Water Resources Management in Bangladesh: Past, Present and Future

A H M Kausher

Project Director & Field Manager
Development of an Investment Plan to support The Implementation of Bangladesh Delta Plan 2100 (Word Bank). On behalf of the Consortia of Castalia US, ARCADIS, NL, SMEC, Bangladesh), H-374, Lane 6, Baridhara DOHS, Dhaka, Bangladesh. E-mail: engineerkausher@yahoo.com

Abstract: *Water Management and Water Governance in Ganges-Brahmaputra-Meghna (GBM) Delta especially in Bangladesh is a crucial issue. Water Management practice and initiative started in ancient times. During ancient rulers, there was some form of water management and governance structure, while in the modern periods, state controlled water management was there for decades and attempts for decentralization of water management and governance were made which is growing gradually towards pro-people through adoption of peoples' participation in management and governance as well. Water management in Bengal in the early stages was better than in other parts of the world. About 3000 years ago, the rulers of the then Bengal introduced overflow irrigation system that was practiced till 1200. From 1200 there were various periods / segment of water management like, the medieval period (1200-1757), colonial Period (1757-1947) and modern period 1947 onward. In the modern period, Government of Bangladesh has taken many initiatives on Water Resource Management (WRM) system. These include nation owned Large Scale projects (50s & 60s) to extensive minor irrigation in winter using Low Lift Pump (LLP) and tube wells and Flood Control and Drainage (FCD) small scale, low cost, quick-gestation flood control and drainage projects (70s-90s) to Integrated Water Resources Management (IWRM). WRM projects included structural and non-structural measures (FF&W – Flood Forecasting and Warning & FP-Flood Proofing). At the onset of 21st Century, adoption of National Water Policy (NWPo) and Guidelines for Participatory Water Management (GPWM) by the Government, Stakeholder participation at all levels of the project cycle, Socio-economic Impact Assessment (SIA) and Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) have been made mandatory in planning practice. Recent day's WRM initiatives pay preference to participatory approach and capacity development to build a resilient nation. Climate change and its impact on economy, livelihood, infrastructure and environment have become a great concern for adaptation and to establish resilience with changes of scenario. Now on, WRM planning will have to consider climate change and add provision of adaptation and resilience to climate change and gradual decentralization of management. This study will help finding out the integration gap in approach, effective participation of stakeholder/community in the project cycle, understanding between agencies and community/stakeholders, focusing on limitation of water resources and optimization of use of the scarce resource and ensure minimum impact on nature and environment.*

Keywords: Water resources, Management, Governance, Climate Change, Adaptation, Resilience, Community, Stakeholder, Decentralization, Participatory.

1. INTRODUCTION

In the ancient period, the human habitation grew around Water Sources and usually natural plantation, the source of food for their survival. With elapse of time and population growth, source of survival water and plants/fruits/crops started getting limited; human community had to find more resources. Initially they found new resources by moving to new areas, but at later stage, they started growing food with additional efforts like cultivation and irrigation. So they have to consider the water source, its quality, distance from farm, transport of water, optimized use etc. All these activities they learn by doing, is termed Water Resources Management in course of time, which now a day is a combination of many activities, lot of considerations such as Technology, Nature, Society and Economy; and involvement of many, States, Stakeholder, Beneficiary, affected community and last not least the anticipated changes of Bio-Physical systems. **Modern Water resource management** is the activity of planning, developing, distributing and managing the optimum use of water **resources**. It is a sub-set of water cycle management. While **water resources** are sources of **water** that are potentially useful. Uses of **water** include agricultural, industrial, household, recreational and environmental activities. The majority of human uses require fresh **water** which is gradually decreasing and additional efforts are needed to get it.

