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Process Development for Hydrological Region-wide Integrated Water Resources Management Model in Bangladesh

Md. Masud Alam

Senior Scientific Officer, Water Resources Planning Organization, Ministry of Water Resources, Dhaka, **BANGLADESH**

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***Corresponding Contact**
Email:
masudwre96@yahoo.com
Cell Phone: +8801911420090

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ABSTRACT

National Water Management Plan, 2004 has delineated the eight Hydrological Regions in Bangladesh, based on appropriate natural features, for planning the development of their water resources. The Hydrological Regions are Southwest (SW), Northeast (NE), North Central (NC), Northwest (NW), South Central (SC), Southeast (SE), Eastern Hills (EH), River and Estuary Region (RE). This study has shown how Integrated Water Resources Management (IWRM) model can be applied in Hydrological region in Bangladesh and at the same time has focused on decentralized water management practice. Lessons have been incorporated from European Union Water Framework Directive (2000/60/EC). European Union Water Framework Directive (EU-WFD) mainly focuses on river basin management rules and principles based on the best scientific knowledge and available technologies. In EU-WFD, River Basin District has been taken as a unit. Here, the each Hydrological Region has been considered as an unit like as 'river basin district' and will be responsible for preparing and implementing their own river basin management plan. It is recognized that the Water Framework Directive (WFD) might be used as an example for Hydrological Region-wide IWRM implementation and economic development for the developing countries like Bangladesh, taking into account their socio-economic conditions. In this study, it has shown how IWRM tools (Institutional Framework, Management Instrument and Enabling Environment) can be applied in Hydrological Region. An analytical method (i.e., the secondary data analysis) has been taken as a methodology. Finally, a Common Implementation Strategy has been undertaken for overall implementation of IWRM plan in each Hydrological Region in Bangladesh.

Key Words: Hydrological Region, Integrated Water Resources Management, Water Framework Directives, Plan, River Basin Management

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INTRODUCTION

Bangladesh is the largest alluvial delta in the world formed from the Ganges-Brahmaputra-Meghna (GBM) river basin and facing a massive water resources challenges such as flood, flash flood, drought, contamination of water bodies, salinity intrusion in ground water and surface water, arsenic contamination in ground water, cyclone and tidal surges in coastal areas, water logging, river bank erosion, drainage congestion due to sedimentation of river channels etc. With dense population, water management is further complicated by diverse and conflicting interests among traditional livelihood activities including agriculture, fisheries, transportation, industries, and water supply, with which poverty is deeply intertwined. Water is also essential for the country's rich and vulnerable natural ecosystems. The future Water resources management and development in Bangladesh will be a very complex issue due to future biophysical uncertainties and socio-economic uncertainties (Bangladesh Delta Plan 2100, Inception report). Important bio-physical uncertainties are sea level rise, changes in upstream flow and future extreme events. The increased uses of water especially through diversion and storage by the upper riparian country have already created a significant impact on the natural flow regime of South West hydrological Region in Bangladesh. Under these circumstances it is of paramount importance for the country to manage this critical resource in an integrated, basin-wide, decentralized and strategic manner while ensuring stakeholder participation.

For the facilitation of Flood control, Drainage, Irrigation and food production, the country did a lot of studies and Plan until 90's (NWMP, 2004). Major policy and plans at that time were the Krug- Mission Report 1957, EPWAPDA Water Master Plan 1964, Land and Water Sector Strategy 1972, Master Plan Organization (MPO) National Water Plan-Phase 1, 1986, MPO National Water Plan Phase-2, 1991 etc. Those studies were criticized due to inadequate policy frameworks, lack of holistic and participatory approach and for not addressing the social and environmental impacts

