BANCID

Yearly Newsletter 2014

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BANGLADESH NATIONAL COMMITTEE OF THE INTERNATIONAL COMMISSION ON IRRIGATION AND DRAINAGE (BANCID)

World Water Day 2014 was observed on Saturday, 22 March, 2014 organized by BANCID under the guidance of Ministry of Water Resources in association with Bangladesh Water Development Board (BWDB), Center for Environmental and Geographic Information Services (CEGIS), Institute of Water Modelling (IWM) and Bangladesh Water Partnership (BWP).

Bangladesh National Committee of the International Commission on Irrigation and Drainage (BANCID) organized a Seminar on "Water and Energy" on the occasion of the World Water Day 2014 under the guidance of Ministry of Water Resources in association with Bangladesh Water Development Board (BWDB), Center for Environmental and Geographic Information Services (CEGIS), Institute of Water Modelling (IWM) and Bangladesh Water Partnership (BWP) at CIRDAP International Conference Centre, Dhaka on Saturday, 22 March, 2014. Eminent Water Experts and Engineers from different organizations, Academicians, Representatives from NGO's attended the Seminar. A special supplement containing messages from Hon'ble Minister, Hon'ble State Minister, Secretary, Ministry of Water Resources, Government of the People's Republic of Bangladesh was published in two well circulated dailies "The Daily Ittefaq" and "The Daily Star".

Mr. Muhammad Nazrul Islam, Bir Protik, MP, honourable State Minister, Ministry of Water Resources graced the occasion as Chief Guest. Dr. Zafar Ahmed Khan, Secretary, Ministry of Water Resources attended the seminar as Special Guest. The Seminar was chaired by Mr. Md. Shahidur Rahman, Director General, Bangladesh Water Development Board and Chairman, BANCID. Welcome address was given by Mr. Md. Jahid Hossain Jahangir, Director, Joint Rivers Commission, Bangladesh and Member Secretary, BANCID and vote of thanks was given by Mr. Md. Shahidur Rahman.

Bangladesh National Committee of the International Commission on Irrigation and Drainage (BANCID)

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BANGLADESH NATIONAL COMMITTEE OF THE INTERNATIONAL COMMISSION ON IRRIGATION AND DRAINAGE

Editorial

The Publication of Annual Newsletter of Bangladesh National Committee of the International Commission on Irrigation and Drainage (BANCID) is a significant initiative taken by the Study and Publication Sub-Committee of BANCID. The aim of this publication is to disseminate information on the activities of BANCID and to receive feedback from the concerned communities.

In this third issue of the newsletter, articles on water management issues have been included. We are thankful to the organizations for submitting the articles. We will be happy to receive comments and suggestions from the concerned organizations on our initiatives of this publication.

Study and Publication Sub-Committee, BANCID.

BANCID Study and Publication Sub-Committee

Dr. M. Shahjahan Mondal	Professor, IWFM, BUET	Convener
Mr. Mir Sajjad Hossain	Member, JRC	Member
Dr. K. Azharul Haq	Vice President, BWP	Member
Mr. Md. Mahfuzur Rahman	Project Co-ordinating Director Char Development and Settlement Project-4 BWDB	Member
Mr. Md. Sarafat Hossain Khan	Project Director, CEIP, BWDB	Member
Mr. Motaher Hossain	Superintending Engineer, Design Circle-6, BWDB	Member
Mr. K. M. Humayun Kabir	Project Director, Capital (Pilot) Dredging of River System in Bangladesh, BWDB	Member
Mr. Md. Hafizullah Chowdhury	Project Director (Rubber Dam Project), BADC	Member
Dr. Nazmun Nahar Karim	Principal Scientific Officer, BARC	Member
Mr. Fazlur Rashid	Director, Processing, BWDB	Member
Mr. Abu Saleh Khan	Deputy Executive Director (Operation), IWM	Member
Mr. Malik Fida A. Khan	Director, Climate Change Study Division, CEGIS	Member
Dr. Atikur Rahman	Associate Professor, Department of Irrigation & Water Management, BAU	Member
Dr. Ruhul Amin	Director, BHWDB	Member
Mr. Kazi Rezaul Karim	Chief Scientific Officer, RRI	Member
Mr. Md. Mofazzal Hossain	Director, JRC and Member Secretary, BANCID	Member Secretary

From Member Secretary's Desk

ACTIVITIES OF THE BANGLADESH NATIONAL COMMITTEE OF THE INTERNATIONAL COMMISSION ON IRRIGATION AND DRAINAGE (BANCID)

The International Commission on Irrigation and Drainage (ICID) was established in 1950 with the objective of promoting technical, economic and social cooperation with regards to irrigation and drainage. In 1957, the ICID's mandate was extended to cover flood control and river training. The members are appointed from different organizations actively engaged in the field of irrigation, drainage, flood control, river training works and other water related activities including one representative from Ministry of Water Resources. Bangladesh National Committee of International Commission on Irrigation and Drainage (BANCID) holds national and international seminars in Bangladesh. BANCID also observes World Water Day on 22nd March every year since 1993.

On the occasion of the World Water Day 2014, BANCID organized a seminar on March 22, 2014. Two papers related to the theme of the seminar were presented, one by Mr. Md. Waji Ullah, Executive Director, CEGIS and the other by Dr. M. Monowar Hossain, Executive Director, IWM.

Three distinguished discussants viz: (i) Dr. Umme Kulsum Navera, Professor, Department of Water Resources Engineering, BUET, (ii) Dr. Sultan Ahmed, Department of Environment and (iii) Dr. K. Azharul Haque, Vice President, BWP and former Managing Director, Dhaka WASA discussed on the presentation and theme of the occasion. Besides, many participants took part in the open discussion and expressed their valuable comments and observations.

The following main observations and recommendations were emerged from the seminar:

1. It is observed that life and livelihood of the millions of people of Bangladesh have been revolving around waters of the rivers in Bangladesh over the ages. Due to geographical location, Bangladesh is the lowest riparian of the three mighty rivers viz the Ganges, the Brahmaputra, and the Meghna.. The total catchment area of these rivers is about 1.72 million sq km of which only 7% lies in Bangladesh. The water availabilities in Bangladesh varies significantly during monsoon and dry season. Bangladesh experiences flood during monsoon and serious water scarcity during dry season. Being lower riparian country of the Ganges, Brahmaputra and Meghna river basins, Bangladesh has no control over its water resources and it alone cannot manage its water resources. Sustainable development of water resources of Bangladesh depends on equitable sharing and basin-wide management of its rivers.
2. The seminar noted that there exists tremendous potential for development of water resources and hydro-power in this region. Joint projects in the regional countries could be undertaken for flow augmentation in dry season's flow and hydro-power development which could help increase food production, improve navigation facilities, fish production, riverine eco-system and overall environment of the region.
3. The Seminar expressed its view that top priority should be given for constructive and meaningful dialogue with the neighbouring countries in order to receive Bangladesh's due shares of water of the common rivers and resolve all water related issues. It also recommends that necessary means and measures should be undertaken to manage the water resources of the country in a comprehensive, integrated and equitable manner and undertake essential steps for basin-wide planning for development of water resources of the International rivers.
4. The Ganges Barrage Project should be implemented on an urgent basis in order to utilize the water meaningfully which is being received under the provision of the Ganges Water Treaty of 1996.
5. Rain water harvesting schemes should be implemented especially in the coastal areas of Bangladesh.
6. Projects for utilization of river water should be planned in such a manner that those do not affect the environmental flow for sustenance of river ecosystem.
7. The seminar recommended for establishment of RBO's in the Ganges and the Brahmaputra river basins towards integrated water resources management.
8. During planning and implementation of water management projects in Bangladesh, especially in the coastal areas, the climate change effects are to be considered with regard to coastal land accretion, erosion, changes to shore line, sea beach, navigability, port and harbor, wet land, safety to coastal cities like drainage, flooding, salinity, sewage and water supply etc.
9. It was opined in the seminar that coordinated, coherent and concerted policies and management plans should be undertaken for sustainable development of water resources and energy.
10. The seminar recommended to explore the possibilities of energy generation from renewable resources like water, wave, solar, wind etc.
11. It was recommended that there is a need for the development of water and energy through ecosystem conservation by ensuring **five R** concepts i.e. **R**ecycle, **R**efuse, **R**educe, **R**euse and **R**eform.

BANCID would like to express its sincere thanks to Joint Rivers Commission, Bangladesh for providing necessary fund towards publication of BANCID Newsletter 2014.