Bangladesh, the delta of the Ganges-Brahmaputra-Meghna (GBM) river system is one of the largest deltas in the world. Totalling approximately 24 thousand kilometres, the country is traversed by a vast network of huge rivers, their tributaries and distributaries, mountain streams, winding seasonal creeks and canals. Some 405 rivers crisscross the country, of which 57 are trans-boundary. Bangladesh has a monsoonal climate with a hot, humid wet season, a cooler dry season and a hot dry pre-monsoon season. In January, the daily maximum temperature averages about 26ºC and in April is about 35ºC. The annual average rainfall varies from 1927 mm in the north west (NW) region, 1950 in the southwest – south central (SW-SC), 2133 in the north central (NC), 2447 in the south east (SE) and 3091 mm in the north east (NE). The corresponding figures for potential evapotranspiration are 1309, 1327, 1275, 1276, and 1261 mm for these regions. Thus, the two most westerly regions are the driest and have the greatest potential evapotranspiration, with rainfall the greatest and potential evapotranspiration least in the northeast. The strong monsoon peak of rainfall happens from May to September or October, with very little rainfall in December and January. The potential evapotranspiration is more evenly distributed, though it is generally higher towards the end of the dry season from March to May. Rainfall exceeds potential evapotranspiration in the wet season, but is less than potential evapotranspiration during the dry season (CSIRO, 2014).

Much of Bangladesh is a low lying, flat flood plain at the confluence of three major rivers and is vulnerable to seasonal (river & flash) and coastal floods & storm surges. About 20% of the country is flooded annually, during extreme events; this can increase up to 60% or more (. The GBM river system has the largest total sediment load (2.4 billion tons) (Anwar, 1988) in the world, derived principally from upstream areas. Coupled with a dynamic hydraulic regime, the main rivers are subject to active erosion and sedimentation processes. On average, some 6000 ha of river bank erosion occurs in the country annually, leading to the displacement of about 50,000 people.

2. METHODOLOGY

In order to draw a picture of WRM in this particular part of the World, review of literature on Water Resources Management Practices, Water Policies, Plans, Achievements of Implementing Agencies, Books, Documents, Reports, Papers on Governance and role of Community in Water Management have been searched in the BWDB, LGED, IWM libraries, notable resource persons have been contacted, and discussed to collect information in different form. Collected reading materials have been reviewed to extract views, comments, critics and consensus of different authors /persons on the subject matter and compiled to prepare a comprehensive overview on Water Resources Management, development, practice, progress, technology, adaptation with ever changing multi-dimensional drivers those influence WRM; from indigenous knowledge exercise to adoption of latest technology, concepts, consideration of socio-economic and biophysical changes

in the regional and global scale.

3. WATER RESOURCES

The water resources available to Bangladesh consist of both internally generated surface water resources (rainfall and runoff) and trans-boundary inflows, and groundwater. According to FAO (2013), annual total renewable water resources amount to approximately 1211 (bcm) (SW-1190 bcm., GW-21 bcm.) Internal renewable water resources are estimated at 105 bcm (SW-84 bcm and GW-21 bcm). Externally renewable water resources total 1106 bcm, of which 0.03 bcm from groundwater and the remainder from trans-boundary river flows. Water resource is the key to the countries' sustainable development. The National Sustainable Development Strategy (NSDS), (Bangladesh Planning Commission, 2013), identifies the following five priority development sectors for the country: Agriculture, Industry, Energy, Transport and Human Resource Development. Human Resource Development is strongly affected by the availability and quality of water resources and a safe sanitation system, with particular poverty, gender and health dimensions.

The SW resources available in Bangladesh include main and regional rivers including trans-boundary and a vast network of wetlands. Water quality is a growing concern for the country, with 32 rivers and many of the wetlands are at serious environmental risk due to pollution, encroachment, and disconnection between wetlands and the river system. Groundwater, the major source of water for irrigation and (safe) drinking water and industry is at threat for arsenic pollution of shallow aquifers and intrusion of salt water, industrial pollution, declining of GWT due to overexploitation etc.