The issue of IWRM is being highlighting globally after the 1990's (RETA, 2009). By keeping the global consistency and avoiding the fragmentation in water sector, Bangladesh has achieved a significant progress in IWRM activities after the period of 90. The Flood Action Plan (FAP, 1989-95) study was the pioneer of IWRM plan in Bangladesh (RETA, 2009). After FAP, the Major Water Related Policy and plan were the National Water Resources Policy, 1999, National Policy for Safe Water Supply and Sanitation (1998), Guidelines for Participatory Water Management (GPWM, 2000), National Water Management Plan (NWMP, 2004), Regional Technical Assistance (RETA, 2009) for IWRM in Bangladesh. The Policy and Plan described above were used mainly to national level. But the Water Resources management demands the hydrological boundary rather than administrative boundary. National Water Management Plan (NWMP, 2004) has delineated the eight hydrological regions in Bangladesh, based on appropriate natural features, for planning the development of their water resources. The Hydrological regions are Southwest (SW), Northeast (NE), North Central (NC), Northwest (NW), South Central (SC), Southeast (SE), Eastern Hills (EH), River and Estuary Region (RE). No proper initiatives have been taken before in accordance with the Hydrological Region-wide Integrated Water Resources Management Plan in Bangladesh. This study has shown how IWRM model can be applied in Hydrological region in Bangladesh.

The National Water Management Plan (NWMP, 2004) has identified the seven fundamental areas of knowledge gaps which have to be considered for further study and analysis. The knowledge gaps are arsenic in ground water, groundwater resources(it's use, quality, quantity and long term strategic implication), Climate Change, Natural Environmental water Resources, Long-term basin-wide water Resources Planning and Management, decentralized water

resources management and private sector participation. This study will emphasis and elaborate the concept of basin-wide water Resources Planning and Management and decentralized water resources management in Bangladesh. Although the Hydrological regions in Bangladesh don't fully implicit the exact idea of basin-wide water Resources Planning and Management as the basin demands it hydrological boundary, but due to unique hydrological features at each hydrological region, we can consider the each Hydrological region as a basin. According to Bangladesh Water Act, 2013 Article 15.1, the Water Resource Planning Organization (WARPO) through the Executive Committee of National Water Resources Council will prepare the National Water Resources Plan considering the water resources availability up to mouza Level. Within each Hydrological Boundary it will be easy to investigate the water resources availability up to mouza Level based on IWRM framework at each Hydrological region in Bangladesh.

The European Union has a long experience for basin-wide integrated water resources management within Europe. The European Parliament and the Council of the European Union established a framework for Community action in the field of water policy in 23 October 2000 European Union's water policies such as the Water Framework Directive (2000/60/EC). The EU's experience (including its 27 Member States) is based on the best scientific knowledge and available technologies. In particular, the Water Framework Directive (2000/60/EC) mainly focuses on river basin management rules and principles. In EU-WFD, River Basin District has taken as a unit. We have considered the each Hydrological Region as an unit. And in Each Hydrological region we can apply the IWRM plan. The existing policy, law, plan, guideline, institutional framework and database system discussed above can provide a good basis for implementing Hydrological Region wide IWRM activities in Bangladesh. There are however still huge gaps for effective implementation of Hydrological Region-wide IWRM Plan in Bangladesh. Till to date, there is no administrative set up in each Hydrological region, many cross-cutting, conflicting and detrimental issues are arising in each hydrological region.

OBJECTIVE OF THE STUDY

The Objective of this study is to set up Hydrological Region-wide IWRM plan in Bangladesh. However, the specific objectives include:

- To delineate the Hydrological Region with their natural features
- To develop basin-wide and decentralized water management concept in Bangaldesh.
- To set up appropriate IWRM plan in each hydrological region
- To understand the salient features of European Union's Water Framework Directive (EU-WFD)
- To implement the Common Strategy for overall implementation of IWRM plan in Bangladesh.

METHODOLOGY

A comprehensive review and analysis has been done for this study. An analytical framework method (ie. the secondary data and information) has been taken as a methodology. A comparative analysis has been done between EU-WFD and Bangladesh Water Management Practice. Finally, a common Implementation Strategy has been developed for overall implementation of IWRM plan in each Hydrological Region in Bangladesh.

