An Investigation of National Water Resources Database, Bangladesh

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The Water Resources Planning Organization (WARPO) is a statutory organization (Water Resources Planning Act, 1992) under the Ministry of Water Resources, which deals with water resources strategic planning and management in Bangladesh. One of the core functions of WARPO is to update and maintain the National Water Resources Database (NWRD). According to National Water Policy (NWPo, 1999) article 5.d.iv., WARPO will set up and update the National Water Resources Database (NWRD) and Information Management System. According to this direction, WARPO has prepared the NWRD while preparing the NWMP in 2001. Now-a-days, the NWRD is used for national and regional level planning, research and study by governmental, non-governmental organizations and others. For national or regional level planning and management, all data should be authentic or reliable and readily accessible. Planners in Bangladesh need access to a wide range of data to assess resources, demands and constraints, evaluate options and formulate alternative strategies. The NWRD is the largest geo-spatial database in the country, which contains more than 450 layers of spatial and temporal datasets. After creation of NWRD, it is being updated with the project activities. Few updated tasks had been done with Integrated Coastal Zone Management Plan (ICZMP) project in 2005. Recently few updated tasks are being continued with Water management Improvement Project (WMIP) project, but it is not enough for proper maintaining of NWRD. This study has shown the details analysis of NWRD, the existing gaps of NWRD and has recommended the common implementation strategy for proper maintaining of NWRD.

Key words: Data base, update, planning, water resources, management

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INTRODUCTION

Water resources assessment requires systematic collection, assembly and reporting of hydrological, physiographic, demographic and socio-economic data. Physical measurements at measurement stations need to be taken with designated frequency and accuracy. The existing network of stations for rainfall, evaporation, discharge, sediment transport and water quality meets the standards of the World Meteorological Organization (WMO) 1974. The government declared the National Water Policy (NWPo) in January 1999. The policy mandated the Water Resources Planning Organization (WARPO) to establish and maintain a National Water Resources Database (NWRD) to meet the demand for data and information of planners, experts, researchers and managers in the water and related sectors by assembling information from various authorized Data Collecting Agencies (DCAs). Generally, quality control is the responsibility of the data collecting agency. Each DCA has its own collection mechanisms with equipment and staff provided from its own budget, often supplemented through project funds. The National Water Resources Database team prepared a draft ‘Guidelines on NWRD Spatial Data Quality’ and ‘Time Series Data Quality Control Guideline’ to promote rigorous quality control by the DCAs. The data contained in NWRD is collected from a wide range of sources and organized into a relational database format, to form the largest geo-spatial database in the country (http://www.warpo.gov.bd/nwrd_brief.html).

The National Water Management Plan (NWMP) was finalized in 2001 and finally approved by the National Water Resources Council (NWRC) in March 2004. The National Water Policy specifies that the Plan should be updated every five years to suit the need and priorities of the Government in line with the Poverty Reduction Strategy Paper (PRSP) and the Millennium Development Goals (MDGs) and to include any outstanding issues not previously covered. Recently the Government of Bangladesh has enacted the Bangladesh Water Act, 2013. In the article 15 of Bangladesh Water Act, 2013, it has shown that the Water Resources Planning Organization (WARPO) has to prepare the National Water Resources Plan (NWRP) through the Executive Committee of National Water Resources Council (ECNWRC). Therefore, for the preparation and implementation of NWRP, the continue collection and updation of water resources data is pre-requisite.

OBJECTIVE OF THIS STUDY

The objective of this study is to analyze the existing database, to identify its laps and gaps. However the specific objectives include:
- Review of existing National Water Resources Database
- Set up questionnaire survey to the National Water Expert
- Establishing the Strength, Weakness, Opportunity, Threat (SWOT) analysis for the existing database
- Implementing the Common Strategy for proper maintaining the database.

OUTCOME OF THIS STUDY

- The gaps in existing database will be identified by this study
- An updated database with incorporating new layers will be established.
- A Common Implementation Strategy will be formed for proper managing of this Database.

METHODOLOGY AND APPROACH

In principle, an analytical framework process has been followed to understand the NWRD. An extensive consultation with questionnaire survey has been done to the national Water Expertise and WARPO professional for getting more appropriate knowledge about the NWRD to strengthen this work. Various documents and reports have been studied for
getting updating information about the database and their recommendation. SWOT (Strength, Weakness, Opportunities, Threat) analysis has been done for better establishing the Common strategy for maintaining the existing Database.

