area with important ecological zones. A riverine environment shapes the daily life of societies along its river banks. Nations, societies, cities and civilization have grown near to rivers. Agriculture dominates the economy of Bangladesh contributing 23.50% of Gross Domestic Product (GDP), which is heavily dependent on both surface water and groundwater (BBS, 2005). In GBM region, particularly in Bangladesh, water is distributed unevenly in space and time due to unilateral withdrawal of water by India. This spatial and temporal variation in water distribution creates a major concern in relation to water availability. The conditions and challenges of water management in Bangladesh are two-fold; scarcity of water during dry season together with water quality deterioration, ground water depletion, salinity intrusion and environmental degradation and too much water during monsoon with devastating flood. To overcome these problems Bangladesh has been persistently trying to negotiate with India since long. In the Joint Rivers Commission (JRC), Bangladesh has held a series of dialogues with India for a pragmatic solution, but as yet it has not been possible to reach a satisfactory solution of the problem. The water resources harnessing and development projects undertaken by the riparian countries could not resolve the problems. The structural measures in isolation done by the respective countries is not the ultimate solution for basin management of the common rivers. It will rather create a severe havoc until and unless the problems not addressed considering the common interest of the co-riparian countries.

2. Objectives

This paper is designed to provide practical solutions for integrated approach and a vision for regional co-operation on transboundary rivers. The specific objectives are:

- to explore the possibility of basin-wide cooperation for water management
- to establish River Basin Organization as an apex body
- to promote the concept of MRD and achieve solidarity in River Basin Management
- to look into ecological and environmental harmony in IWRM frame
- to set principles of shared management of water resources

The ultimate goal is to initiate a constructive and practical dialogue in water management for stronger regional co-operation for the conservation and restoration of environmental sustainability, disaster risk assessment, and utilization of regional potential hydropower resources

3. Major Challenges

The dynamics of water for growth are extremely complex and highly dependent on physical, technological, cultural, political and economic circumstances. Herein lies the following challenges:

- Lack of regional economic priorities
- Lack of political will and political consensus
- Lack of regional partnership for development
- Lack of efficient water governance and non-establishment of regional water rights
- Lack of effective mechanism for optimal regional water sharing arrangements
- Non-compliance of the international conventions on water sharing
- Lack of legislative and administrative framework for resolution of water conflicts
- Lack of establishment of regional coordinating bodies for economic integration
- Lack of conservation storage reservoirs in the Himalayas
- Insufficient capital for hydropower development
- Upstream river basin development beyond the border of the country
- Inter-basin water transfer project/River-linking project of India

These challenges are posing threat for the sustainable management of water resources and poverty reduction strategies. Besides the above Bangladesh has several other challenges. The threat of changes in the climate system has emerged as a new challenge. The impact of climate change will be more vital to economy and society. The climate change will also affect flows in the transboundary rivers. The Himalayan zone is the climate regulator and also water head of the Indian subcontinent. The role of the Himalayas is not only the source of all rivers, they are also the source of the ecological life of the whole region. The problems of water of the Himalayas watershed are a major engineering challenge which can be solved satisfactorily by applying the principles of IWRM. To address the challenges the co-riparian countries should make a paradigm shift and move towards IWRM approaches.

4. Rationale

The present paper is a look at the principles and practices of water management for overall socio-economic development at the river basin. There is a need for regional cooperation related to trans-boundary basin management in the co-riparian countries to reap political, economic, social and cultural benefits. For harnessing the strong potential for accelerating the economic development, this paper emphasizes regional cooperative approaches in river basin management to maximize the welfare of the regions' common people. Any development in a river basin without due consideration to upstream and downstream water demand is bound to have long term adverse impact on the society, economy and the environment. Water quantity was managed previously through supply-side policies rather than managing the demand. The emphasis was mainly on the productive use of water resources, with little attention paid to managing the allocation of water resources (ADB,2003). To cope with water resource management complexity it needs a strategic shift from water supply management to demand management for the sake of the realization of sustainable water utilization under the pressures of heavy population and rapid economic development. In this paper, based on lessons learned from the examples of RBO of the successful countries, scientific research and policy needs are identified for resolving the conflicting interest and political rivalries that have multiple connectivity with GBM basin developments.

5. Country Strategy

In a bid to overcome the constraints, Government of Bangladesh (GOB) has recently developed long term policies to confront the emerging issues in the water sector. The most significant have been the following;

- National Water Policy, 1999
- Guidelines for Participatory Water Management, 2001
- National Water Management Plan, 2002
- Poverty Reduction Strategy, 2004
- Draft National Water Code /Law (under finalization process)
- Coastal Zone Policy, 2005

In addition, several important water-related policies have been established for other sectors, including the National Environment Policy (1992), National Forestry Policy (1994), the National Energy Policy (1996), the National Policy for Safe Water Supply and Sanitation (1998), the National Fisheries Policy (1998), the National Agricultural Policy, and the related Arsenic Mitigation Policy (2004). Both National Water Policy and the National Water Management Plan have taken note of all the major concerns arising out of past water management practices and have issued policy guidelines for their resolution. The plan seeks to carry forward the message of the policy by developing the necessary strategies and plan of action for a 25-year period. Conflict management and negotiation will be key to enable the partners in Integrated Water Resources Management (IWRM) and implementing Poverty Reduction Strategy (PRS).