SCOPE OF WORK

Concept of IWRM

Integrated Water Resources Management (IWRM) is defined as the coordinated development and management of water, land, and related resources in order to maximise economic and social welfare without compromising the sustainability of vital

environmental systems (GWP, 2000). The IWRM framework (i.e. three E's) is based on the Dublin Principles. A critically important element of IWRM is the integration of various sectoral views and interests in the development and implementation of the IWRM framework. An overview of this process is provided in the following figure 1

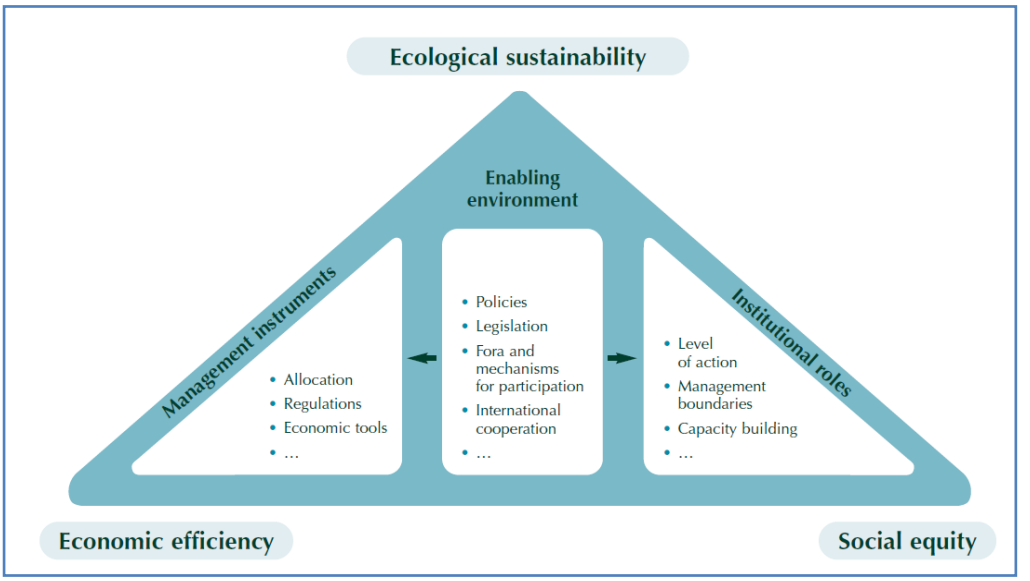


Figure 1: General framework for IWRM

Introduction of Hydrological Region

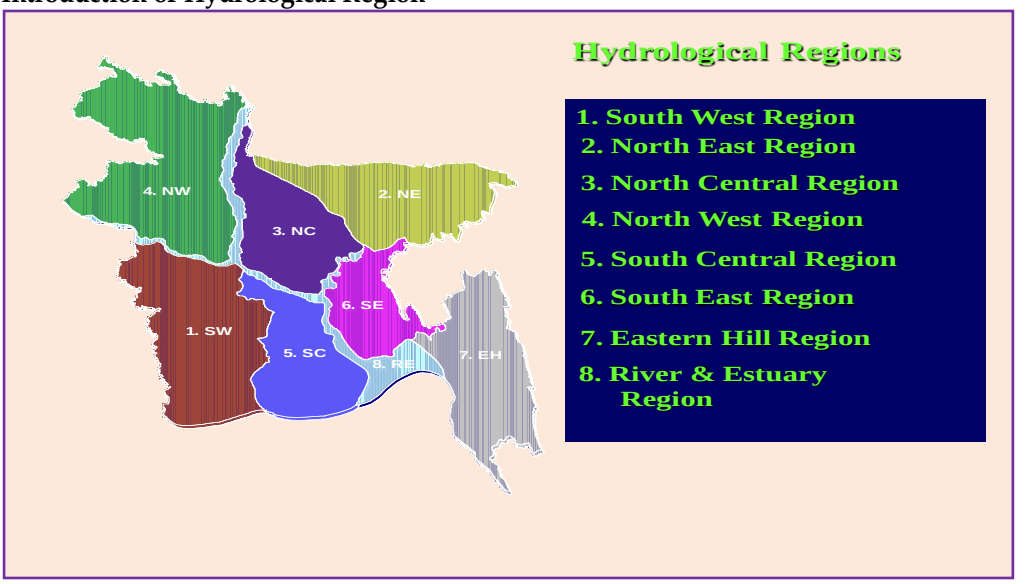


Figure 2: Hydrological Regions of Bangladesh

The Water Resources Planning Organization (WARPO) has delineated the eight hydrological regions in Bangladesh, based on appropriate natural features, for planning

the development of their water resources. The hydrological regions are Northwest (NW), North Central (NC), Northeast (NE), Southeast (SE), South Central (SC), Southwest (SW), Eastern Hills (EH) and Main Rivers and Estuaries (RE). Hydrological region has been shown in the above figure 2.