**SCOPE OF WORK**

**BRIEF REVIEW OF NWRD**

**NWRD Data Sets**

As of February 2008, a total of 406 data layers were available within NWRD. Data layers are updating in NWRD and new 50 data layers are incorporating in NWRD by WMIP project (Source: WARPO). While updating in NWRD, few old data layers stay at previous position and new data layers are adding. As a result by incorporating new layers and updating of old layers a total of 478 data layers are available within NWRD at present (http://www.warpo.gov.bd/pdf/nwrd_Data_list.pdf, Access in March, 2014), which categorized into three hierarchical levels – data group, data type and data layer. Most of the data layers consist of spatial data, time series data and attribute data.

The data groups are:

**Base Data:** Cover administrative boundaries at various levels: national, divisional, district, Upazila and Union. The base data also cover other features such as airway, catchment, navigation, planning unit, power sector project, railway regions, river, road, water bodies and topography.

**Surface Water:** Includes water level, discharge, salinity, sediment, river cross section and relevant Master Plan Organization (MPO) data.

**Groundwater:** Covers water levels, water quality, abstraction, aquifer properties, lithology and information from MPO.

**Meteorological:** Covers rainfall, evaporation, humidity, temperature, wind speed & direction, sunshine-hour data, etc.

**Soil and Agriculture:** Includes geo-ecological zones, crop suitability, crop statistics, drought maps, fertilizer use, land type, agricultural land use and soil association.

**Forest:** Includes forest land data.

**Fisheries:** Covers fish catch data.

**Socio-Economic:** Encompasses census, char land, and economic data.

**Environment:** Covers data related to indicative parameters, industry, natural disaster and surface water quality.

**Images:** Various satellite images like LANDSAT, IRS and SPOT satellite images covering different regions or the whole country are stored in CD-ROM and usually used for WARPO’s internal analysis purposes.

**Document and Report:** This new data group contains the digital version of the National Water Management Plan, December 2001.

The details of data in association with meta data are available in http://www.warpo.gov.bd/pdf/Datacatalogue.pdf

**Data Availability**

Most of the data layers in NWRD consist of spatial data, temporal data and attribute data. Data are provided in both hard and soft copy. The database is designed using Oracle in the back-end to store the data, and Arc View GIS software for spatial query and display. Metadata for each data type are also available in the NWRD, which has been archiving its data layers since the National Water Management Plan of 2004.
Hydro-meteorological data are especially vital for water resources development planning and design. Availability of these data from the various agencies is summarized below:

<table>
<thead>
<tr>
<th>Data Type</th>
<th>Data Collecting Agency</th>
<th>Available Data Range</th>
<th>No. of Stations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Level (Non Tidal)</td>
<td>BWDB</td>
<td>1965 – 2009</td>
<td>275</td>
</tr>
<tr>
<td>Water Level (Tidal)</td>
<td>BWDB</td>
<td>1960 – 2009</td>
<td>181</td>
</tr>
<tr>
<td></td>
<td>BIWTA</td>
<td>1977 – 2002</td>
<td>08</td>
</tr>
<tr>
<td>Discharge (Non Tidal)</td>
<td>BWDB</td>
<td>1934 – 2007</td>
<td>120</td>
</tr>
<tr>
<td>Discharge (Tidal)</td>
<td>BWDB</td>
<td>1964 – 2007</td>
<td>09</td>
</tr>
<tr>
<td>Rainfall</td>
<td>BWDB</td>
<td>1961 – 2008</td>
<td>308</td>
</tr>
<tr>
<td></td>
<td>BMD</td>
<td>1960 – 2008</td>
<td>34</td>
</tr>
<tr>
<td></td>
<td>DPHE</td>
<td>1964 – 1997</td>
<td>4461</td>
</tr>
<tr>
<td>Ground Water Level</td>
<td>BWDB</td>
<td>1967 – 2003</td>
<td>1,256</td>
</tr>
<tr>
<td></td>
<td>DPHE</td>
<td>1964 – 1997</td>
<td>4461</td>
</tr>
<tr>
<td></td>
<td>BADC</td>
<td>1984 – 1991</td>
<td>1,453</td>
</tr>
</tbody>
</table>

Source: WARPO, March, 2014

**Data Quality**
Generally, quality control is the responsibility of the data collecting agency but NWRD checks for obvious errors in time series and spatial data. When supplying to data users, both original and corrected data are provided and data history is explained in the metadata.