4. WATER VULNERABILITY AND CHALLENGES

Challenges are natural as well as man-made, including alternating floods and droughts, cyclones, expanding water needs of a growing population, large scale sedimentation and river bank erosion, rapid urbanization and industrialization, global warming and deforestation. An additional and growing challenge is the deterioration of surface and groundwater water quality, the decline of natural wetlands and water bodies and the maintenance of healthy aquatic ecosystems. Climate change, the expected upstream development and abstraction of water and the lack of a sustainable financing of water resource infrastructure operation & maintenance further exacerbate these challenges (BDP2100, 2015). With enormous crisscross river systems, having mostly low lying deltaic landforms, receiving maximum runoff from Hindu Kush Himalayan (HKH) region and being close proximity to the Bay of Bengal, the country is most vulnerable to climate related disasters. Bangladesh is already experiencing increased temperature, changes in rainfall pattern and distribution, sea level rise and salinity intrusion at an accelerated rate and increased disaster intensity, which will become greater issues in the future (Rahman, LinkedIn. /face book, December 13, 2016).

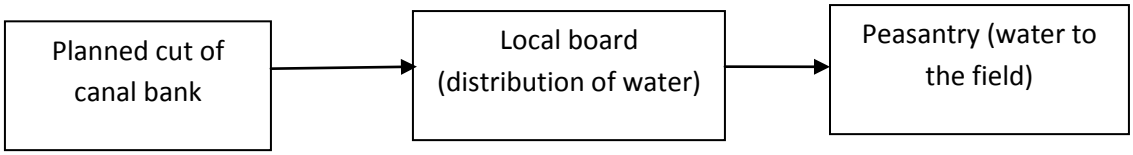
Water Resources Management in Bangladesh

Historical development of water related activity of human kind reached this modern definition "Water Resources Management" after a long way back from Overflow Irrigation-Canal Digging-Pond/Dighi digging-Water Management-Water Resource Management (WRM) to Integrated Water Resource Management (IWRM) and now on future Water Management shall have to be Resilient and Adaptive to Climate Change to ensure Water Governance by Stakeholder participation.

According to Ali (2002) Water Management in Bengal-East Pakistan-Bangladesh can be divided into four distinct Period(s), namely Ancient Period, Medieval Period, Colonial Period and Modern Period. The periodic development is discussed here briefly.

Ancient Period

Irrigation (Water Management) in Bengal in the early stages was better than in other parts of the world. About 3000 year ago, the rulers of the then Bengal introduced overflow irrigation system that was practiced till 1200. Ancient ruler's representative used to planned

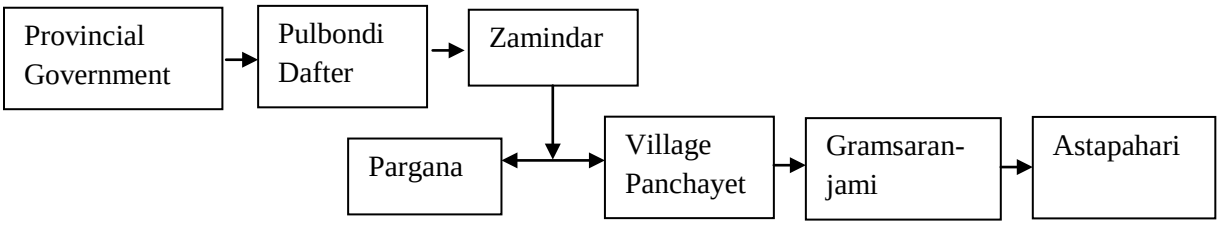


cutting of the canal bank, handover the responsibility of distribution of water to the local boards. The boards working through the peasantry ensured water distribution in the field. The management of overflow irrigation was systematic (as shown above) and somehow involved peasantry participation (Ali, 2002).

The medieval period (1200-1757) (Sultani , Turkish and Mughals Period)

During this period, the irrigation practice improved from overflow to tank irrigation, Flood control through construction of embankments and improvement of drainage facilities began, which continued till the end of the Mughal Empire in 1757.