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BANCID National Committee

From its establishment in 1973, BANCID is actively involved in dissemination of research outcome and news related to irrigation, drainage, climate change and other water related issues both home and abroad. The present 18 members approved Committee (2014-2016) headed by Director General, BWDB is as follows:

1.	**Director General** *Bangladesh Water Development Board (BWDB), Dhaka.*	*Chairman*
2.	**Head** *Department of Water Resources Engineering* *Bangladesh University of Engineering & Technology (BUET), Dhaka.*	*Vice Chairman*
3.	**Dr. M. A. Quassem** *Water Expert and Former Director General* *Water Resources Planning Organization (WARPO), Dhaka.*	*Member*
4.	**Member** *Joint Rivers Commission, Bangladesh (JRC), Dhaka.*	*Member*
5.	**Director General** *Water Resources Planning Organization (WARPO), Dhaka.*	*Member*
6.	**Director General** *River Research Institute (RRI), Faridpur.*	*Member*
7.	**Director General** *Bangladesh Haor and Wetland Development Board (BHWDB), Dhaka.*	*Member*
8.	**Executive Chairman** *Bangladesh Agricultural Research Council (BARC), Dhaka.*	*Member*
9.	**Head** *Department of Irrigation and Water Management* *Bangladesh Agricultural University (BAU), Mymensingh.*	*Member*
10.	**Chief Engineer** *Local Government Engineering Department (LGED), Dhaka.*	*Member*
11.	**Chief Engineer** *Public Health Engineering Department (DPHE), Dhaka.*	*Member*
12.	**Managing Director** *Dhaka Water Supply Authority (DWASA), Dhaka.*	*Member*
13.	**Chairman** *Bangladesh Agricultural Development Corporation (BADC), Dhaka.*	*Member*
14.	**Executive Director** *Centre for Environmental and Geographic Information Services (CEGIS), Dhaka*	*Member*
15.	**Executive Director** *Institute of Water Modelling (IWM), Dhaka.*	*Member*
16.	**President** *Bangladesh Water Partnership (BWP), Dhaka.*	*Member*
17.	**Deputy Secretary (Administration)** *Ministry of Water Resources* *Government of the People's Republic of Bangladesh, Dhaka.*	*Member*
18.	**Director** *Joint Rivers Commission, Bangladesh (JRC), Dhaka.*	*Member Secretary*

Opportunity for Mitigating the Effect of Oblique Flow on Bank Protection Work in Braided River

Engr. Motaher Hossain, Superintending Engineer, Design Circle-6, BWDB
Dr. Umme Kulsum Navera, Professor, Department of Water Resources Engineering, BUET
Poly Das, Assistant Engineer, Design Circle-2, BWDB

Introduction

Rivers are dynamic entities with boundaries such as bank and bed which are subjected to erosion and deposition (Mosselman, 2009). Bangladesh is an alluvial delta of the Ganges, the Brahmaputra and the Meghna. Hydro-dynamically rivers are very active in nature here. Due to this, river erosion is a common scenario in Bangladesh (Das, 2014). The large rivers in Bangladesh are mainly braided and meandering in nature and riverbank erosion is an endemic and recurrent natural hazard (Mosselman, 2009).

Normally erosion occurs in concave bank of meandering channels. But braided river is highly susceptible to channel migration and avulsion (Rahman, 2010). The unpredictable shifting behavior of the rivers and their encroachments not only affect the rural floodplain population but also urban growth centers and infrastructures.

There is no systematic pattern of erosion in the braided river system. Oblique flow changes and accelerates the erosion process in a braided river than meandering river. There are a number of variables in the braided river system and are very important to understand its behavior to prevent erosion. Different studies on braided rivers are mostly qualitative. But there is a significant lack of quantitative studies in braided rivers. This study has been done to understand the fluvial process of braided rivers.

Presence of Oblique Flow in Bangladesh

The Brahmaputra-Jamuna in Bangladesh is a classic example of a braided river and is highly susceptible to channel migration and avulsion.

Figure 1: Presence of Oblique Flow in the Jamuna River based on a satellite image

Figure 2: Oblique Flow at Sirajgonj Hard Point (2009)

Study on Oblique Flow by Physical Model

To understand the behavior of different processes in the river system, both physical and numerical models are used. Physical modelling is a better way for perception of the nature of rivers due to flow current interactions. Different behaviors of river can be incorporated in physical models. A physical model based study has been conducted in River Research Institute to understand the behavior of a part of a braided river when it is under attack of oblique flow.

The physical model study was funded by Institute of Water Modelling (IWM). The model was developed in a scale ratio of 1:50 for a straight bank with variable oblique channel angle (20°, 40° and 60°) and discharge ratio (1:1.2, 1:1.4 and 1:1.6). Effect on unprotected bank, bank protection work and launching behavior of protection material due to oblique flow was identified. Stone boulders and geo-bags were used as river bank protection materials.

Figure 3: Physical Model Set-up at RRI, Faridpur

Revetment works by stone boulders and geo-bags were done with the analyzed results of unprotected conditions. Launching behavior of both the materials was analyzed in this study.

Model Output Summary

Around 20m bank shifting and 10.60m bed scour in unprotected bank condition were observed and measured. The overall analysis of the experimental setups can be summarized as below:

1. Scour pattern and most affected zone due to oblique flow in the main channel change with the characteristics of chute channel.
2. Scour depth increases with the increase of discharge ratio but the variation in scour depth is high for higher secondary channel angle.
3. Erosion rate in main channel increases with a dominant oblique flow, i.e. with the increase of oblique flow angle.
4. An extra multiplying factor was reassessed by analysis of the physical model outputs and found as 1.30 to 1.72 depending on the angle of oblique flow for unprotected condition.
5. Thalweg channel pattern changes with protective material type.
6. Launching behavior changes with the change of material type. Launching behavior of stone boulder and geo-bag is different. Stone boulder launches at a maximum slope of 1:2.42 without any bare spaces and the slope varies from mild to steep slope with the changes of discharge ratio and oblique flow angle. On the other hand, there is no uniformity of slopes of geo-bags and frequent bare spaces found while it launched to meet the scour.
7. Stone boulder has a better launching property than geo-bag. It maintains a well defined areal coverage.
8. Geo-bag has less areal coverage as a protective material. Sometimes it works as a bundle. Due to non-responsive behavior there always remains the probability of slope failure.
9. Movement of geo-bags from launching area in some extent has been found.

Recommendations

The research has been done to observe only a few parameters of braided river. Further study on the following topics is expected to be a complete guidance for defining the nature of braided river for oblique flow:

1. Research on a total braided river section containing several chars to define a complete behavior of braided river.
2. Modeling work with true prototype condition, i.e. unconfined right bank.
3. Protection work completed by only slope pitching and launching apron without extending the slope up to the bottom of model bed would be helpful in identifying mode of slope failure in a braided river and launching behavior due to oblique flow.

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Char Development and Settlement Project-IV (CDSP-IV)

Md. Mahfuzur Rahman, Project Director, CDSP-IV, BWDB

Bangladesh is the largest delta of the world formed mainly by alluvial deposit of the Ganges – the Brahmaputra - the Meghna river system. About 1.1 billion ton of sediment is carried down to the Meghna estuary through the Lower Meghna River.

Over the years, the Government has recognized the opportunities of land accretion. It obviously provides the country with more land that can serve to mitigate the population pressure and to enhance the food security. In 1957 and 1964 two cross dams were constructed over the low flowing estuarine channel of the Meghna River to connect islands and mudflats to the mainland. As a result, more than 1000 km2 of land has been reclaimed in the south-east delta of the country.

When a new char becomes fit for cultivation, powerful people (Jotdar) takes the control of new land. The river-eroded families from adjacent areas start migrating into the newly formed land for settlement and livelihood under active control of powerful people. Initially land is low, subjected to regular tidal flooding during monsoon. There is no access to drinking water, especially in winter and no system of communication. The settlers are dependent on low-yielding Aman rice crop, some Rabi crops and little fish ground in low area or caught in open water. Some income is derived from tending cattle. People have no official title on the land they occupy. They are vulnerable to a set of risks such as flooding, storms and salinity, unavailability of fresh water and social insecurity. These challenges cannot be addressed through activities of a single sector or organization.

Since 1991, new polders are being constructed with an aim to integrated development of reclaimed coastal land as well as settlement of landless people by creating an enabling environment through Dutch Aided Char Development and Settlement Project (CDSP) in south of Noakhali. Meanwhile, three phases completed with brilliant success and CDSP-IV started in May 2011 and expected to be completed by June 2018. The project is financed by International Fund for Agricultural Development (IFAD), Government of the Netherlands (GoN) and Government of Bangladesh (GoB).

The overall objective of the project is to reduce poverty and hunger for poor people living on newly accreted coastal chars, which would be achieved via improved and more secured livelihood. Security for people and livelihood would be provided through water management and climate resilient infrastructures and also by providing poor households with legal title to land.

The project is being implemented by six agencies. These are Bangladesh Water Development Board (BWDB) (Lead agency), Local Government Engineering Department (LGED), Ministry of Land (MoL), Department of Public Health Engineering (DPHE), Department of Agriculture Extension (DAE) and Forest Department (FD) under five ministries where Ministry of Water Resources (MoWR) is the lead ministry. In addition, four NGOs are also working. In each agency, there is a Project Director (PD) and the PD, BWDB is the Project Coordinating Director (PCD). On behalf of GoN, a Technical Assistance (TA) team is supporting implementation and coordination of the project. Top of the management structure is the Inter Ministerial Steering Committee (IMSC), chaired by the Secretary of MoWR. The next level is the Project Management Committee (PMC) chaired by PCD of BWDB, other PDs being the Members and the Team Leaders, TA team being the Member Secretary. It is the central decision making body of the project. The coordination through PMC is unique arrangement in the country. It is the first ever integrated approach involving 6 government agencies and non-government organizations with community participation to some extent in development of newly accreted coastal char area.