As noted earlier, the two standard guidelines namely ‘Guidelines on NWRD Spatial Data Quality’ and ‘Time Series Data Quality Control Guideline’ developed by WARPO for quality checking of time series and spatial data. These documents are being finalized by WMIP project.

**Data Accessibility**
Data are available to all relevant users upon request through appropriate governmental authorities. The Director General, WARPO is the approving authority on such requests.

**Data Updating**
For updating the NWRD database, WARPO has to pay a royalty to the data collecting agencies, except in the case of BWDB data. Budgetary limitations have seriously restricted the updating effort, so that updating since the end of the NWMP project has been generally insignificant. However, some work has been done in the Integrated Coastal Resources Database (ICRD) of WARPO, supported under the Integrated Coastal Zone Management Plan project. Progress on updating the NWRD database on development programs has been slow. From the end of the NWMP (2001) until August 2007 WARPO has requested 11 sectoral government agencies to provide their respective development activities in defined formats. Only Bangladesh Water Development Board (BWDB) and Local Government Engineering Department (LGED) responded (Source: WARPO). In 2009, WARPO started updatation process of NWRD by WMIP project. Under this project the existing data layer will be updated and new 50 data layers will be incorporated. This project will be end on June 2014. Upto January 2014, total of 140 data layers have been updated of NWRD and 145 data layers have been updated of ICRD.

**Data Archiving**
All data are stored in a single oracle server. NWRD maintains a system of regularly archiving the data once or twice a month depending on frequency and extent of new data being added.

**MOUs Between WARPO and Other Agencies**
WARPO has signed Memorandum of Understanding (MOUs) with Bangladesh Water Development Board (BWDB), Local Government Engineering Department (LGED), and Joint River Commission (JRC), Physical Infrastructure Division of the Planning Commission, Char Development and Settlement Project of BWDB, and the Center for Environmental and Geographic Information Services (CEGIS). These MOUs mostly concern data sharing arrangements.
### Major Data collecting agencies and their corresponding data

<table>
<thead>
<tr>
<th>Data collecting agencies</th>
<th>Major data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bangladesh Water Development Board (BWDB)</td>
<td>Surface Water Level</td>
</tr>
<tr>
<td></td>
<td>Discharge</td>
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<tr>
<td></td>
<td>Sediment</td>
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<td></td>
<td>Rainfall</td>
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<tr>
<td></td>
<td>Evaporation</td>
</tr>
<tr>
<td></td>
<td>Surface water quality</td>
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<tr>
<td></td>
<td>Ground water level and quality</td>
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<tr>
<td></td>
<td>River Morphology</td>
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<tr>
<td></td>
<td>Lithology</td>
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<tr>
<td></td>
<td>Aquifer testing etc</td>
</tr>
<tr>
<td>Bangladesh Inland Water Transport Authority (BIWTA)</td>
<td>Water level</td>
</tr>
<tr>
<td></td>
<td>Bathymetric data</td>
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<tr>
<td>Bangladesh Agriculture Development Corporation (BADC)</td>
<td>irrigation equipment,</td>
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<tr>
<td></td>
<td>irrigation water quality,</td>
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<tr>
<td></td>
<td>ground water levels,</td>
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<td></td>
<td>irrigation costs, and</td>
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<td></td>
<td>crop production costs etc</td>
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<tr>
<td></td>
<td>Water Quality etc</td>
</tr>
<tr>
<td>Department of Public Health Engineering (DPHE)</td>
<td>Ground water table</td>
</tr>
<tr>
<td></td>
<td>Water quality etc</td>
</tr>
<tr>
<td>Bangladesh Meteorological Department (BMD)</td>
<td>Temperature</td>
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<td></td>
<td>Relative humidity</td>
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<td></td>
<td>Rainfall</td>
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<td></td>
<td>Sunshine</td>
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<td></td>
<td>Soil moisture</td>
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<td></td>
<td>Pan evaporation</td>
</tr>
<tr>
<td>Bangladesh Bureau of Statistics (BBS)</td>
<td>census data</td>
</tr>
<tr>
<td></td>
<td>Agricultural products</td>
</tr>
<tr>
<td>Soil Resources Development Institute (SRDI)</td>
<td>Soil data</td>
</tr>
<tr>
<td>Institute of Water Modeling (IWM)</td>
<td>Water level (Tidal and Non tidal)</td>
</tr>
<tr>
<td></td>
<td>Discharge (Tidal and non tidal)</td>
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<tr>
<td></td>
<td>Velocity profile</td>
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<td>River cross section</td>
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<td>Bathymetric data</td>
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<td>Suspended sediment</td>
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<td>Bed sample</td>
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<td></td>
<td>Ground Water Level</td>
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<td>Evaporation</td>
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<td></td>
<td>Rainfall</td>
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<td></td>
<td>Water Quality</td>
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<tr>
<td></td>
<td>Land Topography</td>
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<tr>
<td>Center for Geographic Information Service (CEGIS)</td>
<td>Water level</td>
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<td></td>
<td>Discharge</td>
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<td></td>
<td>Groundwater level</td>
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<td></td>
<td>Groundwater quality</td>
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<td>River cross section</td>
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<td>Rainfall</td>
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<td></td>
<td>Temperature</td>
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<td></td>
<td>Humidity</td>
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<td></td>
<td>Wind speed</td>
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<tr>
<td></td>
<td>Sunshine hour</td>
</tr>
<tr>
<td></td>
<td>Evaporation</td>
</tr>
</tbody>
</table>
Data Users
A number of data users depend on the NWRD. The most common categories of data users are:

- Government organizations
- Semi-government organizations
- Autonomous bodies
- Projects and programs of governmental, semi-governmental, and autonomous organizations
- Local and international non-government organizations
- Private companies
- International organizations
- Local and foreign educational institutions
- Local and overseas researchers
- Individual users and
- Others

Data Dissemination
One of the important and mandated routine tasks of WARPO is data dissemination. From 1999 to till now, WARPO is disseminating data to National and International organizations, Universities research organizations, projects etc. Data is being used for water resources planning, management, research, study etc. From October 2013 to January 2014, WARPO has disseminated Data to 10 agencies including River Research Institute (RRI), Bangladesh University of Engineering and Technology (BUET), Dhaka University, Bangladesh Agricultural University (BAU), BRAC University etc from NWRD and Integrated Coastal Resources Database (ICRD) and has earned total taka of 543484 by discounting rate in Education and Research sector according to WARPO Data dissemination policy

Under WMIP project, the data layers of NWRD are updating and the 50 layers from the following layers will be incorporated. The layers are:

- Agro Based Industry
- Aman Area
- Aman Area
- Bathymetry of Main River
- Bio Ecological Zone
- Boro Area Cropping Intensity
- Cyclone Shelter Information
- Cyclone Track
- Demand of Food Grain
- Detail Area Plan
- Drinking Water and Sanitation Information 2001
- Drinking Water Quality Standards
- Dhaka Water Supply and Sanitation (DWASA) Zone
- Eco-tourism Information
- Erosion and Accretion (1996-2001) in Coastal Zone
- Erosion Vulnerable Location of Major Rivers
- Fish Sanctuaries
- Flood Prone Areas of Bangladesh
- Gas Transmission Line
- Geological classes
- Groundwater Zoning 2004
- Hilisa Spawning and Shrimp Farming Area
This project will be end on June 2014

**QUESTIONNAIRE SURVEY**

Questionnaire survey has been done to the National Water Expertize and WARPO professional for getting more appropriate information and to strengthen the work. In the questionnaire survey, it was asked that what are the gaps in NWRD and what should be the recommendation for updating of NWRD. Here are the few reflections of questionnaire survey.

**Dr. Sultan Ahmed** (Email: sultan.doe@doe-bd.org), Director (Natural Resource Management) in Department of Environment (DoE), Said that, WARPO should update NWRD by systematic revenue budget.

**Mr. Md. Saiful Hossain** (Email: pso_eng@warpo.gov.bd), PSO, Engineering section of WARPO thinks that for maintenance and updation of NWRD, the data should be free for public access. He mentioned that before enactment of Bangladesh Water Act 2013, there was no legal framework for other organizations to give data in WARPO. Now Bangladesh Water Act-2013 is legal framework for WARPO by which WARPO can collect data from other Organizations according to the article 41 of this Act.