6. Regional Strategy

Regional co-operation on trans-boundary river basin management is the key to achieving long term sustainable development of the region. Countries in the GBM region can build a framework for cooperation based upon shared vision, which would encompass the common Sustainable Water Management Issues:

- Enhancing regional co-operation for implementing IWRM
- Designing cost effective river basin management
- Strengthening water saving
- Utilization of regional potential hydro power resources
- Reinforcing water resources protection
- Ensuring compliance of international conventions/treaties
- Negotiating and executing conflict resolution
- Ensuring Water Security and Water Rights

- Holding workshop, conference and publicity drive
- Capacity building and social learning
- Strong political commitments and good governance

In order to address the issues, basin wide development and management of water resources should be done in a holistic manner. This paper covers the issues of water resources sharing exclusively from shared river basin. It tries to solve the problem by proposing for establishing RBO of the riparian countries, which is considered necessary to balance the demand and supply of water and for implementation of IWRM.

6.1 Regional Priority Efforts and Initiatives

Priority actions on the above issues are required for achieving the goal-1 of the Millennium Development Goals (MDGs). Implementing country level PRS will need coordinated regional approaches to attaining the region's socio-economic challenges. Figure 1 shows the multidimensional aspects of water resources management culminating in regional benefits.

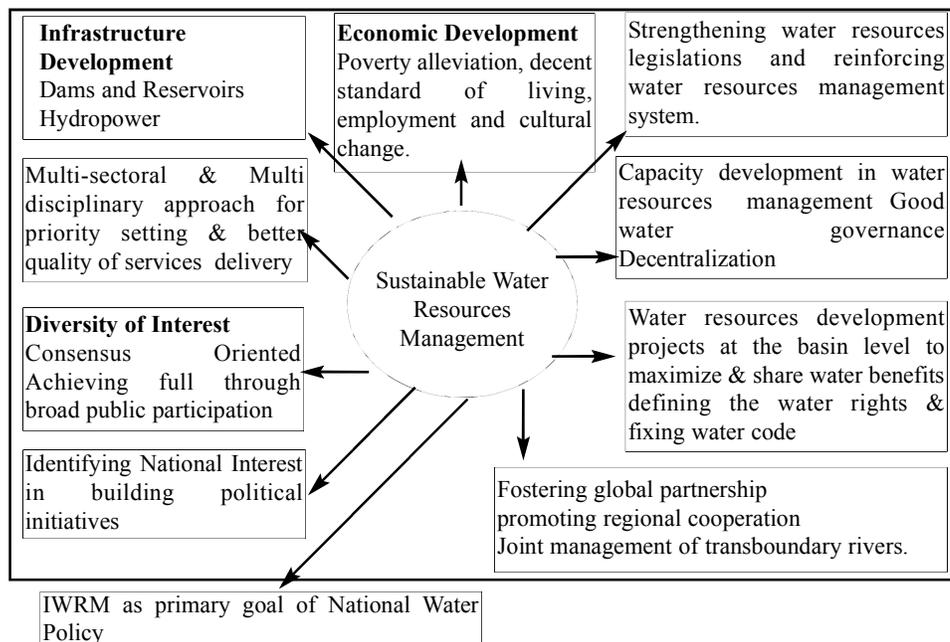


Figure : Sound Water Resources Management and Development

6.2 Regional Development Opportunities

Water resources management and its planning is a challenging task because of the seasonal variation of availability of water along with the competing demands for water. Governing water wisely requires a vision, sustainable development, social justice, political leadership and actions. Suggested measures against water management issues on trans-boundary basins are delineated in Table-1.

To achieve the targets in an agrarian country like Bangladesh, agricultural production should be increased by providing improved irrigation through conjunctive use of surface and ground water. BWDB is responsible for water resources management with allied organizations like Water Resources Planning Organization (WARPO), and River Research Institute (RRI) under the Ministry of Water Resources (MoWR). The Institute of Water Modelling (IWM) and the Center for Environmental and Geographic Information Services (CEGIS) established by GoB provide technical support and environmental management, respectively, and function under the aegis of MoWR. IWM has been carrying out modeling activities for improved irrigation management, flood management, flood forecasting, groundwater modeling, morphological assessment, prediction modelling etc. Technical monitoring of environmental parameters are being accomplished by BWDB, IWM, CEGIS, Bangladesh Meteorological Department (BMD), and Space Research and Remote Sensing Organization (SPARRSO). Water resources modeling exercises will play a vital role for prediction and optimization of trans-boundary water resources.

7. Role of JRC in Transboundary Rivers

Bangladesh had established with India the Indo-Bangladesh Joint Rivers, Commission (JRC) in 1972 for working together in harnessing the rivers common to both the countries and address other issues relating to transboundary rivers for the benefit of the peoples of the two countries. Over the years Bangladesh has been sincerely trying to arrive at a long term/permanent agreement with India for sharing the flows of the transboundary rivers. These efforts are yet to produce appreciable results although the Ganges Water Treaty (GWT), 1996 was a milestone in water sharing issues between Bangladesh and India. But in the absence of any agreement on sharing of the other transboundary rivers the dry season flow of the Teesta, Dharla, Dudkumar, Manu, Khowai, Gumti and Muhuri rivers in Bangladesh has been drastically reduced due to upstream diversion. Similar has been the case with the flows of Mohananda, Bhairab, Kodla and a number of other common rivers. JRC has been exerting all out efforts in this regard to fulfil the expectations of the people.