The Mughal rulers maintained the previous systems and added the concept of additional canal along the river channels (for better irrigation, drainage and navigation) and embankments besides the rivers. The Mughals also added dredging of rivers (Ali, 2002). The Mughals maintained an independent "Pulbandi Daftar" for looking after embankments, roads, bridges and river dredging. The Pulbandi Daftar delegated functions to the local Zamindars and Government allocated budget in the form of a deduction from land revenue collected by them from the Parganas. Thus, the Zamindars took responsibility of FCDI management and maintenance by deploying day and night workers named 'Astaprahari". Astapaharis worked under supervision of village officials of 'Gramsaranjami', the gramsanjami worked under the direction of Village Panchayet. Everyone works of FCDIM within the limits of a mouza were looked after by Village Panchayet. Similarly, these works within a Zamindari were looked after by the Zamindars. The hierarchy is presented below (Ali, 2002).



Colonial Period (1757-1947)

The British regime covering 1757-1947 is called the Colonial Period. Colonial British rulers abolished the Pulbandi Daftar. Zamindars were relieved of their traditional duties. The state support to the Village Panchayet was withdrawn and the gramsaranjami was dissolved. As a result, the maintenance of canals and embankments were neglected. Unofficially, the local Zamindars continued their maintenance job for a long period of time until the Zamindari system was abolished by the British ruler. The end results were frequent flooding and subsequent crop damage.

Modern period 1947 onward

Recent Past 1947-71 - East Bengal got independence as a part of Pakistan and was named East Pakistan in 1947, and the modern period starts. Negligence of the British Rulers in WM system maintenance for long 200 years, conditions of the WM system badly deteriorated resulting frequent flood and damage of crops. Prior to 1947 there had not been any Government-led national scale water sector development Policy, plan or program. Recent past 1947-71 historical events towards WRM include appointment of Krug Mission, 1956/7 and formulation of first ever 20 years Master Plan (IECO), 1964, which emphasised on large scale FCDI projects development of WR of the country to achieve the goal of increasing agriculture production to achieve

national self-sufficiency (Ali, 2002), examples are implementation of CEP, KIP, GKIP and CIP projects. Implementation of Master Plan 1964 yielded immediate results. After two decades, reviews and evaluations indicated that the performance of large scale projects had deteriorated considerably, especially in terms of O & M (Rahman et al., 2007), everything under state ownership.

Present Period 1972 onwards: Key events and key development features are discussed below.

(A) Land and Water Resources Sector Study (World Bank), 1972: Creation of the BWDB in 1972, adoption of a strategy of extensive minor irrigation in winter using LLP and tube wells and for flood control small scale, low cost, quick-gestation flood control projects in shallow flooded area (DFID, WRM in Bangladesh). This was a major deviation in the strategy followed since 1964. Examples include implementation of EIP, LRP, DDP and SRP. The main aims of the project were to increase in agricultural production and generation of employment for unskilled laborers during slack season and "increased participation of the beneficiaries in planning, operation and maintenance" through allocating earthwork to Landless Contracting Societies (LCS) (Datta, 1999), which was internalized within BWDB and GoB by including in GPWM.

(B) **Establishment Master Planning Organization, 1980 and WARPO in 1991; National Water Plan I, 1986 and II, 1991; Flood Action Plan, 1989; Merger of WARPO and FPCO, 1999:** In the 1980s, focus was shifted from mono-sector (agriculture) to multi-sector approach, Master Plan Organization (MPO) was created to undertake national water plan that prepared National Water Plan-I in 1986, NWP-I and National Water plan (NWP-II) in 1991 and Bangladesh Water and Flood Management Strategy 1995.These national plans assembled substantial information and used wide range of planning models and analytical tools for public sector strategies and programs, many of which were adopted by the Government and endorsed by donors (FPCO, BWFMS, 1995).