**Mr. Md. Rezaul Karim** (Email: pso_me@warpo.gov.bd), PSO (In charge), Monitoring and Evaluation section of WARPO said that All the relevant data collecting agencies should be aware of about the Bangladesh Water Act 2013, where it is mandated to give the data in WARPO. To perform these activities, WARPO has to arrange seminar with the stakeholders for proper dissemination of Bangladesh Water Act 2013.

**Mr. Md. Saiful Alam** (Email: dir_plan@warpo.gov.bd) director (planning) of WARPO thinks that WARPO has to maintain the quality of Data by checking WARPO professional. He, however, mentioned that WARPO has to collect data from all relevant organizations with Memorandum of Understanding (MoU).

**Dr. Sultan Ahmed** (Email: md-nrm@barc.gov.bd), Member Director (Routine Charge), Bangladesh Agricultural Research Council (BARC), said that NWRD is an excellent database and useful for agricultural information. He mentioned that BARC has an excellent database; therefore NWRD should linkage with BARC database. He also emphasized that, WARPO need more MoU with organizations, especially with BARC. He recommends to incorporate some missing data in NWRD such as Hills area agricultural Information, SAARC Agricultural information, Soil salinity data etc.

**Dr. M.A. Matin** (Email: mamatin@wre.buet.ac.bd), Professor, Department of Water Resources Engineering, BUET, Dhaka-1000, said that there is a lacks of logistic support and management tool of WARPO for maintaining NWRD. He mentioned that NWRD is an excellent tool for managing water resources in an integrated manner, but it is not fully web enabled. He also mentioned that there is no definite data collection and dissemination strategy. He highlighted...
that data should be free for student and researchers. He recommends to incorporate the updated bathymetric data, catchment delineation data in Mouza level, morphological data in NWRD. He, however emphasized the Institutional capacity building and strong data dissemination policy.

**Sardar M. Shah-Newaz** (Email: sms@iwmbd.org), Principal Specialist & Director, Flood Management Division, IWM mentioned that NWRD is the multi-sectoral, large scale water sector database. NWRD should contain updated bathymetric data, transboundary flow condition, Climate Change data. He highlights for the necessities of stakeholder consultation, trained manpower in WARPO.

**Malik Fida A Khan** (Email: mkhan@cegisbd.com), Director, Climate Change Study Division, CEGIS said that NWRD is the Richest Database in Water Sector Bangladesh. He recommends for latest census data, world heritage data, mouza boundary data, and wetland biodiversity data in NWRD. He thinks that extensive stakeholder consultation, trained manpower in WARPO, strong dissemination policy, fully web enabled NWRD are needed for proper functioning of NWRD.

**Mr. M. Salim Bhuiyan** (Email: bhuiyan_salim@yahoo.com), Chief Training of BWDB (Former Superintending Engineer of Processing and Flood Forecasting Circle of BWDB) said that NWRD is the excellent database for hydraulic research and development. He mentioned that, online payment system is required for NWRD. He also said that as BWDB is the prime Data providers in NWRD, therefore extensive consultation is needed with BWDB for collecting and processing of Hydro-meteorological Data in NWRD. He said that some data such as erosion accretion rate in major rivers, wave run up, river bed slope etc, should stay in NWRD. He highlights for the quality control of NWRD.

**DATABASE DEVELOPMENT**

**Recommended by National Water Management Plan Draft Development Strategy (NWMP-DDS)**

The National Water Management Plan project Draft Development Strategy (NWMP-DDS), Volume 09, Annex K: ‘Data Management’ has recommended the following areas for NWRD development.