Table 1 : Development Opportunities and Potentials

Objectives	Diagnostic analysis	Solutions
Regional Economic growth and 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 ➤ Basin wide management ➤ River basin planning using mathematical modelling ➤ River basin management ➤ Hydro power development ➤ Flood forecasting & warning system
Poverty Reduction and Rising per capita income	<ul style="list-style-type: none"> ➤ Erosion control ➤ Land accretion ➤ Char development ➤ Irrigation Development 	<ul style="list-style-type: none"> ➤ River erosion mitigation project ➤ Resettlement action planning ➤ Water Management Improvement Project (WMIP) ➤ Irrigation & drainage management modeling under command area development ➤ Morphological assessment & Prediction modeling
Greater physical production and Food Security	<ul style="list-style-type: none"> ➤ Irrigation Management ➤ 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
Health outcome and ➤ Human development	<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
Quality of growth and higher living standard	<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"> ➤ Conjunctive use of surface & groundwater ➤ Integrated planning for sustainable water management ➤ Urban flood control & drainage improvement
Ensure environmental sustainability and bio diversity restoration and protection of eco-system	<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 global partnerships & promoting regional co-operation

IWRM through an Apex Body (RBO)

7.1 Environmental Impacts of Upstream Interventions

The flows of many of the transboundary rivers are being diverted by upstream withdrawal causing drastic reduction of water flows producing deleterious effects on the lives, properties, and bio-diversity and overall to the environment. The Farakka Barrage across the Ganges, Barrages across Mahananda, Teesta, Monu, Khowai, Gumti, Muhuri, Kodla etc. are posing a serious threat in the water resources management in Bangladesh. Likewise, Farakka Barrage causes a massive devastation in Malda on its upstream and Murshidabad on its downstream in West Bengal in India (Banerjee, 1999). Huge sedimentation, increasing flood intensity, bank failure and avulsion of the river are some of its impacts. These have resulted in population displacement, impoverisation and marginalization of the rural people living by the river side to a large extent. Bangladesh has been facing environmental degradation every year since the commissioning of Farakka Barrage in 1975. The Governments of Bangladesh and India have signed a 30-year Treaty for Sharing the Ganges Waters at Farakka in 1996. Under the provision of the Treaty the Government of Bangladesh and India have been sharing the Ganges water at Farakka since 1997. With a view to using meaningfully the waters received in the Ganges under the provision of the GWT, the GOB has planned to construct Ganges Barrage for which a feasibility study and detailed engineering for Ganges Barrage project are under active consideration of the Government of Bangladesh.

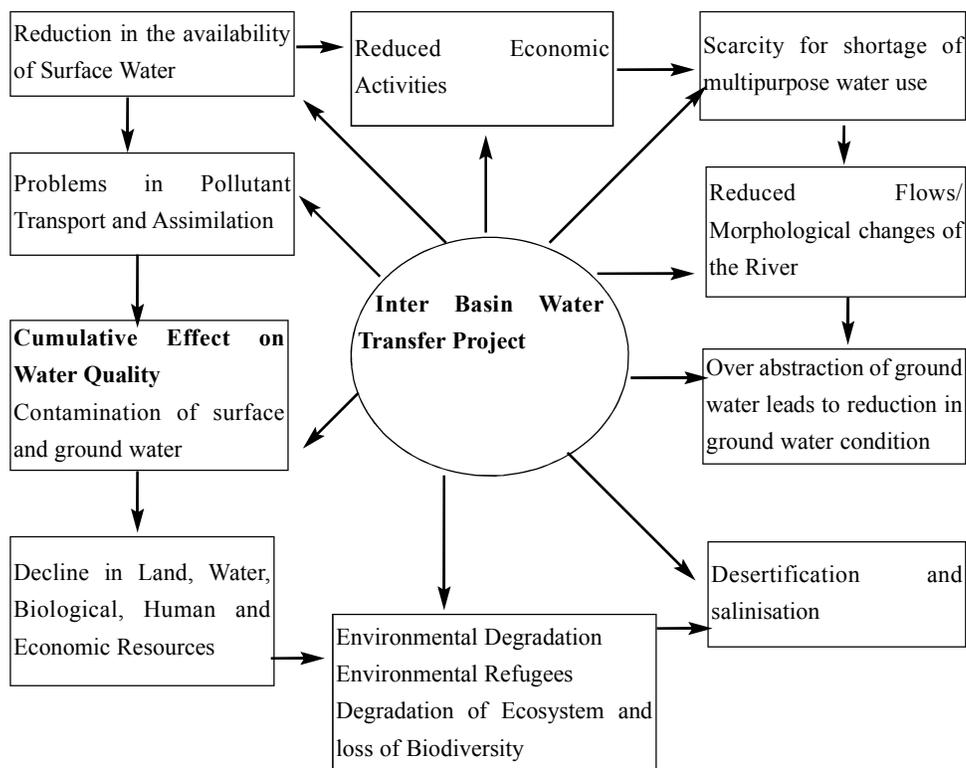
7.2 River Linking Project and the Non-compliance of International Law

India has a Mega Plan of Inter-Basin water transfer by connecting 37 rivers with 30 links. Out of the total 30 links, 14 links are in the Himalayan rivers and 16 in peninsular rivers. About 173 billion cubic meter of waters would be transferred from one river to the other through this project to irrigate 30 million ha of agriculture land and to generate 35,000 MW of power. Government of India has already started the feasibility study of these link canals and in the meantime completed two studies of the Himalayan and 14 studies of the peninsular component. However, five links are identified from peninsular component as first priority for immediate implementation of the project. The approximate cost of the project is about 120 billion US Dollar, which is equivalent to 5,60,000 Crores Indian Rupees.