The project area comprises the new chars named "Nanguliarchar, Nolerchar, Caringchar and Char Zia-Uddin" in Noakhali district and Urir-Char under Chittagong district with total area of 26,300 hectares having about 22,000 households.

Agency wise activities

Major activities under (i) BWDB are construction of embankments, drainage sluices, closures, and excavation/re-excavation of khals; (ii) LGED are construction of cyclone shelters, roads, bridges, culverts, markets, ghats and union complexes; (iii) DPHE are construction of deep tube wells, single pit latrines; (iv) MoL are land allotment and khas land distribution; (v) FD are mangrove forest, foreshore forest, embankment/road/block plantation; (vi) DAE are demonstration of high value/low value crop, training and adaptive research and pilot trial. NGOs are working for group formation, micro financing, health and family planning, water and sanitation, homestead agriculture and value chain development, legal and human rights, disaster management and climate change activities. Each landless family gets highest 1.50 acres of land and land title is given in the name of both wife and husband through MoL. Improved and more secured livelihoods are achieved through the implementation of activities of other agencies.

In CDSP, empowerment of women is ensured through land titling, providing leadership role in Water Management Groups (WMG), tube well user groups (fully women), LCS groups and by awareness development. Rights of wives are ensured through providing 50% land ownership to women and 100% in case of women headed household.

Gender issues are an integral part of all policies and guidance of CDSP-IV. Gender inequality poses a major impediment to achieving sustainable development. The concept of 'gender mainstreaming' in the project has been ensured through active participation of men and women in all project activities during planning, implementation and operation, maintenance during post project.

Expected achievement

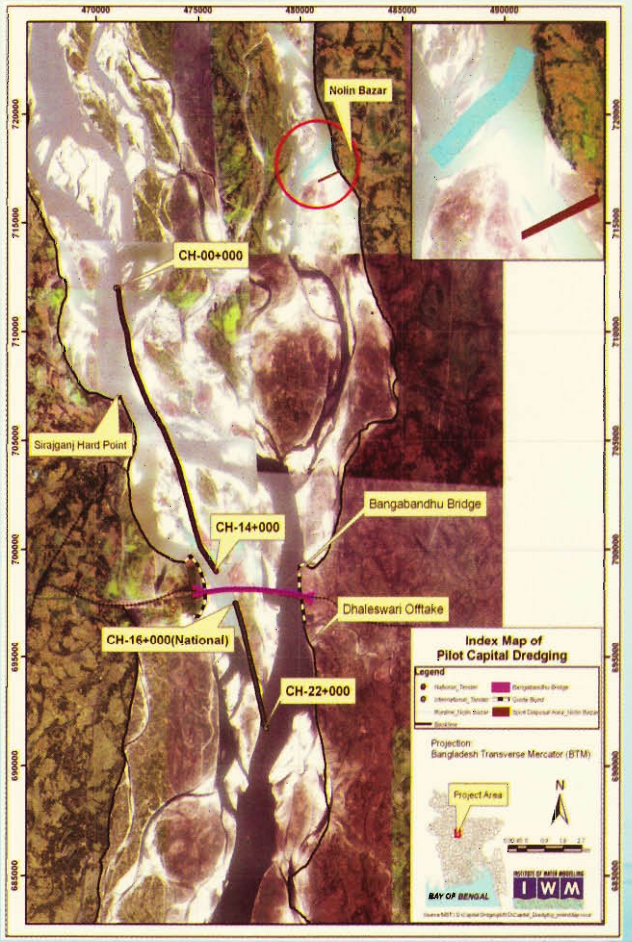
- The project will provide flood protection, improved drainage & irrigation facility to 13,623 ha area and also protection from cyclone;
- Total 18923 acre (7661 ha) of khas land distributed among 14000 families/ landless farmers;
- Communication improvement;
- Improvement of water & sanitation facility for 1,55,000 persons through tube wells & latrines;
- Empowerment of women through land titling & providing leadership role in WMOs;
- Ecological balance & stabilization of soil by plantation;
- Enhancement of agricultural output through demonstration of farms & training;
- Overall livelihood improvement of char settlers;
- Increase in agricultural production by about 37,570 MT / yr (BDT 5,624 Lakh).

Pilot Capital Dredging of the Jamuna–Lessons Learnt

Abu Saleh Khan, Deputy Executive Director (Operations), IWM
Md. Amirul Islam, Director, Survey and Data Division, IWM
Mir Mostafa Kamal, PEng., Director, River Engineering Division, IWM
K. M. Humayun Kabir, Project Director, Capital (Pilot) Dredging of River System in Bangladesh, BWDB

Bangladesh is a great delta formed by the alluvial deposits of the three mighty rivers: the Ganges, the Brahmaputra and the Meghna. The river system drains off 1,350 billion cubic meters (BCM) of water, from a total catchment area of about 1.72 million sq km, through Bangladesh into the Bay of Bengal. Out of this large catchment area, only 7% lies in Bangladesh. The Ganges-Brahmaputra-Meghna (GBM) river system carries probably the largest total sediment discharge of all of the world's rivers. All the major rivers of Bangladesh carry huge sediment loads from the large catchments that have been estimated to about 1.0 to 1.1 billion tons annually. Lion share of the sediments is deposited in the rivers within Bangladesh that has created problems like increased flooding propensity, frequent riverbank erosion and damage to existing bank protection works, reduced navigability of rivers and closures of off-takes in dry season.

In 2010, Bangladesh Water Development Board (BWDB) took up a project titled Capital (Pilot) Dredging of River System of Bangladesh (CDRSB). The Project has two components – (1) Physical component (pilot dredging of 2km+20km of the Jamuna), and (2) Study component.



The pilot dredging has been implemented for "learning from doing" before implementation of a mega dredging project in Bangladesh. The capital (pilot) dredging was planned at two locations having specific objectives:

1. Dredging of the Jamuna River from upstream of Sirajganj Hard Point through Bangabandhu Bridge to Dhaleswari Offtake – 20km (to divert the flow from the west channel into the mid channel to reduce the risk of failure of Sirajganj Hard Point and to guide the flow along the middle of the existing char through the Bangabandhu Bridge to Dhaleswari Offtake).
2. Dredging of the Channel of Jamuna in front of Nalin Bazar near Bhuapur-Tarakandi Road – 2km (to divert the flow from the existing left anabranch of the Jamuna River for reducing erosion near Nalin Bazar, thus saving the existing Bhuapur-Tarakandi road embankment).

In order to achieve the objectives of pilot dredging, four cross-bars along the right bank of the Jamuna and one cross-bar near Nalin Bazar were also constructed using the dredged spoils.

Institute of Water Modelling (IWM) was entrusted to provide support service to BWDB for the implementation of dredging. IWM was assigned with the tasks of quality control, monitoring and impact assessment of dredging of the Jamuna River. The tasks were accomplished through survey, primary data acquisition and mathematical modelling.

The Jamuna (about 240 km in Bangladesh) is braided river having an average width of about 11 km in Bangladesh area. The pilot dredging was limited to for length of only 20 km having bed width of 120 m, which is very much partial (small) in comparison with the length and width of the river. Partial work may provide partial information. As such, the dredging has been done as a pilot case to generate data/information and knowledge/experience for the implementation of large scale dredging activities. Hence, the lessons, which have been learnt by partial dredging (in respect of length and width), do not constitute a complete picture of metamorphosis of the Jamuna during/after the dredging operations. However, the following statements of lessons learnt may be worth reviewing:

- Flowing anabranches of the Jamuna can be closed and diversion of flow is possible by constructing sufficiently strong cross-bars;
- Major volume of siltation occurs within the early month of monsoon after dredging. As a result, the dredged area gets silted up considerably after passing one flood. It is, thus, clear that partial dredging in a river like the Jamuna will not sustain. Construction of some cross-bars and bank protection works, and intelligent/adaptive dredging in well-planned manner would give better result;
- The river carries huge sediment load and channel shifts from one location to another. The siltation pattern of the river in different year shows dissimilarity. So, dredging would only be effective if continuous effort is devoted to keep the dredged river alignment in place;
- Social impact assessment is very important before taking up large scale dredging through the chars for channelization and land reclamation in a river like the Jamuna. Settlement provision is very important when dredging is planned through the char;
- Careful planning is needed for the dumping of dredged material. It is not possible to dump the dredged materials by crossing the wide flowing channels;
- Management of dredged spoil is a very crucial issue. The dredged spoil should be disposed off properly, and protected from river current, rain water wash away, etc.;
- The dredging alignments should be fixed up by simulation of dynamic numerical model, backed up by field survey data, for better performance of dredging. Change of dredging alignment (that was finalized by modelling exercises) may lead to less effective dredging.