The major and specific characteristics of each Hydrological region have been given below (NWMP, 2004)

South-West Hydrological Region: Major water related problems in this zone are:

- Tidal Flood, Flash Flood, and Riverine Flood
- Drought in Dry season
- Water Pollution
- Water Logging
- Land Subsidence
- Salinity Intrusion in Ground water
- Arsenic Contamination in Ground water
- Sedimentation and drainage congestion
- River bank erosion
- Natural disaster such as cyclone, tidal surge etc.
- Climate Change and sea level rise etc.

The specific measures to this region are (NWMP, 2004, Options for Ganges Dependent Area-OGDA, 2002):

- Restoration of Dry season fresh water in flow to the region especially by Gorai river restoration
- Construction of Ganges Barrage
- Rehabilitation of GK scheme
- Khulna-Jessore Drainage Rehabilitation program and Tidal River Management (TRM)
- Expansion of Ground water
- Polder improvement
- Improvement of Khulna City water Supply and Sewerage system

Other specific issues are:

- Preservations of the Sundarbans
- Maintenance of the Coastal Embankment System
- Alleviation of Coastal drainage system
- Remedial actions for existing FCDI schemes
- Flood proofing needs in the charlands and low lying areas

Northeast Hydrological Region: Major water related specific issues in this zone are:

- Environmental Management of the Haor Basin
- Flash Flooding and Remedial actions for existing FCD schemes
- Flood proofing of villages in the Haor Basin
- Erosion of Old Brahmaputra left Bank
- Drainage Congestion of Kalny-Kushiyara and other rivers
- Local development of hill irrigation

North Central Region: Major Specific issues in this region are:
- Bulk Water Supply and Pollution clean-up for Dhaka city
- Encroachment on Buriganga and other rivers and Channels in Dhaka
- Flooding and Drainage Problems in parts of the region
- Flood proofing needs in the Charlands and low lying areas
- Improvement of Flood Control, Drainage and Sewerage system of Dhaka City

North West Hydrological region: Major specific Water resources issues in this zone are:
- Erosion along the right Bank of Brahmaputra
- Flooding and Drainage Problems
- Remedial measures for existing FCD(I) schemes
- Drought in the western fringes, especially the High Barind
- Flood proofing needs in the Charlands and Low lying areas
- Improvement of Flood Control, Storm Drainage , Water Supply and Sanitation system of Rajsahi City

South Central Hydrological region: South Central Hydrological region suffers few similar problems to the South West Region. Major specific Water resources issues in this zone are:
- Maintenance of the existing coastal embankment system
- Flood proofing needs in the Charlands and Low lying areas
- Siltation and Drainage congestion
- Improved Cyclone protection

South East Hydrological region: This region is particularly affected by Arsenic contamination. Specific water resources issues in this zone are:
- Gaseous aquifer
- Improved cyclone protection
- Maintenance of the existing coastal embankment system and drainage congestion
- Protection of newly accreted lands against tidal flooding
- Remedial action for existing inland FCD schemes
- Coastal afforestation

Eastern Hill Region: The major water related issues in this region are:
- Small-scale irrigation development in the CHT
- Mini-hydropower development in the CHT
- Improved cyclone protection in the CCP
- Maintenance of the existing coastal embankment system
- Optimum use of Kaptai reservoir
- Improvement of Flood Control, Storm Drainage , Water Supply and Sanitation system of Chittagong City
- Coastal protection and afforestation

River and Estuary Region: The major water related issues are:
- An affordable long-term strategy for erosion protection
- An affordable long-term strategy for regional Augmentation
- Flood proofing needs in the charlands and low lying areas
- Improved cyclone protection in the Meghna Estuary

- Erosion of Meghna River
- Land accretion and Land reclamation
- Timely protected newly accreted Lands
- Construction of Ganges, Brahmaputra and Meghna river.

The intricate nature of drainage systems within the country requires that activity for planning and management of the nation's river systems is undertaken within the context of hydrological regions. The principal river systems create natural boundaries for these regions. The hilly areas of the east form another hydrological region.