The Project will start a regional controversy and produce adverse effect on the river eco-system and cause serious disturbance of water regime, geo-morphology, hydro-geology and result in water non-availability scenarios in areas from where

water will be diverted. The flows of these rivers sustain the livelihood, civilization, habitat and culture of millions of people of this region. The Mega project, as envisaged, will be much more severe and devastating in the deltaic regions of Bangladesh than that of Ganges Dependent Area (GDA) due to the upstream withdrawal of Farakka. Diversion of water of these rivers would cause massive economic damage through depletion of fish stocks, lowering ground water level, encroachment of ground water salinity, arsenic contamination by means of reduced flushing in sub-surface flow regime, degrading bio-diversity and eco-system with loss of navigability. Sub-surface hydraulic gradient is very low in Bangladesh, in general. Reduced groundwater recharge might reduce the hydraulic gradient further and that will again cause the reduction of groundwater flushing. Groundwater flushing can be considered as a natural means of arsenic removal from aquifer system. Moreover, there will be progressive depletion of groundwater that would cause groundwater mining and environmental degradation. For such negative impact there will be groundwater flow reversal towards rivers and unusual depletion will cause changing of pumping technology and thus increase irrigation cost to farmers. Bangladesh considers that inter-basin water transfer is unjust and violation of the international norms and agreement. India should, therefore, take into consideration the concerns of the co-riparian countries before implementation of such a mega project which would lead to a total disaster in the region. The threats and risks of socio-economic and environmental impacts from the Indian River Linking Project is delineated in Figure 2.

The project will cause major changes to the environmental characteristics for the entire country triggering one of the major socio-economic and environmental disasters. Inter basin water transfer projects and projects aiming at changing courses of rivers in other countries of the world in the past ended up with ecological disasters. Bangladesh possesses diverse ecosystems consisting of the flood plains at different stages of development, peat basins, estuaries and the mangroves of the Sundarban. All these ecosystems will be affected adversely due to the reduced dry season flows of the common rivers. The implementation of the River linking project will drastically reduce the influx of surface and ground water to Bangladesh. The combined impact of climate hazards and climate change will be fatal to the agriculture, water and other resource systems. UNESCO has declared the Sundarban as a world heritage site for unique natural features and scenic beauty. High salinity levels, high tidal volumes and sediment concentrations in the rivers of the Sundarban will seriously degrade the Sundarban ecosystem and bio-diversity. On a broader scale, these resources,

Figure 2 : Probable Impacts of Inter Basin Water Transfer Project on Bangladesh

which are part of the world stock of biodiversity, will produce significant social and ethical implications (BBS, 2005)

8. Global and Regional Perspective on Water Issues

Access to freshwater resources is a global concern since the beginning of human civilization. Of the total available water resources of the world, around 2.5 to 3.5 percent is freshwater or 35 to 49 Mkm³ (UNESCO, 1993). If a quick “blue accounting” on global perspective is made, it reveals that as much as 97.5% of world's water is salty, 1.67% is locked up in ice caps and glaciers, 0.17% lies too remote for human access, 0.53% comes at the wrong time and place (e.g. 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% of total water is only available for human needs. Water professionals are referring to the global water situation as a crisis which will have its impact in the 21st century.

During the past century, while world population has tripled, the use of water has increased six-fold. It is estimated that water use will rise by some 50 percent in the next 30 years, leaving half the world's population in severe water stress by 2025 (4th WWF, 2006). Asia with 60% of the world's population has access to only 36% of the water, while South America with 6% of the population has 26% of the global supply. Australia, with less than 1% of the population has about 5% of the water, and the Middle East and North Africa with 5% of the population has less than 1% of the water. At the country level, the inequalities are even greater: A citizen in North America has over 10,000 cubic meters/year, whereas one in Egypt has to get by on about one tenth of that (1,100 cubic meters/year), and in Jordan, it is less than a quarter of the Egyptian figure: 260 cubic meters/person/year.(Rahman, S.M.M. 2003)

Demand for food is increasing because of growing population. Total population of the country will increase from about 129 million to 181 million by 2025 and 224 million by 2050 (NWMP, 2002). Increase of food production will be the main challenge in the foreseeable future. The pressure on scarce water resources will be severe in the future for food security, sustainable economic growth and development. Regional efforts are needed to achieve food security, poverty alleviation and livelihood improvement. Water conflict started among the countries of this region as hydrological system boundaries are common to all these countries. About half of the world's land area is situated in transboundary river basin (WWC, 2003). On a global basis more than 200 river basins are shared by two or more countries, occupying about 60% of the earth's surface. Many treaties have been signed for transboundary water systems, but none seems to cover river basins resulting in economic, environmental and even political crisis among nations.

9. Political Economy of Transboundary Water Management

From the discussion above, it is quite clear that GBM region has experienced long-standing historical disputes around politics of water planning for the common river basins. This has resulted in creating mistrust among the countries of the region. The co-basin states have tried to resolve the disputes but unfortunately because of regional and socio-political controversy these initiatives have largely failed. This failure prevented to capture the great opportunity of social and economic development of the region. It calls for political consensus of the riparian countries. South Asian Association for Regional Co-operation (SAARC) is one of the best forums which could solve the water dispute. But they did not heed to the riparian disputes and consequently the impasse persisted.

Freshwater quality and quantity issues are becoming serious and most critical challenges to the five basin countries. The major factors for freshwater conflicts are human activities like high population growth, agricultural development, rapid rates of industrialization, upstream diversions and abstractions (Figure 3). These factors are affecting water availability both quantitatively and qualitatively, which ultimately leads to water dispute among the co-basin states. There is already clear evidence of escalating conflicts in different parts of the world centered around water quantity and quality issues. While the water quantity crisis is well known in the GBM region freshwater quality will become the principal limiting factor for sustainable development. China for the first time publicly stated that water quality is now limiting economic development (Stephen, T.T. 1999).