Brief on National Water Resources Database (NWRD) & Integrated Coastal Resources Database (ICRD) in Water Resources Planning Organization (WARPO)

Fazlur Rashid, Director, Processing, BWDB (Former Principal Scientific Officer, Water Resources, WARPO)

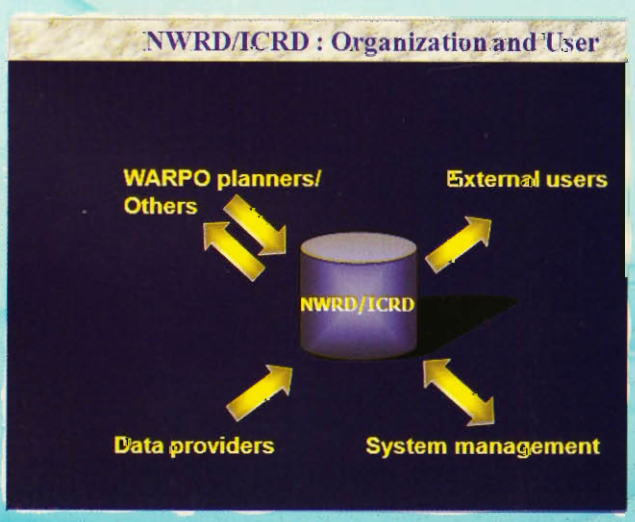
Water Resources Planning Organization (WARPO) has developed National Water Resources Database (NWRD) to meet the demand of consistent data and information from the planners, researchers and managers working in water sector. It is a mandate of WARPO to establish and update the NWRD. The NWRD has become the largest geo-spatial database in the country, which holds spatial, temporal and attribute information on water resources. WARPO collates data from different primary data collecting agencies, does needful conversion, processing and quality checks of the data layers. Data is being scrutinized through proper temporal and spatial quality guidelines.

NWRD holds more than 550 data layers, out of which 125 layers are spatial data. Data in the NWRD are organized in several main groups which are: Base data, Surface water, Groundwater, Soil and Agriculture, Fisheries, Forest, Socio-economic, Meteorological, Environment and Images. A web enabled meta-database has been created to browse through Internet/Intranet.

NWRD data is being disseminated to large no. of users in universities, government & non government agencies, national and international institutions and others in their favored formats.

Objectives

- Support water resources planning including the National Water Management Plan (NWMP),
- Organize the data collected from different agencies, organizations or projects,
- Check the quality of existing data, and establish a data quality checking procedure and guidelines,
- Develop GIS based tools and other application tools and a meta-database,
- Identify the need for additional data layers for planning purposes,
- Construct additional data layers to enhance and enrich the database,
- Develop a future data management strategy for WARPO and
- Make data available to all users.



WARPO received a mandate through the 'Coastal Zone Policy 2005' to set up Integrated Coastal Resources Database (ICRD), which is linked to NWRD as a sub-set. Data of different sectors of coastal zone of Bangladesh (19 coastal districts) are kept in ICRD. ICRD provides means to prepare an up-datable rich picture of vulnerabilities and opportunities in the coast and usable for decision & policy makers.

Data from primary and secondary sources have been collected, collated and compiled. Presently 600 data layers have been collected and generated for ICRD. The summary of data can be presented based on 6 indicators as follows:

Administration and Institutions (ADM): Administrative Area, Participation, FMOs/CBOs, GoB Organizations, Informal Organizations, NGOs, Laws, Regulations, Policies etc.

Economics and Finance (ECO): Credit, Employment, Foreign Currency Earning, GDP, Savings, Wages, Agriculture, Fishery, Industry, Services, etc.

Funds and Interventions (FUN): Water, Health, Food Assisted Program etc.

Human beings and Social Conditions (HUM): Demography, Financial Assets, Gender Related Data, Education and Skills, Health, Income, Natural Assets, Physical Assets, Social etc.

Assets, Infrastructure and Services (INF): Agriculture Sector, Communication Sector, Education Sector, Health Sector, Power Sector, Protection, Transport Sector etc.

Natural Resources and Environment (NRE): Chars and Inter-tidal Areas, Estuarine Dynamics, Fish and other Aquatic Resources, Plain Land Forest, Shallow Aquifer, Homestead Gardens, Mangroves, Agricultural Land, Ponds and Ghers, Settlement Area/Industrial Area/Infrastructure: Air, Humidity, Rainfall, Sunshine, Wind, Gas and Oil, Sand and Minerals, Deep Sea, Estuary Branches and Coastal Waters, Floodplains (Wetland), Perennial Water Body, River etc.

Maintenance, Updating and Dissemination of NWRD

Some of the worth-mentioning output of Maintenance, Updating and Dissemination of NWRD are as follows:

1. Updating of NWRD and IT Support,
2. Establishment of High Resolution RS Reference Bank and Corresponding GCPs,
3. Network Development,
4. MIS Development for NWMP Implementation and Monitoring,
5. Review and update of ICRD as a subset of NWRD Updating.
   - Development of New Application Software,
   - Data Quality Control and Assessment Tool,
   - On-line Help Desk Tool,
   - A new WARPO Library Catalog Tool has been developed and linked to WARPO website,
   - Data Upload Tool,
   - Tool for Updating Metadata and Bundle Information,

- Data Inventory Tool,
- Establishment of High Resolution RS Reference Bank and GCPs,
- A GCP data bank containing 2571 GCPs is developed,
- 'Report on GCP Databank' and 'Need Assessment, Inventory Report' has been prepared,
- The reports have been distributed to other relevant organizations, dealing with GCP and satellite images for comments,
- GCP databank has been sent to Survey of Bangladesh (SOB) for authentication.

Mode of Data Dissemination and Payment

1) An official request letter from the user should be addressed to the Director General (DG), WARPO in prescribed form by hand to hand/post/fax/email. 'Prescribed form for Data Request of NWRD/ICRD' is available at WARPO website (www.warpo.gov.bd),
2) WARPO would prepare an estimate for requested data on the basis of up-to-date pricing,
3) The estimation should be sent to the user by email/fax for confirmation of data purchase,
4) Approval of the estimate by the DG, WARPO,
5) Sending/submission of invoice to the user by email/fax/hand to hand,
6) Data supply media in general should be CD or DVD to be supplied by the user,
7) Payment should be made through pay order/ bank draft in favor of "Director General, WARPO (NWRD/ICRD)" against the invoice in advance of data supply.

Conditions for Data Dissemination

i) WARPO does not take responsibility for the quality of secondary data as the data are from secondary sources,

ii) The data recipient/user warrants that no liability of whatever form should be placed upon WARPO for inaccuracies in the data arising from the use of the data or those who make subsequent use of any information derived from the data,

iii) The data recipient/user agrees to advise WARPO of any errors detected in the data,

iv) The data recipient/user agrees to acknowledge the source of the data in any report or publication,

v) The use of data is valid only for single user,

vi) If there is any query about data, it should be placed to WARPO within a month from the date of data received,

vii) The data recipient/user agrees not to transfer this data in whole or part to another party without prior permission of WARPO,

viii) The recipient/user of data is not allowed to sell or disseminate the data received from WARPO. Followings are available in WARPO website (www.warpo.gov.bd):

- Prescribed form for Data Request of NWRD/ICRD
- Data Catalogue of NWRD
- Data Catalogue of ICRD

Options for improving cooperation

Inter-agency co-operation and relationship is essential for sustainability of any development. The number of errors can be reduced over time if there is feedback from users of the database.

Assessment of the Impact of Climate Change on Sunflower Yield in Coastal Bangladesh Using the AquaCrop Model

Debanjali Saha, Lecturer, IWFM, BUET

Introduction

Bangladesh is a delta shaped lower riparian country in the Ganges-Brahmaputra-Meghna basin. The coastal region of Bangladesh has a 700 km long coastal belt and an area of about 47,000 km2 over 19 districts. The coastal area, mostly the south-western portion, is highly vulnerable to frequent natural hazards such as cyclones, storm surges and flooding. Moreover, anthropogenic events have increased the water and soil salinity up to a damaging extent. This has hampered the agricultural activity, especially during the dry season, which is one of the main livelihoods of the coastal people. Given the circumstances, the local people have started cultivating less water requiring cash crops like sunflower, watermelon and sesame, which have good market values. Sunflower is getting popularity as an emerging crop in the area since its first introduction on an experimental basis by an international NGO called Bangladesh Rural Advancement Committee (BRAC). Now this crop is being cultivated by many farmers though in a small-scale. However, its lower water requirement, less investment cost, good profit and health benefits of its oil have drawn farmers' attention. Many farmers are now willing to cultivate sunflower during the dry season instead of keeping their lands fallow to improve their economic condition and achieve solvency.