Meanwhile WARPO has prepared a National Water Management Plan (NWMP) addressing the overall resource management issues in each region and the whole of Bangladesh, and providing directions for the short, intermediate, and long runs.

In this study the IWRM plan has been focused to each Hydrological region based on IWRM frame work and with the help of EU-WFD. The planning methodology will ensure co-operation across sectors and people's participation in the process.

European Union's Water Framework Directive EU-WFD

The European Union has a long experience for basin wide integrated water resources management within Europe. The European Parliament and the Council of the European Union established a framework for Community action in the field of water policy in 23 October 2000 European Union's water policies such as the Water Framework Directive (2000/60/EC). The EU's experience (including its 27 Member States) is based on the best scientific knowledge and available technologies. In particular, the Water Framework Directive (2000/60/EC) mainly focuses on river basin management rules and principles. It is recognized that the Water Framework Directive (WFD) might be used as an example for basin-wide IWRM implementation and economic development for the developing countries, taking into account their socio-economic conditions.

This study will show that, how the European Union Water Framework Directive (WFD) model can be adapted for basin wide integrated planning for a developing country Bangladesh.

Lesson learn from EU-WFD

European Union's Water Framework Directive (EU-WFD) has established the River basin District and River Basin Management Plan based on common objectives for water status, and common monitoring and assessment strategies. In the same way, the Government of Bangladesh has to establish the Competent Authority for each of the hydrological in accordance with River basin District. This competent authority at each Hydrological Region will be the branch office of WARPO and WARPO will act as a co-ordinating body for these competent authorities. The competent authority at each hydrological region will be responsible for the preparation of River Basin Management Plan at each Hydrological Region based on Hydro-morphological characteristics of each hydrological region, common problems and specific water related issues, common objectives for water status (qualitative and quantitative), human impacts at each hydrological region, common monitoring and assessment strategies and other issued described in NWMP, 2004, Bangladesh Water Act, 2013 and other relevant Government documents. This River Basin Management Plan (RBMP) will be a subset of National Water Resources Plan (NWRP) and with the assistance of this River Basin Management Plan, WARPO will prepare the National Water Resources Plan (NWRP).The component authorities will also be responsible for the implementation of River Basin Management Plan and National Water

Resources Plan (NWRP) under the guidance of WARPO. This concept can be treated as a decentralized manner of WARPO, based on hydrological region.

The Government of Bangladesh (responsible organization is the Joint River Commission, Bangladesh) will endeavour to enter into agreements with co-riparian countries (India, Nepal, China, Bhutan and Mayanmar) for sharing the waters of international rivers, data exchange, resource planning and long-term management of water resources under normal and emergency conditions of flood, drought and water pollution. While moving towards the attainment of basin-wide plans in the long run with co-riparian countries, it is necessary for Bangladesh to concentrate on the development of these individual hydrological Regions to meet short and intermediate term requirements. This way WARPO will work close contact with JRC for trans-boundary water issue.