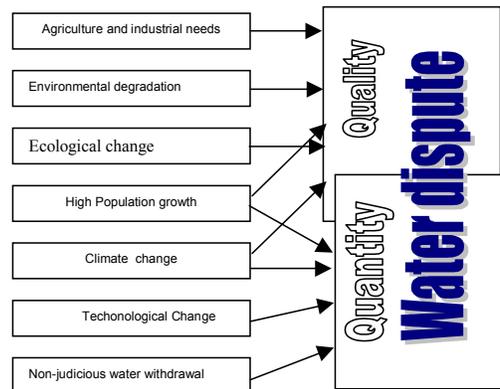


Figure 3 : Factors of Freshwater Disputes

The conflict in transboundary water management can only be resolved prioritizing establishment of RBO for optimizing water resources. Regional cooperation would serve the best interests and would create regional solidarities among the different riparian countries. Regional efforts in solving the problems are wide ranging and multidimensional that Bangladesh is facing for development. In the GBM basins where severe imbalances of water availability exist during different periods of the year, it is imperative that any solution for a problem will have an adverse impact on another. The river basin is the hydrological unit of water resources management as they are interconnected and allocation of water in one part of a basin will affect the other parts of the same. As such basin management has to be done rationally so that connected regions are not affected seriously (Ahmed, 2007). The issues of transboundary flows, river morphology, population, habitat, power generation, infrastructure, agriculture, forestry etc. in the GBM basins have all to be considered in a holistic manner using and developing appropriate technologies in each sector.

The hydrological regions of river basin will be well managed if there is political processes and water legislation. Basin management through establishing RBO will provide an ideal forum for coordination, conflict resolution and resource assessment (Ahmed, 2004). The vision is set on principles of IWRM. This would not be an easy task, but one that must be achieved. Political and economic cooperation on sound and sustainable water resources management will lead to a more efficient use of the resources in the region by resolving disputes. This will contribute to regional security, world peace and sustainable economic development.

10. The Case for River Basin Organization

As water is of fundamental importance to human activities and prime concern to sustain the life, livelihood and culture, it must deal with improving water management and protection of the environment.. There is a strong case for government involvement in the development and management of water resources. A continuing dialogue amongst the co-riparian countries and extensive further consultations are needed to develop long term strategies in response to the increasing demands for water. To meet the increasing challenges of water scarcity, pollution of ecosystems, water and other related resources need to be developed in an integrated manner. The establishment of RBO will act as a common platform to reinforce country level efforts and ensure planning and implementation of IWRM in the river basin context. The IWRM should address quantity and quality concerns for surface and ground water and opportunities for their conjunctive use (ADB,2003). Bangladesh needs to work with its co-riparians towards overall basin management focusing on the different hydrological regions and promoting regional cooperation. This is supported by NWP of Bangladesh emphasizing basin-wide planning for development of resources of transboundary rivers (GoB, 1999)

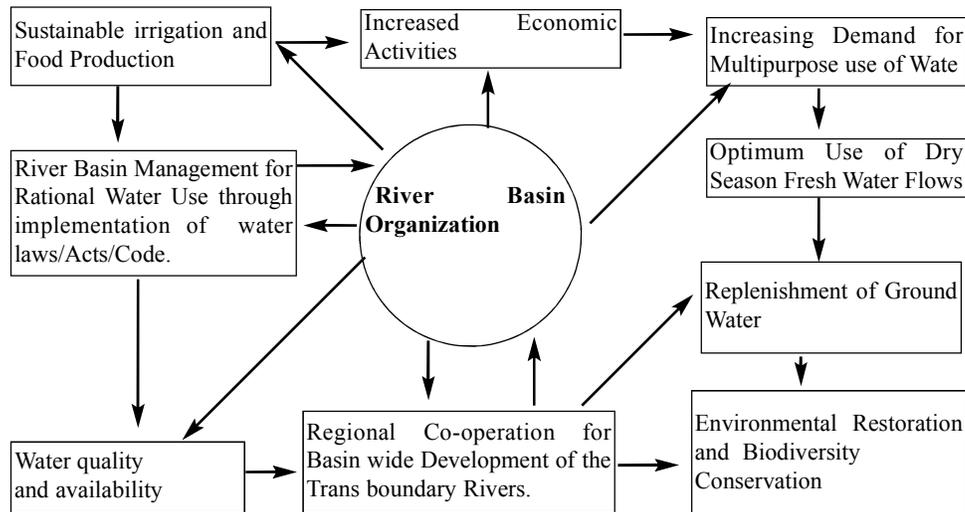
The GBM basins cover five countries-China, India, Nepal, Bhutan and Bangladesh. All the rivers originate from the Himalayan ranges and there is a considerable potential for regional cooperation for optimal harnessing of the regional water resources. This issue of cooperation should form part of a long-term water vision for Bangladesh. Potentials for such cooperation exist for flow augmentation and hydropower generation through sharing tranboundary rivers. Bangladesh can take an initiative for the regional cooperation towards realizing the potential of augmenting the dry season flows of the Ganges and other rivers for the benefit of all the co-riparian countries.

Regional cooperation is an important driving force for solidarity in river basin management where potential water benefits will be substantial for maintaining the region's economic dynamism. One of the options is augmenting the Ganges flows through the construction of a reservoir on the Sunkosh River in Bhutan may be explored. Likewise, the proposed Sapta Kosi High Dam on the Kosi river (a tributary of the Ganges) in Nepal could bring significant benefits to India, Nepal, Bhutan and Bangladesh in terms of flow augmentation. Bangladesh can collaborate with Nepal and India for the construction of this dam for mutual benefits. Basin management in Nepal will conserve soil resources, mitigate flood and augment dry season flow for the areas in the downstream. On the other hand, from economic consideration, the development of the immense hydro-electric potential in Nepal will not only boost up the Nepali economy but can be a cheap source of energy for Bangladesh and India. Therefore, a conjunctive water and power development plan for the region is imperative.