The AquaCrop, a crop productivity simulation model developed recently by the Food and Agricultural Organization, has been widely used for simulating crop yield under different field conditions in different seasons and locations. The salinity module of the model has been released in 2012 and is yet to be tested for its performance. It is important to mention here that many popular crop models including DSSAT do not have the salinity component and hence are not useful in coastal region. However, there are many coastal areas in the world where high salinity is a major constraint for coastal agriculture. The coastal population is increasing worldwide and agricultural activities are being intensified for maintaining food security and livelihood. Therefore, decision support via a suitable crop model is necessary for survival of coastal agriculture and betterment of the coastal people. For this purpose, the AquaCrop model can be helpful. Also, changes in future climate are likely to affect the yield of sunflower. Such impact needs to be evaluated. This knowledge is required for bringing the cultivation of this crop in a large-scale for economic improvement of the coastal people.

Methodology and Data Collection

For calibration and validation of the AquaCrop model, an experimental study was conducted with Hysun 33, a local variety of sunflower, during the dry season of 2014 in the coastal region of Bangladesh. From seeding to harvesting stage, necessary data have been collected from two different plots by field measurements and monitoring during the different growth stages of sunflower. Collected field data included canopy cover at initial and maximum stages, maximum rooting depth, days to maximum canopy, senescence and maturity, duration of flowering, etc. Relevant conservative data were obtained from the crop library of the AquaCrop model and its Reference Manual. Soil salinity was measured in laboratory from the six samples collected from the fields and irrigation water salinity was measured in the fields during the different growth stages of sunflower. Observed climate data for the year 2014 were collected from the local climatic station (Khulna) of the Bangladesh Meteorological Department. For future prediction, climate data from 2015-2050 for climate change scenario A1B, which is most widely used in Bangladesh, were collected from the outputs of the PRECIS model run at the Met Office, Hadley Centre, UK.

Results and Discussion

For calibration of the model, initial canopy cover of 0.39% and maximum canopy cover of 65% were calculated from the field data. In a crop season of 129 days, 18 days were required for sunflower to build up the harvest index. The reference harvest index of 35% was taken from the AquaCrop library. Also, a minimum salinity threshold of 2 dS/m and a maximum threshold of 12 dS/m were used in the model. For the year 2014, the observed sunflower yield from the field was 1.20 t/ha whereas the model simulated yield was 1.25 t/ha.

The calibrated model was then used for validation with observed data from another field. The model parameters were kept as they were in calibration. The observed and simulated yields were 1.10 t/ha and 1.14 t/ha, respectively. This indicated a good performance of the AquaCrop model in simulating sunflower yield in the saline coastal areas of Bangladesh. Then the parameterized model was used for prediction of sunflower yield under future climate where a slightly increasing trend was found (Figure 1). The results indicated that, if the maximum temperature during the main flowering stage of the crop remains within an acceptable limit, which is 40 °C or less for sunflower, the sunflower yield would be slightly higher than the present yield. These findings of increasing yield may be encouraging for the local farmers to invest in this cash crop for increasing income and reducing poverty.

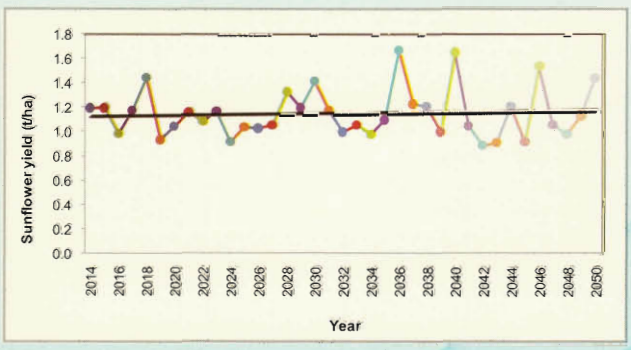


Figure 1: Simulated sunflower yield in coastal Bangladesh during 2015-2050

Conclusion

The increasing salinity of the coastal areas of Bangladesh has restricted the availability of fresh water for irrigation and hence people are now shifting to cultivation of cash crops like sunflower, which is suitable for both consumption and sale. Though the impact of climate change on agriculture has mostly been found to be negative from many studies, its impact on sunflower appears to be positive indicating good future potential of this emerging crop in the coastal region. This indicates that crop-specific studies are needed to be performed rather than having generalized opinion about the impact of climate change on different crops. Also, the findings of increasing yield may encourage the local farmers to invest in sunflower cultivation which is expected to improve their socio-economic condition in future.

ICID-CIID

Irrigation with wastewater in Bangladesh-problems and prospects

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Introduction

Water is vital for all known forms of life. Major areas of uses of water include agricultural, industrial, household, recreational, environmental, etc. Among all, agriculture is the largest user and uses about 80% of world's available supply. With the increasing population and industrialization, the demand for water is also increasing in other sectors, while the quality of water is decreasing with uses. In many arid and semi-arid regions of the world, water, especially good quality water, is becoming an increasingly scarce resource. Therefore, it has been a need to find alternative sources of irrigation water to ensure the sustainability of the available resources (Thawale et al., 2006). Water with marginal quality could be an important alternative source to meet the irrigation demand of agriculture. Quality of water originating from a community is chemically and biologically altered by a variety of uses being loaded with a diversity of wastes and this water is commonly known as wastewater. It may be originated from agricultural practices, domestic wastes, industrial sources, municipal sources, highway drainage, etc.

Coverage of wastewater

The global volume of wastewater is over 1500 km3 per year. A large part of it is being used worldwide for irrigation in agriculture. Raw or partially treated wastewater is being applied to almost 20 million hectares of agricultural land in 50 countries of the world and is contributing to irrigate 20% area of world's agriculture. According to ESCAP (2000), about 725 million cubic meters of wastewater is produced annually from urban areas of Bangladesh of which 90% is untreated.

Quality parameters of wastewater for irrigation

Irrigation with wastewater is encouraged when its quality is suitable for the crops to be cultivated without deteriorating environmental quality. The important quality parameters of wastewater, from an agricultural point of view are: physical properties such as total dissolved solids, electrical conductivity, temperature, color/turbidity, hardness and sediments, and chemical properties such as acidity, type and concentration of cations and anions (calcium, magnesium, sulphate, sodium adsorption ratio, boron, nitrate nitrogen, potassium, etc.). Water quality should be such that it will not induce salinity, nor will pollute soil. Some important quality parameters with recommended values are presented in Table 1.

Table 1: Some important quality parameters of wastewater for irrigation

Quality parameters	FAO standard	Bangladesh standard
pH	6A.5-8.0	6.0-9.0
EC (dS/m)	0.7	2.25
NO3-N (mg/1)	30	10
PO4-P (mg/1)	10	6
TSS (mg/1)	<100	<200
TDS (mg/1)	<450	<2100
Na (mg/1)	69	1000

Agronomic and economic benefits of wastewater irrigation

Wastewater is extensively used in agriculture because it is a rich source of nutrients and provides all the moisture necessary for crop growth. Properly treated wastewater can be a good source of irrigation due to its good nutritive value. Most crops give higher than potential yields with irrigation using wastewater. From an economic point of view, irrigation of crops with wastewater under proper agronomic and water management practices may provide the following benefits: (1) higher yields, (2) additional water for irrigation, and (3) value of fertilizer saved. Recently, a few studies have been conducted at Bangladesh Agricultural University to irrigate wheat with different types of wastewater. The results presented in Table 2 show that higher yields were obtained in most of the cases irrigated with wastewater. The environmental and soil quality impacts were also assessed and no threat to the soil and environment was observed. However, nutrient supply in excess of crop needs may negatively affect crop yield (Hussain et al., 2002). Economic benefit is also diminished if toxic compounds are present.

Table 2: Effect of different irrigation treatments on the grain yield of wheat

Irrigation treatment	Grain yield (t/ha)		
	Sugarcane mill wastewater (Hasan, 2011)	Dairy wastewater (Kundu et al., 2013)	Dairy wastewater (Islam, 2015)
Fresh water	3.44	1.53	2.80
(Wastewater: Fresh water=1:1)	4.12	1.8 3	2.7 0
Wastewater	4.26	1.50	2.90

Impacts of wastewater irrigation on soil

The impact of wastewater irrigation on soil depends on a number of factors such as soil properties, plant characteristics, and sources of wastewater. Potential impact on agricultural soil is caused mainly due to the presence of high nutrient concentrations (nitrogen and phosphorus), high total dissolved solids, and other constituents such as heavy metals, which are accumulated into the soil over time. Wastewater can seal soil pores and reduce hydraulic conductivity of soil. Accumulated pollutants and salts in root zone of soil cause harmful effects on soil health and crop yields. Wastewater irrigation may lead to transport of heavy metals into soils and may cause crop contamination affecting soil flora and fauna. Salinity-related impacts of wastewater irrigation on soil resources can be expressed in economic terms by potential yield and income loss, loss of soil productivity, depreciation in market value of land, and cost of soil reclamation measures. The potential impacts depend on the time of irrigation. Long term irrigation with wastewater increases salts, organic matters, and plant nutrients in soil (Munir et al., 2006).