(C) National Water Policy, 1999; Guidelines for Participatory Water Management, 2001; National Water Management Plan, 2004 (completed in 2001); Coastal Zone Policy, 2005:

The strategy BWFMS recommended preparing a **National Water Policy** and a **National Water Management Plan.** The Government of Bangladesh Finalized the National Water Policy in 1999 (Ministry of Water Resources, 1999). The declaration of the National Water Policy is a bold step towards Good Governance in Bangladesh. (Honourable Prime Minister Sheikh Hasina, Ministry of Water Resources, 1999, forward). It is the policy of the Government that all necessary means and measures will be taken to manage the water resources of the country in a comprehensive, integrated and equitable manner (**Ministry of Water Resources, 1999, p-2).** The policy is bringing order and discipline in the exploration, management and use of water resources in Bangladesh with stakeholders /people's participation at all stages of project cycle in sustainable WRM**. Guidelines for Participatory Water Management, 2001**, followed by **Participatory Water Management Rules, 2014** was formulated for wise implementation of the National Policy and Strategy. Socio-economic Impact Assessment (SIA) and Environmental Impact Assessment (EIA) and Environmental Management Plan (EMP) have been made mandatory in planning practice. National Water Management Plan, 2004 outlined 84 programs under 8 clusters for integrated, comprehensive and sustainable WRM of the Country**. Haor Master Plan**, 2013 and **National Water Act, 2013** added opportunities for efficient WRM and water governance as well.

5. FUTURE WRM

Integrated Water Resource Assessment (CSIRO, 2014); The project studied water resources in Bangladesh from both a physical and a socio-economic perspective, examined both water supply and water demand issues, where demand has both physical components (irrigation water demand) and socio- economic components (urban and industrial demand, demand for food and hence irrigation). It examined historical water use and crop production, and the likely future water use influenced by climate change, population growth and a growing economy. This also examined the impacts of changing water on the national economy and on the vulnerability of individuals and households.

Update National Water Management Plan (WARPO), is on-going that will take into account findings of IWRA (CSIRO), Policy, Strategy, Guidelines, Acts, Rules and Regulations. It will pay preference to participatory approach and capacity development to build a resilient nation. Climate change and its impact on economy, livelihood, infrastructure and environment has become a great concern for adaptation and to establish resilience with changes of scenario. Now on, WRM planning will have to consider climate change and add provision of adaptation and resilience to climate change and gradual decentralization of management. The SDG, Bangladesh Vision 2021, Bangladesh Vision 2041 will be guiding future WRM planning. The ongoing Bangladesh Delta Plan 2100 will help us to find out the integration gap in approach, effective participation of stakeholder/community in the project cycle, understanding between agencies and community/stakeholders, capacity building of implementing agencies, focusing on limitation of water resources and optimization of use of the scarce resource and ensure minimum impact on nature and environment.

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Present status and future trend of coastal zone management. Recently coastal zone management, development and planning have received serious attention by BGD. The ICZM approach not only helps mitigate the effects of disasters, but also provides opportunities for sustainable resource utilization.Â The Coastal Zone Management Policy (CZMP) in Bangladesh includes a wide range of issues from economic development to ecosystem protection and conservation. But there has no particular option to address natural disaster or reduction of vulnerabilities. There is no clear guideline on how local development agencies should work with government bodies.Â resources as well as spatial planning in Bangladesh delta. CONCLUSION. The Water and Sanitation Program is a multi-donor partnership administered by the World Bank to support poor people in obtaining affordable, safe, and sustainable access to water and sanitation services. Benchmarking to Improve Urban Water Supply Delivery in Bangladesh. Acknowledgments This note was prepared by the Bangladesh Benchmarking Project Team, led by Abdul Motaleb (Senior Water and Sanitation Specialist, Water Sanitation Program), Arif Ahamed (Water and Sanitation Specialist, SASDU), Zakir Hossain (Local Consultant), and Cesar E. Yniguez (Benchmarking Adviser), with advisory assistanc Higher future domestic and agricultural water demands that have a higher priority than industrial water, means that there is a higher risk of water shortage to the textile industry by 2030 and higher costs of water abstraction. 2) Increasing water quality risks.Â The capacities of current water governance landscape in Bangladesh to address the physical water risks of textile industry are limited by: 1) the problem of non-align incentives of textile water use, in which very little incentives exist in practice for the industry to have rational use of water and treat their effluent appropriately; 2) overlapping and ambiguity of responsibilities coupled with resource.Â 14 Chapter 3 Water Resources Management in Bangladesh. 17 3.1.