Establishing River Basin Organization for such regional cooperation in water sector at the macro-level is more essential to make micro-level water resources management sustainable. Network of Asia River Basin Organizations (NARBO) expects to enhance capacity for IWRM, ensure sustainable use of water for effective implementation of IWRM and conflict resolution (4th WWF, 2006). The RBO would be responsible to undertake all development and management works considering the problems of each basin based on mutual interest. RBO should be formed for management of water resources following the principles of IWRM. An approach to regional development efforts in the context of RBO for achieving sound and sustainable water resources development is illustrated in Figure-4.

The creation of RBO will act as a catalyst for regional growth and maximize economic and social welfare through coordinated management of water. It will facilitate multipurpose and optimum use of the water of common rivers flowing through Bangladesh, China, India, Nepal and Bhutan. In a wider regional context, mutual trust and confidence, building inter dependencies are essential for the co-basin countries for deriving many untapped benefits. The negative impacts of upstream withdrawal on society, national economy, culture, environment, overall livelihood, navigation and hydropower at a river basin level can be removed through techno-economic solutions of intellectual connectivity and political consensus. The protection of downstream ecosystems from upstream pollution highlights necessity for integrated management of the waters of GBM basin.

Figure 4 : Diagram showing the impact of River Basin Organization on Water Resources



11. Regional Cooperation

Effective regional cooperation on water resources management and environmental protection is vital for promoting long term sustainable national and regional development. Economic benefits of regional cooperation will be the increasing integration of national economies of the co-riparian countries. The argument is that the economies of regional countries will be generated through obtaining mutual gains by promoting investments in water infrastructures, trade, transport and commerce. Regional benefits from cooperation among the co-riparian countries will reinforce the effort of strengthening global integration of the respective country. But trans-boundary cooperation for managing shared water basins is difficult because the benefits may not accrue equitably to the riparian countries. This will require an integrated approach towards establishing institutions- agreements, laws and organized procedures and administrations.

There are compelling arguments for formation of sub-regional and multilateral cooperation as globalization has made the world interdependent. The Global Water Partnership (GWP, 1996), is an international network open to all organizations involved in water resources management for bilateral and multilateral development in the sustainable management of water resources. The World Water Council (WWC) has established a World Commission on water for the 21st century. Under the aegis of the Commission each country is expected to

prepare a Water vision for 2025 (BWP, 2004). In conformity with the above, GOB has already taken NWMP containing short, medium and long term programs for achieving water vision by 2025. There is an urgent need to create public opinion in all the basin countries for promoting regional cooperation for sustainable economic development. Increased cooperation is urgently needed among all countries to compete effectively in a global economy. For developing and promoting active collaboration SAARC can patronize the RBO as proposed to harness the potential of the water resources of the GBM region. This will produce positive impact on sub regional and regional cooperation and on broader economic development by improving trans-boundary water resources management.

11.1 Regional Hydropower Development

Power supply of Bangladesh, India, Bhutan and Nepal can be increased to boost up industrial and agricultural production. There must be an expectation of a positive win-win outcome through regional hydropower development. The Power supply capacity and access to electricity and hydropower potential in the region is delineated in Table 3.

Table 3 : Installed Generation Capacity, Hydro Potential and Access to Electricity (Four Border Countries)

Country	Hydro potential (MW)	Installed Capacity (MW)	Access to Electricity
Bangladesh	Negligible	5,135	42%(2006)
Bhutan	30,000	445	30%(2001)
India	20,000	112,058	65%(2006)
Nepal	85,000	522	40%(2001)

Source: Bangladesh Power Development Board (BPDB)

Figure 5 is the projection of electricity demand and supply situation in Bangladesh which suggests requirement of substantial capacity enhancement to provide electricity to a huge population yet to be served. Due to shortage of power supply, there is loss in production in agriculture, industries and economic activities. In the context of limited non-renewable energy resources such as gas, coal etc., it is high time to explore future hydropower potential in the backdrop of existing power crisis. This will enable Bangladesh to reduce its current dependence on thermal electricity and develop an environment friendly power sector.

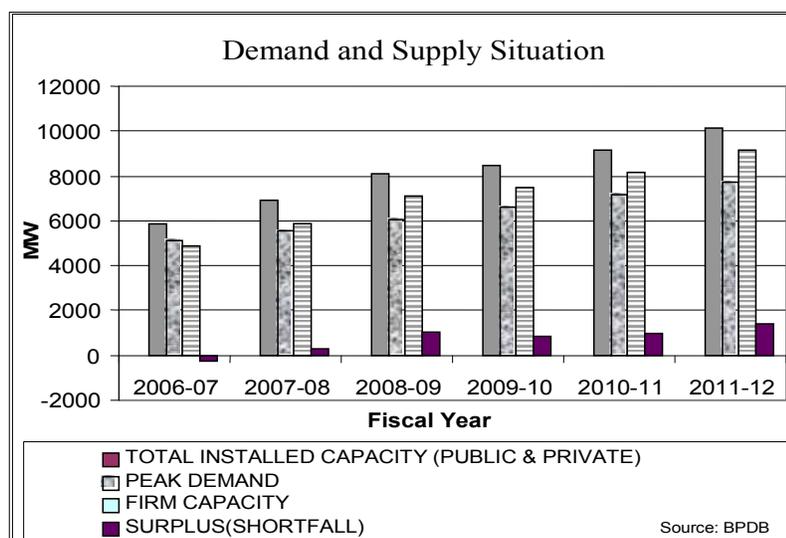


Figure 5: Load Generation Balance

11.2 Major Constraints for Hydropower Development

Exploring the huge hydro potential would be difficult and challenging. Major constraints in regional hydropower development and electrical interconnection are as follows:

- Lack of political consensus
- Insufficient financial resources
- Mitigation of environmental impact
- Lack of institutional mechanism for governance and regulations

11.3 Benefits of Regional Interconnections

Benefits of regional interconnections and hydropower development in co-basin states are identified as follows:

- Regional power transfer
- Enhance system reliability
- Improve security and diversity of power supply
- Increase economic efficiency in system operation
- Reduce environmental impacts
- Reduce the requirement of reserve capacity and hence reduce the cost of energy for the consumer.