Impacts of wastewater on human health

Use of wastewater without proper treatment is the main cause of adverse health effects. Bacteria, viruses, and parasites are the types of pathogens in wastewater that are hazardous to humans. Fungi can cause skin, eye, and respiratory infections and grow in sewage sludge. Most farmers, consumers, and government agents in developing countries are not fully aware of the potential health impacts of using wastewater for irrigation. While 50% of the farmers using wastewater spends Tk. 50-100 per month against medical purposes, 65% of the farmers using fresh water spends less than Tk. 50 for the same purpose in Bangladesh. Table 3 shows the perceived ideas of the farmers of the impacts of wastewater irrigation on human health in major irrigated areas in Bangladesh.

Table 3: Perceived negative impacts of wastewater irrigation on farmer's health at different locations in Bangladesh (M. A. Mojid et al., 2010)

Locations	Diseases/health problems
Bogra	No disease
Chittagong	Diarrhea, skin blistering, irritation, bad smell
Comilla	No disease, irritation, bad smell
Khulna	No disease, irritation, bad smell
Mymensingh	Skin blistering, irritation, injury to hands and legs, odd smell, mosquito nuisance
Rajshahi	Skin blistering, irritation, injury to hands and legs, bad smell
Sylhet	Skin blistering, irritation, bad smell

Conclusion

Clean water is essential for all living things. To protect the surface water from pollution, the effective treatment and management of wastewater is a must. Without healthy water for drinking, cooking, fishing, and farming, the human race would perish. Before using wastewater, it should be managed properly to get maximum environmental benefits. Wastewater should be released in open places like rivers, canals or ponds after necessary treatments.

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Participatory Water Management: LGED Perspective

Md. Joynal Abedin, Additional Chief Engineer (IWRM), LGED

From time immemorial, water resources have been playing an imperative role in flourishing civilization. All living bodies including human beings have been using water as one of the inevitable natural resources in their day to day life. Day by day the use of water has been diversified beyond the boundary of agriculture towards industries resulting in a substantial contribution to the economic development universally. Like most of the countries of the world, water resources have been performing as a leading medium in the economic development of Bangladesh, although it is an unfortunate fact that it faces frequent natural calamities like flood, drought etc. basically due to its geographic location. As such, interventions especially surface water management has been become an unavoidable reality in Bangladesh perspective.

The management activities have been incepted through Thana Irrigation Project (TIP) since 1960s in Bangladesh. LGED's involvement was as a service provider within a limited scope under the then "Works Program" wing of Thana Training and Development Center (TTDC). LGED's water management activities have been widespread within the framework of the later versions of TIP, namely, Integrated Rural Works Program (IRWP) in 1980s under "Works Program" and Infrastructure Development Program (IDP) in late 1980s under LGEB. After reformation as LGED, it has been implementing Water Resources Development activities as a component of development projects till 1995-96, which in succession uplifted to sectoral program under water sector that started its journey through Small Scale Water Resources Development Sector Projects (SSWRDSP).

Meanwhile, the participatory concept of water management has become in the limelight globally following the second principle of Dublin Statement for participatory water management which states "....water management and development should be based on a participatory approach involving users, planners and policy makers at all levels". On the other hand, the necessity of a fare harmonization among the institutions related to water resources development and management and formulation of a reasonable periphery regarding the jurisdiction and portfolio became foreseeable. Subsequently, Government of Bangladesh has made major reforms in water sector to materialize the water resources (especially development and management) issues with a realistic and optimal purview emphasizing on the institutionalization of participatory concept.

Government has formulated the National Water Policy (NWPo) in 1999 aimed to provide direction to all agencies working with the water sector and institutions that relate to water sector in one form or another to achieve specified objectives. In succession, National Water Management Plan (NWMP) has been introduced in 2004 to implement the NWPo and contribute to national economic development through rational management of water resources in a way that protects the natural environment and improves the standard of livelihood of the people of Bangladesh especially marginal farmers and fishermen communities. From the essence of the practice of the NWMP Government in turn enacted the "Bangladesh Water Act" in 2013 to make it more effective and object oriented for proper protection of water resources within a legal framework.

As per NWPo, "The Local Government will implement Flood Control, Drainage & Irrigation (FCDI) projects having command areas of 1000 hectares or less". LGED, as the technical support agency to all local government institutions, established Integrated Water Management Unit in 2003 with a vision "to perform the inter-related and complementary functions of development, operation & maintenance of small scale water resources infrastructure ensuring community participation including LGIs with special attention to environmental and social issues like gender & development (GAD) and to provide technical and institutional support to strengthen WMCAs including LGIs in association with related service providing agencies of GoB". It has been implementing SSWRD projects since 1995 conforming to Government plans, policies and rules & regulations.

Out of four projects, SSWRDP-I (1995-2002) with a total cost of US$ 58 million and SSWRDP-II (2002-2009) with a total cost of US$ 78 million have meanwhile been completed. Under SSWRDP-I, 280 sub-projects have been implemented providing irrigation facilities to around 164,900 hectares of cultivable land benefitting about 142,500 farms and fishermen families while under SSWRDP-II, 300 sub-projects have been implemented providing irrigation facilities to around 180,000 hectares and benefitting about 280,000 families. SSWRDP-III (2007-2016) is ongoing with a total cost of US$ 65 million and a projected target to implement 200 sub-projects whereas PSSWRSP-IV (2009-2017) is being implemented with a total cost of US$ 65 million and a projected target to implement 250 sub-projects including 150 enhancement packages. Besides, 15 rubber dams have been constructed under one completed project while second project is ongoing with a target to construct another 15 rubber dams financed by the Ministry of Agriculture.

Ranjana-Jharna Sub-Project, Sherpur

One Technical Assistance project under JICA finance is also under implementation with a major objective to formulate a model studying the previous projects addressing the lapses and discrepancies as an intervening attempt to institutionalize the concept of real participatory water management in SSWRD. Basic SSWRD interventions under LGED limit to Flood Management (through resectioning/ reconstruction of embankments, dykes etc.), Drainage improvement (through re-excavation of drainage channels), Water Conservation (through weirs, water retention structures, rubber dams etc.) and Command Area Development (through overhead tank, buried pipe and lined canal system).

At present, four stages are generally followed in a sub-project development cycle starting from preliminary planning to operation & maintenance. Stage one deals with identification and feasibility based on the stakeholder driven process to address specific surface water management needs through Union Development Coordination Committee (UDCC) to IWRM unit. Stage two covers design and institution building that includes District Level Inter Agency Project Evaluation Committee (DLIAPEC) approval, formation of Water Management Cooperative Association (WMCA) registered with Department of Cooperatives (DOC) and finalization of detailed design in beneficiary meeting. Stage three limits within the construction and first year operation & maintenance confirming the participation of WMCA throughout the process. Stage four i.e. the final stage is the sustainable operation & maintenance and the most vital stage after handing over the sub-project through a formal lease agreement with LGED where LGED and other line departments/ government agencies (like DAE, DOC, DOL, DOF and others) provide necessary supports to WMCAs in performing their standard O&M programs (planning, budgeting, micro-credit activities, audit, election, routine maintenance and other related activities).

One Rubber dam under operation

With a view to introduce a social revolution in preserving bio-diversity, developing livestock, increasing fisheries and agricultural products through integrated management of water resources enhance positive change in the lifestyle of poor community and prepare an optimum field to flourish local leadership through developing socio-economic infrastructure of the rural community, to introduce a fair competition among the rural stakeholders and beneficiaries in particular Government has introduced the National Water Award Policy for SSWRM in 2011 to award best performing WMCAs in three categories namely, maintenance of water resources structures; sustainable institutional development and operation including micro-credit; and leadership in proper management of water resources. The positive outcome of this intervention is quite evident. Very recently, Dariapur WMCA (a sub-project implemented under SSWRDP-I) in Chapai Nawabgonj has been achieved Prime Ministers special award for leadership. The arrow of expectation towards the horizon of a total participatory water management from LGED's bow has been released, yet to travel a long way to reach the pinnacle of success.

Impact of climate change on actual crop evapotranspiration of boro rice in Bangladesh

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Climate change is one of the major scientific facts in the present century and it is a reality now. The global average surface air temperature has been increased by 0.60C during the 20th century. The Intergovernmental Panel on Climate Change (IPCC) projects that the global mean temperature may increase by 0.8 to 2.60C and 1.4 to 5.80C by 2050 and 2100, respectively (Houghton et al., 2001; McCarthy et al., 2001). Continuing emissions of greenhouse gases from human activities are likely to result in significant changes in climate. Now, it is one of the most important global environmental challenges facing humanity with implications for food production. Many scientists evaluated that climate change may profoundly affect crop water requirement and to have influence on irrigation water resources in many regions of the world.

Bangladesh is a developing country having a gross area of about 1,47,570 km2 with having a high growth rate of population. Rice is the main crop and staple food of Bangladeshi people. It is also strategically important in the agricultural development and economy of the country. Rice crop covers about 79% of the total cropped area and about 77% of the total irrigated area. Rice irrigated area was 1.23 million hectare in 1979-80 which increased to 5.42 million hectare in 2011-12 and boro rice covers 86% of total rice irrigated area (BBS, 2013). Cultivation of HYV of boro rice is almost dependent on irrigation water resources. In addition, pollution of surface water and groundwater, scarcity of surface water in dry season and groundwater mining are the common phenomenon of Bangladesh. Also population growth, rapid urbanization, increased irrigated land and industrialization are imposing rapidly growing demands and pressure on irrigation water resources. Due to the extensive pressure on irrigation water resources, how much changes of boro rice water demand under changing climate in Bangladesh has become a vital concern in recent days for irrigation engineers, hydrologists, agronomists, ecologists and water policy makers. So, impact of climate changes on rice water demand was investigated during 2006 to date in different Hydrological Regions of Bangladesh.