- WARPO need liaison with other data holding agencies such as BBS etc.
- It is important for WARPO to continuously participate in a forum to discuss with other organizations how they manage their data.
- Apart from the specific needs of the WARPO planners, the NWRD needs to be general resources for planning at regional and sub-regional levels, and particularly for preparation of Local Area Development Plans.
- To maintain quality control, WARPO needs a rigorous examination of existing data collection and analysis procedures, and a re-examination of the way data is collected in the future.
- Management plans need to be drawn up to improve quality control within the data collecting agencies to use the facilities offered by the NWRD to raise standards by cross checking with other data, and to get feedback from users to identify and eliminate errors.
- WARPO should Update NWRD tools for quality checking
- Data collected at public expense must be disseminated freely to all, with the fewest possible restrictions, to ensure that its value is maximized.
- Inter-Agency Cooperation is must. The collection and dissemination of data have to be brought under legislation.
- For sustainability of NWRD, WARPO needs staff, training, equipment and outside support.
- Adequate budget is pre-condition for proper maintaining of NWRD.
Recommended by NWMP
NWMP in Program ID: EE007-“NWRD improved Data Collection and processing facilities” recommended for stake holder consultation for principle of common standard, access protocol and data pricing option. NWMP also recommended for one stop data retrieve and availability of all reports in digital format.

Recommended by Regional Technical Assistant Project (RETA)
RETA project recommended for collection of hydro-meteorological data by outsourcing method, archiving of project database, adopting new technology, avoiding duplication in NWRD, quality control and open exchange the data between organizations.

Recommended by WMIP
Under WMIP project the data layers are updating and 50 new data layers are incorporating in the existing database. Also MIS is being developing under WMIP project.

Recommended by NWPo
According to NWPo, 1999, in article 4.15.a, “The Government will develop a central database and management information system (MIS) consolidating information from various data collection and research agencies on the existing hydrological systems, supply and use of national water resources, water quality, and the eco-system”.

Article 5.d.iv, in NWPo, “WARPO will Set up and update the National Water Resources Database (NWRD) and Information Management System”.

Recommended by Coastal Zone Policy (CZPo), 2005.
Article 5.5.2 of the Coastal Zone Policy (CZPo, 2005) of Bangladesh recommends the establishment of an Integrated Coastal Resources Database (ICRD).

Recommended by Bangladesh Water Act, 2013
According to Article 15 and 15.2.c in Bangladesh Water Act 2013, “WARPO shall, through the Executive Committee of National Water Resources Council, Place for approval before the Council a draft of the National Water Resources Plan (NWRP) prepared in accordance with the Water Resources Planning Act, 1992. In addition to the matters mentioned in the Water Resources Planning Act, 1992, the National Water Resources Plan shall contained the scientifically analyzed of all data and information on water resources”

IDENTIFYING GAPS AND DISCUSSIONS

GAPS IN NWRD

Gaps in Data collection
The equipment, trained manpower and financial resources of the various data collecting agencies are often inadequate to collect process and publish data in a timely manner. BWDB closed some water level stations when gauge readers retired and were not replaced (ADB, RETA, 2009). In addition, many of the non-departmental gauge readers under BWDB are no longer interested to work with the old remuneration package and this has created serious constraints in data collection. Most projects in the water sector have their own form of data collection and information processing, and present their outputs in the form of reports and project databases. There is no formal requirement that the reports or data are forwarded to a central archive. As a result, some valuable research data and findings may be lost or are not available to other users. Technological change in instrumentation is rapid, and new technologies for gathering information more accurately and safely should be adopted as quickly as practicable. Newer technologies usually involve easier field procedures and less effort for collecting data than traditional methods. Remote sensors can collect, store and or transmit data without human error with proper setup and calibration. Well-calibrated hydrodynamic models allow interpolation of water levels and flows within a sparse observation network.
NWMP documents overlap in data collection activities. BWDB and BMD collect meteorological data, BWDB and BIWTA as well as IWM and CEGIS collect water level and morphological data. BWDB, DPHE and BARC all have responsibilities for groundwater data. This situation remains little changed over the past decade since this was documented. This has resulted in duplication of some of the work, gaps between data collected and user needs, inconsistent data formats, and needless expenditures.

Due to lack of stronger institutional shape and MoU with other agencies as well as lack of revenue budget, the collection of data process hindrance in WARPO.

**Drawback in Quality Check**

At present, there is no standard in place for checking and maintaining the quality of water resources data at a national level. The problem of data quality control is widespread and profound, permeating even the most basic data and affecting the entire data collection process (ADB, RETA, 2009). When agencies are assigned the responsibility to collect data, this responsibility should include data collection in accordance with recognized standards. Due to lack of proper funding, trained manpower the Data collecting agencies fail to maintain the quality of data. To improve the data quality, the NWRD team prepared a draft ‘Guidelines on NWRD Spatial Data Quality’ and ‘Time Series Data Quality Control Guideline’ during NWMP project. But this document has not finalized yet. According to the National Water Policy, WARPO is responsible for updating the NWMP every five years. In preparing the 2001 NWMP, data was checked for completeness and consistency for the period 1966-1995. About 15 more years of data have been collected and needs checking.