- Attract private sector investment to the regional power sector
- Conservation of non renewable energy resources.
- Optimum utilization of primary energy resources.

12. Multipurpose River Basin Development

Bangladesh can forge ahead for a regional and basin wide multi-purpose river basin development for hydro-power generation. MRD is fundamental for efficient and dynamic exploitation of water resources over time for irrigation, flood control, erosion prevention, fisheries, industrial water supply, navigation and hydropower generation (World Bank, 1994). The development plan, undertaken so far, had a dominant focus on a single purpose rather than multipurpose development objectives. MRD might be a catalyst for regional growth and sustainable tool for socio-economic and environmental development that will enhance the quality of life shown in Figure 6. It can also be a tool to resolve conflicts by addressing the issue considering social, economical and environmental aspects.

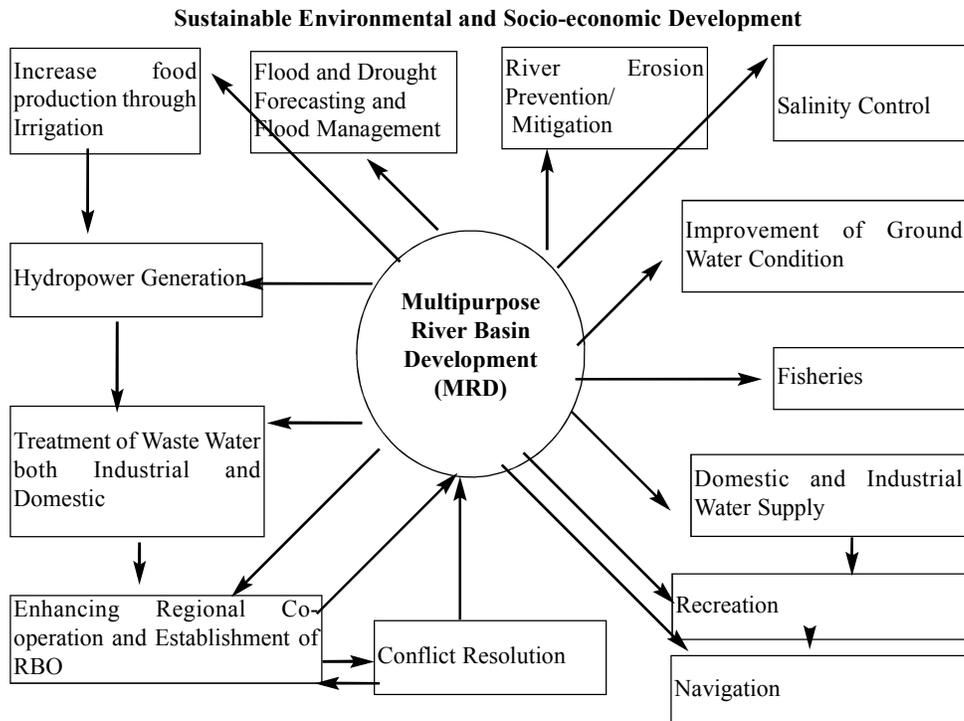


Figure 6: Dynamic and Efficient Exploitation of Water Resources through MRD

The MRD concept has not yet been developed for various historical, political and economic regions. As a result its potential for economic growth and environmental sustenance at the regional and sub-regional level has largely remained unrealized. Although MRD is difficult for accomplishment and full of challenges for Bangladesh alone, nevertheless many problems can be solved with dynamic programming. MRD, a framework for sustainable water use for the countries with predominantly transboundary rivers can help obtain consensus that will decide in a participatory way for undertaking development strategies and investment plans.

13. Global Lessons for Improving Water Management

Basin management provides an ideal forum for co-ordination, community involvement, conflict resolution, resource assessment and management. There are many experiences throughout the world that provide lessons and give different experiences of shared basin management. Shared waters offer more potential for cooperation than for conflict if managed properly and amicably. River Basin Organizations have been set up in many parts of the world, in particular Europe and America, where problems of water sharing of the common rivers flowing across the regions have been solved through systematic consultations, deliberation, political negotiation and formation of institutional legal framework. (World Bank, 1994; UN, 2000; 4th WWF, 2006). Bangladesh has many lessons to learn from global experiences for solving its water related problems.

14. Recommendations

Recommendations for the co-riparian countries cover a wide range of issues that require accelerated action in a concerted manner by strengthening and reinforcing, which are:

- RBO should be formed with the Government nominated representatives/experts of the co-riparian countries for conflict resolution and to review the project proposal made by the co-riparian countries.
- GOB should accelerate and promote RBO to ensure water rights through collaboration among the co-riparian countries to initiate a practical study for water availability scenarios.
- Multi-scale and multilateral cooperation must be achieved for reducing water stress and flood management at regional and transboundary basins through provision of advisory services by the RBO.