Daily climatic parameters of Dhaka & Mymensingh of North Central, Sreemangal & Sylhet of North East and Bogra, Rajshahi, Dinajpur & Rangpur of North West Hydrological Regions of Bangladesh for a period of 30 years (1976-2010) were collected from the Bangladesh Meteorological Department. BR3, BR14, BRRIdhan 28 and BRRIdhan 29 are very popular rice varieties and cultivated in these locations in boro season. So BR3 & BR14 for Dhaka & Mymensingh and BRRIdhan 28 & BRRIdhan 29 for Sreemangal, Sylhet, Bogra, Rajshahi, Dinajpur & Rangpur were selected for these locations. Released year, growing period, seed sowing time, seedling age, growing stages of each variety and harvest time data of these rice varieties were collected from Bangladesh Rice Research Institute. Staggered seed sowing i.e. 50% area for first seed sowing for seedling and 50% area for second seed sowing for seedling were considered. FAO Penman Monteith method has been used for determination of reference crop evapotranspiration. Crop coefficients of rice according to the growth stages are 1.05 for initial stage, 1.20 for mid season stage and 0.90 for late season stage. Crop coefficient of initial stage, 1.05 was considered for all rice varieties (Allen et al., 1998). Crop coefficients of mid season, development and late season stages of different varieties of boro rice were adjusted by single crop coefficient approach. Actual crop evapotranspiration (ETc) or boro rice water demand was calculated by multiplying the reference crop evapotranspiration by crop coefficient of different growing stages. The trend of total growing season actual crop evapotranspiration of boro rice was detected and estimated by MAKESENS trend model.

Results revealed that trend of actual crop evapotranspiration of boro rice significantly decreased at the rate of 2.69 (BR3), 3.00 (BR14) mm/season in Dhaka and 3.41(BR3), 2.35 (BR14) mm/season in Mymensingh (Fig. 1). Actual crop evapotranspiration of boro rice decreased by 78.0 & 66.0 mm in Dhaka and 99.0 & 52.0 mm in Mymensingh during 1976 to 2005 & 1983 to 2005, respectively.

In Sreemangal, ETc of BRRI dhan 28 & BRRI dhan 29 decreased at the rate of 2.314 & 2.697 mm/season and increased at the rate of 2.788 & 2.922 mm/season in Sylhet during 1994 to 2010 (Fig. 2). In 17 years, ETc of BRRI dhan 28 & BRRI dhan 29 were decreased by 37 & 43 mm in Sreemangal and increased by 45 & 47 mm in Sylhet.

The trend of ETc of boro rice decreased in Bogra, Dinajpur, Rangpur and increased in Rajshahi. The rate of deceasing of ETc of BRRI dhan 28 & BRRI dhan 29 was 1.117 & 0.464 mm/season for Bogra; 4.013 & 4.224 mm/season for Dinajpur and 2.395 & 2.524 mm/season for Rangpur during 1994 to 2010 (Fig. 3). Decreased ETc of BRRI dhan 28 & BRRI dhan 29 was 17.87 & 7.42 mm in Bogra; 64.20 & 67.58 mm in Dinajpur and 38.32 & 40.38 mm in Rangpur. In Rajshahi, the increasing rate of ETc of BRRI dhan 28 & BRRI dhan 29 was 0.613 & 0.348 mm/season and increased by 9.81 & 5.56 mm, respectively during 1994 to 2010.

This study can provide basic information on changes of actual crop evapotranspiration of boro rice due to climate changes and play useful role in sustainable irrigation water resources management in North Central, North East and North West Hydrological Regions of Bangladesh.

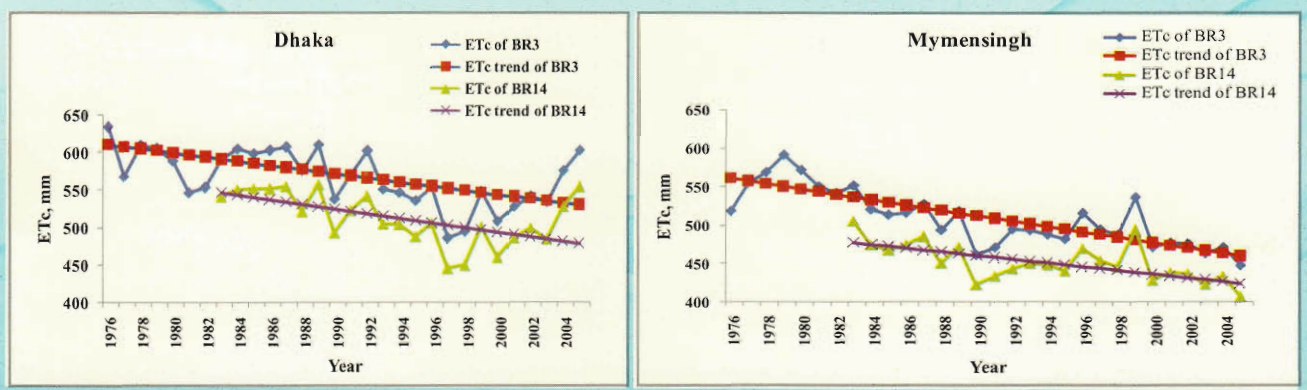

Figure 1: Trend of total growing season actual crop evapotranspiration of BR3 and BR14 in boro season in North Central Hydrological Region of Bangladesh

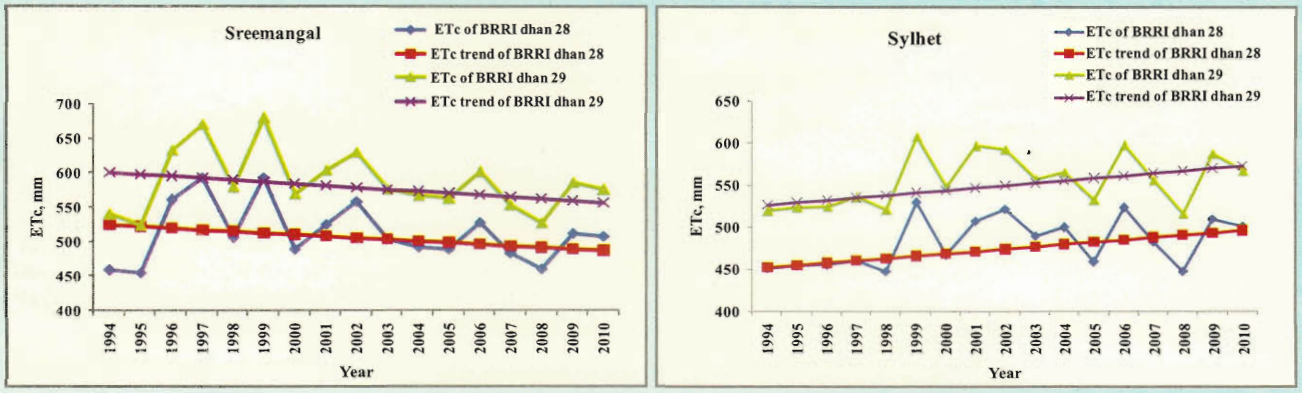

Figure 2: Trend of total growing season actual crop evapotranspiration of BRRI dhan 28 & BRRI dhan 29 in boro season in North East Hydrological Region of Bangladesh