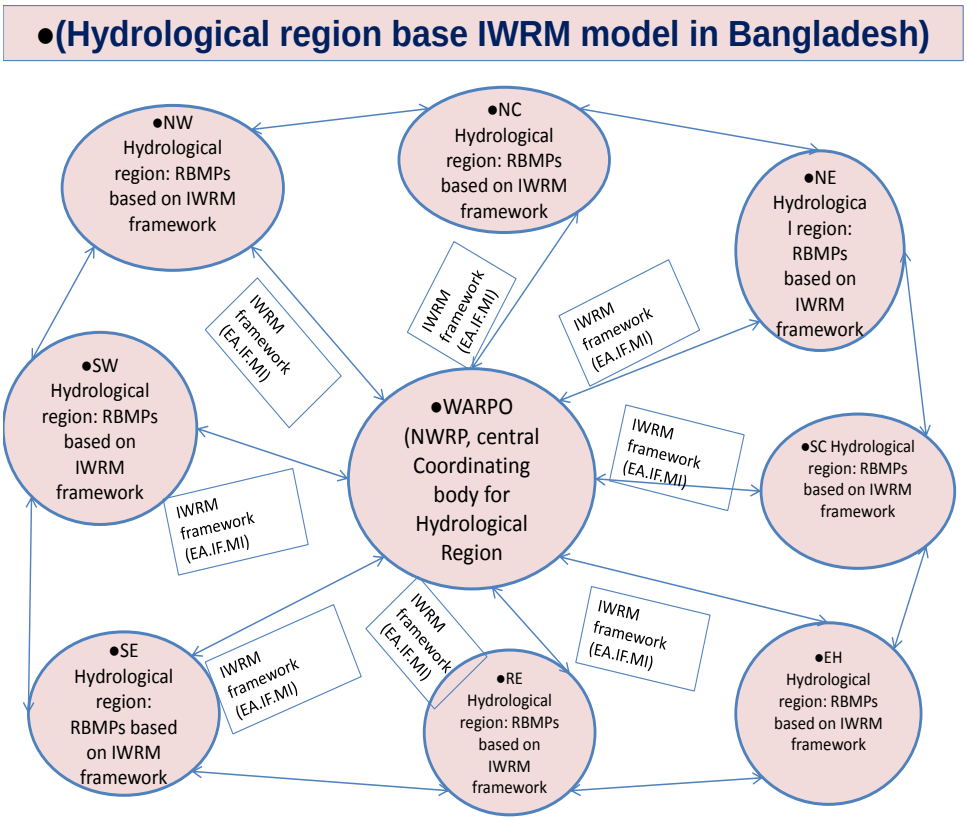
WARPO along with the competent authority will periodically update River Basin Management Plan (RBMPs as well as National Water Resources Plan (NWRP) addressing the overall resource management issues in each hydrological region and the whole of Bangladesh, and providing directions for the short, intermediate, and long runs. The plan will be executed by different agencies with the guidance of WARPO. This is the main mechanism of achieving the objectives and goal of National Water Resources Plan (NWRP), decentralized and basin wide water management practice in Bangladesh.

While carrying the monitoring program of water bodies in each Hydrological region, the competent authorities will use this information in developing their own plans and program of measures. The competent authorities will make the compulsory basic measures such as the licensing of discharges and abstraction, and where necessary the supplementary measures. Supplementary measures will be undertaken if the basic measures are not sufficient to meet the objectives of water bodies. In this way, the Programme of Measures and other detailed information regarding the river basin will be packaged and presented in a document called a River Basin Management Plan in hydrological regions.

However, while preparing and implementing the overall river basin management plan at each hydrological region, the extensive stakeholder consultation will be ensured at every stage and all the tools and framework of IWRM will be followed. The involvement of all the relevant Organizations, policy and Plan, data and information will be assured. In this way, the formulation and implementation process of River Basin Management Plan (RBMPs) as well as National Water Resources Plan (NWRP) will fundamentally follow the three pillars of IWRM such as Institutional framework (Competent authority and presence of other organizations), Management Instrument (data and information) and Enabling Environment (policy and plan etc.) As discussed earlier the River Basin Management plan at each Hydrological Region will be periodically reviewed and updated through the competent authority.

Common Implementation of Integrated Water Resources Management (IWRM) model in each Hydrological Region (HR)

The Following diagram depicts the overall River Basin Management Plan at each Hydrological Region and their coordination with National Water Resources Plan (NWRP). WARPO will prepare the National Water Resources Plan (NWRP) with the assist of River Basin Management Plan and by following the IWRM tools and framework.



DISCUSSION AND MAJOR DRAWBACKS

NWMP identified lot of knowledge gaps while preparing their Plan. Among them the decentralized water management and Long term basin wide planning and management are mentionable. In principle, the decentralized water management practice and basin wide Long term water resources planning and management are still emerging issues. The Bangladesh Water Act, 2013, has given the mandate to WARPO for preparing the National Water Resources Plan (NWRP) based on the description of water Resources with present Geographical location and mouza map. But no appropriate institutional structure has been formed yet up to hydrological region. Another important issue is that basin water water resources management always demands the hydrological boundary rather than administrative boundary. It is therefore the Competent Authority at Each Hydrological region is pre-requisite for basin-wide water management. It is now a question also for decentralized formation of WARPO. The concept of HR wide water management practice will serve a decentralized water management concepts as well as basin wide IWRM concepts. But the reality is that the Government needs appropriate budget and technology for reformation of the process. If it happens one step progress will ahead in relation with decentralized water management and basin-wide IWRM in Bangladesh. Here, Hydrological unit has been considered as like as basin. Recently, the Bangladesh delta Plan 2100 formulation project is ongoing. The concept HR wide IWRM practice will help to formulate the appropriate plan in specified zone under deep future uncertainty.