- India, Bangladesh, Bhutan, Nepal and China should come forward in view of the recent water stress in the Himalays countries, fostered by the GWP.
- Common storage reservoir should be undertaken at a suitable location to meet up the scarcity of water during the dry season.
- A vast hydro-electric potential should be developed drawing technical support and representatives from the region and outside to maximize and share water benefits.
- MRD should act as instrumental and catalyst in ensuring solidarity among co-riparian countries for regional security, economic development and world peace.
- The co-riparian countries must be brought under consensus among different political parties and civil societies to rationalize the water resources management.
- Lower riparian countries must have voices to create strong public opinion and to participate in all decision making processes which may affect the stakeholders at the sub-regional level.
- Attempts to be made to implement GWT and allied treaties properly for sharing the water of other common rivers immediately through a process of mutual consultation.
- Strong leadership, political commitment, formulation of relevant rules, regulations, laws and principals are urgently needed to avoid extreme conflicts for water and resolve the dispute by enhancing sustainable regional cooperation.
- Long-term research should be undertaken by the national, regional and global water experts under the umbrella of an apex body.

15. Conclusions

Availability of fresh water is being a limiting factor for economic development and livelihood in the GBM region. Conflicts and disputes have already started and have been widening day by day among the co-riparian countries for water sharing of transboundary rivers. All concerned organizations like JRC, SAARC and NARBO could not as yet find any satisfactory way to solve the problem. Each country is trying in an isolated way, as a result of which disputes are increasing rather than being solved. To solve this problem a common platform is yet to form. Here in this paper, River Basin Organization (RBO) to be an Apex Body has been proposed which would serve as a common institution for co-basin states to

establish judicious water allocation and using issues. The riparian disputes can be resolved through this institution to promote rational utilization and management of the resources by adopting and implementing 'no harm' principle of the trans-boundary conventions and agreements. The co-basin countries must move forward to a long term sustainable development establishing a viable RBO to be formed with the Government nominated experts of the co-riparian countries. It will help towards the achievement and attaining the MDGs of the countries uniformly embodying technological innovations on water resources development and management.

References

1. ADB (2005). *ADB Review*, News from the Asian Development Bank, October 2005, P.3
2. ADB,2003, *The Water Policy of the Asian Development Bank*, ADB, June 2003, P.17
3. Ahmed, Murshed (2004), 'Development and Management Challenges of Integrated Planning for Sustainable Productivity of Water Resources', *Bangladesh Journal of Political Economy (BJPE)*, Volume 21, No. 2, December 2004, P.123
4. Ahmed, Murshed (2007), 'Some Reflections on Multipurpose on River Basin Development and Strategies for Achieving Sustainable Solutions in Conflict Management of Water Resources', presented and published in an International Pre-Conference Volume-II on Water and Flood Management organized by IWFm of BUET, 12-14 March, 2007, Dhaka, Bangladesh. P.688
5. BBS, (2005), *Compendium of Environment Statistics of Bangladesh*, Bangladesh Bureau of Statistics, GOB. P.70 & P. 91
6. Banerjee, Monisha (1999), *A Report on the Impact of Farakka Barrage on the Human Fabric* (A study of the upstream and downstream areas of Farakka Barrage), South Asia Network on Dams, Rivers and People, New Delhi, India, November 1999, P.5
7. Internet, <http://www.asiawaterwire.net/node/84>
8. Internet (2006): www.hydropower-dams.com: International Journal on Hydropower & Dams & Network Events Limited, Supporting Organizations: etc., 2006
9. Miah, M. Moniruzzaman (ed) (2004). *Bangladesh Water Partnership, Water Management in Bangladesh*, Published by Ahmed Kawsar Boipatro, P. 8
10. GoB, (1999), Ministry of Water Resources, Government of Bangladesh, *National Water Policy*, Dhaka, 1999
11. NWMP, (2002), Ministry of Water Resources, Government of Bangladesh, *National Water Management Plan*, Volume-2, Main Report, Dhaka 2002, P. 23
12. Rahman, S.M.M et.al (2003), *Conflict management of international river basins: A case study of GBM River Basins*, presented in a Regional Conference organized by BUET and sponsored by UNESCO, 2003. P-3,17.
13. Stephen, T. T.(1999), et al, *Water Quality Processes and Policy* (ed.) P.9
14. 4th WWF, (2006), *Fourth World Water Forum, Official Delegate Publication*, Mexico, March 16-22, 2006, P. 170

15. 4th WWF, (2006), *Fourth World Water Forum, Thematic Documents, Mexico*, March 16-22, 2006, P.68-69
16. 4th WWF, (2006), *Fourth World Water Forum, Regional Document Mexico*, March 16-22, 2006, P. 29
17. 4th WWF, (2006), *Fourth World Water Forum, Asia-Pacific Regional Document*, March 16-22, 2006, P. 58
18. The World Bank (1994), *Multipurpose River Basin Development in China*, EDI Seminar Series, (ed.), Peter Sun, October, 1994, P.10.
19. UN (2000), *Principles and Practices of Water Allocation Among Water-Use Sector*, Water Resources Series, No. 80, P.107, 66.
20. UN (2005), *The Convention on the Law of the Non-Navigational Uses of International Watercourses 1997*, Article 7, P.5.
21. UNESCO (1993), *Proceedings of the UNESCO/WMO/ICSU International Conference on Hydrology, Towards the 21st Century: Research and Operational Needs*, 22-26 March 1993, Paris. P-11
22. WWC (2003), *World Water Actions*, Forum Edition, March 2003, P.46
23. *Water Front*, (2004), Stockholm Water Front, No 1, April 2004, P.9