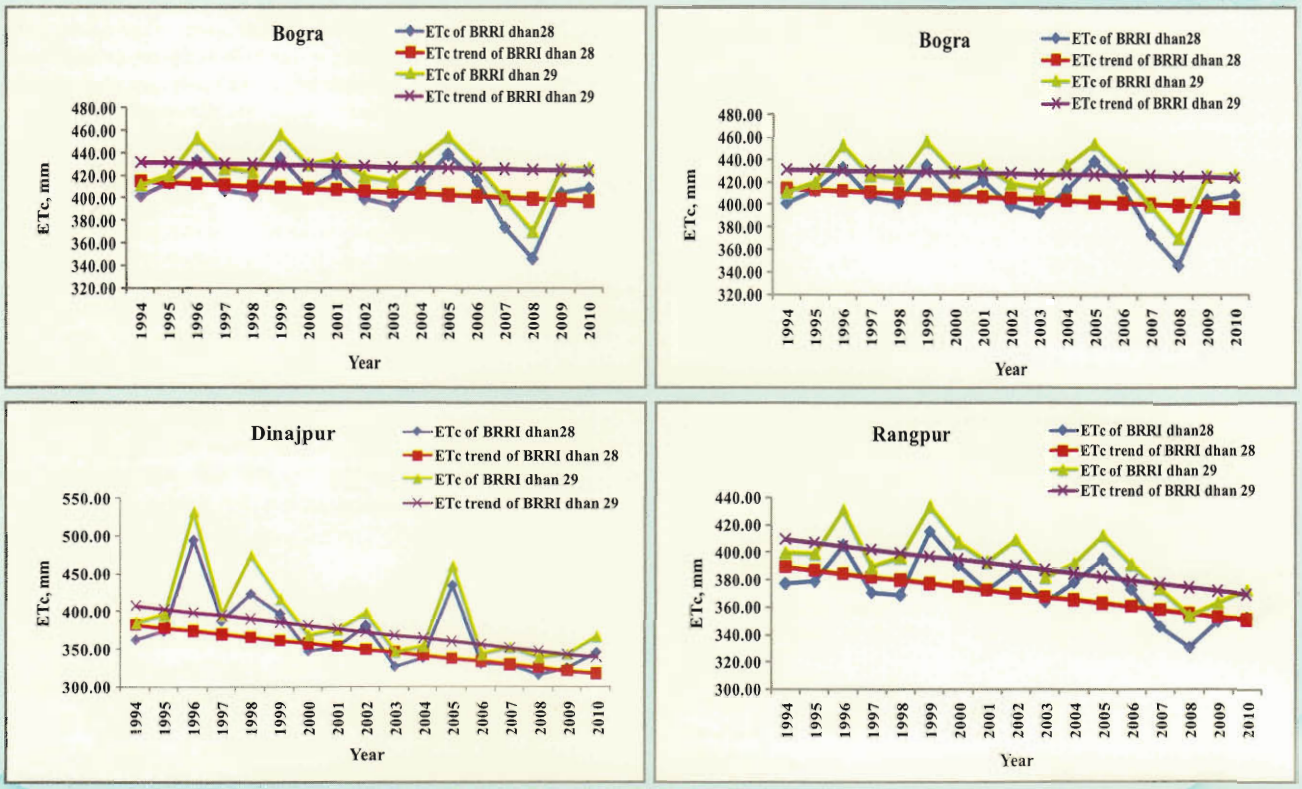

Figure 3: Trend of total growing season actual crop evapotranspiration of BRRI dhan 28 & BRRI dhan 29 in boro season in North West Hydrological Region of Bangladesh

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Role of Youth in Promoting Sustainable Water Management: Initiatives and Actions taken by BWP

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1. Introduction

Young people have a key role to play in Sustainable Water Management. They are the prime mover, main stakeholders, policy makers and a major resource group playing an important role in taking up responsibilities, sensitizing the other stakeholders, mobilize community, acting as a catalyst for bringing about change.

In order to promote youth bulge, Bangladesh Water Partnership (BWP) is taking many initiatives and activities, since its establishment in 1998, through its partners, and Area Water Partnerships (AWP). The activities, for example, are observance of various days like World Water Day, World Environment Day, International Women's Day etc., promoting Safe Water Management & Climate Change Adaptation through Primary & Secondary Schools, capacity building of youth brigade on water, sanitation and hygiene, and providing training for enhancing youth skill in water resources management.

2. Initiatives and Actions taken by BWP

a. Promoting Safe Water Management & Climate Change Adaptation through Secondary Schools in Chitra-Nabaganga Area Water partnership (AWP)

The research study was implemented in April 2014 in association with Chitra-Nabaganga AWP in Narail district. The objective of the research was to build knowledge capacity of youths about climate change and its adaptation and mitigation in water resources and its use.

Students of the best school by essay competition

The project included class room training followed by essay competition and information exchange workshop on "climate change impacts in your area and its possible mitigation" among the youths. The class room training issues included water resources and impacts of climate change, IWRM, drinking and agricultural water management and other aspects.

b. Capacity Building of Youth Brigade in Rural Based Secondary and Primary Schools on Water, Sanitation and Hygiene in South-Western Region

WASH program was undertaken in collaboration with Bangladesh Folklore Research Institute (BFRI) and Gorai Area Water Partnership (GAWP) at four secondary and four primary schools at each of the two Upazilas, namely, Kushtia Sadar and Mirpur. The total number of students trained is 560. It helped create awareness among the students through in-depth training in the selected schools and brought in the desired change at attitude in health and hygiene. The community leaders (Chairman and Members of Union Parisad) who joined the workshop program also conveyed the message to the community. The Youth Brigade in Schools under the guidance of their teachers also changed the attitude of the students and their parents in the family.

c. Observed World Water Day

This is a regular program implemented each year in collaboration with BWP's partner organizations with special emphasis on youths, school children, and community based organizations creating awareness and sensitizing the youth on the impending water scarcity and its sustainable management through mobilizing community.

Ms. Mukta Akter reading out the key messages with Dr. Iftekharuzzaman, ED, TIB (5th from right)

In 2010, the newly formed Padma-Gorai Youth Water Forum observed the World Water Day in a big way. They brought rally in the Kushtia town and Padma–Gorai River Basin with the theme of the year 'Clean Water for a Healthy World' on 22 March. Over 200 students (both boys and girls from schools and universities in Kushtia) joined the rally. They also hold a workshop to make future generation aware on water issues and its importance on health and their role to protect water bodies.

The Bhairab River Area Water Partnership and Initiative for Right View (NGO) also organized a Workshop on 'Ensuring Water Quality: Problems and Potentials' on the theme of the year in Local School Health Clinic in Khulna in 2010. About 100 participants participated from various water related organizations and Khulna University. The workshop emphasized on review of National Water Policy and its implementation, treatment of Mayur River water in Khulna for city water supply, adequate allocation of budget in solving water problems, creating reservoir of safe and sweet water, construction of water treatment plants, increase of surface water as groundwater table is depleting, desalinization of water as water is saline in this coastal city, removal of illegal encroachment from the rivers in Southwest region and solution of trans-boundary water problem to ensure freshwater supply from upstream rivers.

d. Building Knowledge and Promoting Total Sanitation Among Students and Teachers in High and Primary Schools in the Gorai River AWP

The project was implemented in 2013 on Water, Sanitation and Hygiene in 20 schools of Sadar Upazila, Kushtia. There were 200 students and 20 teachers in the program. A training module on awareness building among school children has already been developed keeping view in Integrated Water Resources Management (IWRM) and Sanitation program. A youth forum would also be organized for sharing IWRM and Sanitation knowledge among the stakeholders.

A female student is delivering her speech in the program

e. Workshop on Creating Awareness Among the Youth in the Surma Basin to Operational IWRM

A workshop to raise awareness about Integrated Water Resources Management (IWRM) among the young generation of the society in the Surma Basin Area was organized in the Shahjalal University of Science and Technology, Sylhet in 2011. About 120 participants from different departments were present at the workshop and actively took part in the discussion session.

The Hon'ble Chief Guest, Professor Dr. Md Saleh Uddin, the then hon'ble Vice Chancellor of Shahjalal University of Science and Technology mentioned that proper water recycling process should be addressed by the concerning authority and this awareness raising program is a great initiative to raise awareness among the youth people of the society about the value of water resources and inspiring them to manage this resources properly.

Mr Giasuddin Ahmed Choudhury, the then Executive Director of Center for Environmental and Geographic Information Services (CEGIS), in his keynote paper, urged for ensuring sustainable water resources management integration for sustainable social and economic development.

f. Sanitation for All

Bhairab Area Water Partnership/ Initiative for Right View (IRV) jointly observed the sanitation month elaborately on 21 October 2010 creating awareness with special emphasis on young people on sanitation.

Rally organized by youth participants

3. Role of Youth in Promoting Sustainable Water Management

The roles may be as following:

- Support country in promoting sanitation and hygiene education and awareness-raising through social networking, campaign etc.,
- Mobilize community to a dedicated water goal for sustainable social and economic development,
- Create an internet-based platform to share information,
- Mobilize community to educate on water and sanitation issues,
- Engage youth in decision-making processes related to water management,
- Taking active role in monitoring and managing the community's water resource.

4. Challenges

The challenges are:

- Absence of good practices in water management,
- Lack of youth involvement in water management practices,
- Lack of knowledge on the concept of optimal uses of water resources,
- Lack of strategic & technical skill in water management,
- Lack of proper networking to share ideas and views on sustainable water management,
- Lack of recognition of youth volunteer services in water sector,
- No basic education on water management for curriculum in school,
- School dropouts due to lack of proper sanitation especially for girls.

5. Way Forward

Some way forwards are:

- Strengthen youth involvement in raising awareness on water management including water conservation, pollution prevention, climate change impacts etc.,
- Stimulate youth to build necessary bridge amongst the neighbour countries to cooperate and collaborate in the joint management of the water resources of the trans-boundary rivers like the Indus, Ganges and Brahmaputra,
- Youth should be involved in decision-making and governance,
- Encourage youth for active participants in forming the future water agenda,
- Engaging youth for Integrated Water Resource Management,
- The youth is the most flexible group to be easily able to be adapted to changes. This should be considered as an opportunity for sustainable solutions especially in the area of water management and other connected sectors.