CONCLUSION

During the last 50 decades, a remarkable progress has been shown in Bangladesh. Lot of policies, Plans, regulations are undertaken by the Government of Bangladesh for managing and developing Water Resources in Bangladesh. Those are the milestone. Yet lots of tasks are still pending. Among them, decentralized water management and basin wide water management are mentionable. Now the Common issue in Bangladesh Water sector is to formulate the future adaptation policy under deep future uncertainty such as Climate Change, upstream withdrawal, population pressure etc. For managing the water resources with future uncertainty it is top most priority to give the focus on decentralized water management considering basin as a unit. This study has shown how basin wide IWRM can be considered for better water management practice with the lesson learned from EU-WFD.

REFERENCES

ADB, 2009. "Final Report and Road Map" and "Annexes". Regional Technical Assistance (RETA) Supporting IWRM (Bangladesh), ADB RETA Project No: 39199, Dhaka: Asian Development Bank, Water Resources Planning organization, Ministry of Water Resources, Government of the People's Republic of Bangladesh

Alam, M. (2014). An Evaluation of Water Resources Planning Organization, an Apex Planning Organization in Water Sector Bangladesh. *Asian Journal Of Applied Science And Engineering, 3*(1), 121-136.

Alam, M., Rahman, M., & Alam, M. (2014). An Investigation of National Water Resources Database, Bangladesh.*Asian Journal Of Applied Science And Engineering, 3*(2), 185-200.

Alam, M., Willems, P., & Alam, M. (2014). Comparative Assessment of Urban Flood Risks due to Urbanization and Climate Change in the Turnhout Valley of Belgium. *ABC Journal Of Advanced Research, 3*(1), 14-23.

Alam, M.M. & Quevauviller Ph. (2013). A Comparative Analysis of Bangladesh water management practice with the European Water Framework Directive. *Engineering International*, 1(2), 48-60.

Alam, M.M. & Quevauviller Ph. (2014). An evaluation of Integrated Water Resources Management (IWRM) activities in Bangladesh. *Asia Pacific Journal of Energy and Environment*, 1(1), 22-38.

Belgium, 2011. An evaluation of Integrated Water Resources Management (IWRM) activities in Bangladesh for sustainable Water Resources development and Comparison with European Water Management System. Master's Thesis, Hydraulics Lab, Katholieke Universiteit Leuven and Vrije Universiteit Brussel (VUB), Belgium, September 2011.

GED, Planning Commision, 2014. Inception Report, Bangladesh Delta Plan 2100 formulation project.

Global Water Partnership, 2000. Technical Advisory Committee (TAC) Background Papers, NO. 4, Integrated Water Resources Management, ,SE -105 25 Stockholm, Sweden).

MoWR, 1999. National Water Policy, Ministry of Water Resources, Government of the People's Republic of Bangladesh.

MoWR, 2013. Bangladesh Water Act, Ministry of Water Resources, Government of the People's Republic of Bangladesh.

United Nation Water, 1992. The *Dublin* statement- *www.gdrc.org/ uem/water/dublin-statement*

WARPO, 2001. National Water Management Plan, Vol.1: Summery Report, Water Resources Planning organization, Ministry of Water Resources, Government of the People's Republic of Bangladesh.

WARPO, 2001. National Water Management Plan, Vol.2: Main Report, Water Resources Planning organization, Ministry of Water Resources, Government of the People's Republic of Bangladesh.

WARPO, 2002. Vol.1: Options for the Ganges Dependent Area, Main Report, Water Resources Planning organization, Ministry of Water Resources, Government of the People's Republic of Bangladesh.

WARPO, 2015. Web page of Water Resources Planning Organization, Ministry of Water Resources, Bangladesh. (http://www.warpo.gov.bd)

WFD, 2000/60/EC. Water Framework Directive (www. ec.europa.eu/environment/water/water-framework)

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