**Drawbacks in Data Storage and Archiving**

The current situation is that large quantities of data are spread over many different organizations. A common theme throughout these organizations is the absence of sound backup and archiving policies for the electronic data that they retain and the corresponding failure to adapt their backup and archiving systems to new infrastructure that is introduced as the computer technologies evolve. In part this problem also results from insufficient financing.

**Problems in Dissemination**

According to the Water Resources Planning Act 1992, WARPO is responsible for collecting, analyzing and disseminating water resources related information. According to The National Water Policy, 1999 (NWPo), WARPO has the mandate to create, maintain and update the NWRD. According to data dissemination policy of WARPO, for research student the discounting rate is 80%. It means that only 20% cost of the data is taken from research Student. For research Organization, this cost is 50% of the total cost. Data is fully free for data providing agencies. And for others, the data is provided with full cost (Source: WARPO). But the dissemination is not web enabled. Director General (DG) of WARPO is the ultimate authority for disseminating the data. Dissemination procedure takes lot of time for getting data from WARPO. WARPO Board of Directors (BoD) approved the Data Dissemination Policy of WARPO in the 13th meeting held in September 29, 2013 where BOD recommended for extensive consultation of Data Dissemination Policy among the stakeholders. BoD also recommended for separate pricing policy for consultancy field. It is notable that, The Government of Bangladesh hasn’t approved the dissemination policy still now. Regarding the dissemination policy, the stakeholder consultation is not satisfactory at all.

**In sufficient Staffing**

At present, the IT section of WARPO is responsible for maintaining the NWRD database. One Principle Scientific Officer (PSO), one Senior Scientific Officer (SSO) and one Scientific Officer (SO) exist in this section. In fact, the staffing is quite inadequate for maintain the database.
Absence of Revenue budget
Budgetary allocations for data procurement are irregular and generally inadequate in WARPO. After creation of NWRD, the database is updating by project basis. Few updated task were done during ICZM project in 2003 to 2005. From 2009, the updated task is continued by WMIP project.

Lack of Permanent office building
WARPO has no permanent Office building. The availability of permanent purpose built premises would facilitate the work of WARPO on a number of fronts but particularly in relation to managing the database system. The matter of hope that, the permanent office building is being built on 72 green road during the budgetary year 2013-2014. The present rented building may be shift in new places in December 2015.

Gaps in Monitoring and Information system
Apart from BWDB and LGED, most agencies involved in implementing the National Water Management Plan do not readily share their data with WARPO. Implementation status of the NWMP is an important aspect of updating this Plan. Monitoring and Implementation status of NWMP is not satisfactory by WARPO.

Drawbacks in MOUs Between WARPO and Other Agencies
WARPO has signed Memoranda of Understanding (MOUs) with Bangladesh Water Development Board (BWDB), Local Government Engineering Department (LGED), Joint River Commission (JRC), Physical Infrastructure Division of the Planning Commission, Char Development and Settlement Project of BWDB, and the Center for Environmental and Geographic Information Services (CEGIS). These MOUs mostly concern data sharing arrangements. While the MOUs do provide the basis for intent of action, they are weak in terms of providing any measure of authority to WARPO if the counterpart agency fails to take the actions that were agreed to.

Lack of Stakeholder consultation
Although Draft Development Strategy Annex –K in NWMP, RETA project, NWMP suggested WARPO to arrange enormous consultation with stakeholder related to data management issue, but unfortunately this task had been done quite few.

Absence of new layers in NWRD
Although by WMIP project the few data layers are incorporating in NWRD, but still the following data layers are not available in NWRD and these data layers are demanded by the users from the establishing of NWRD in 1998-2001. These data layers have been collected by questionnaire survey, user demand and literature review. The listed data layers are as follows:

- Flood Extent data for different year with different depth
- Standing Water bodies
- Soil Moisture content in whole Bangladesh
- Surface Water salinity in Coastal region in Bangladesh
- Surface Water Temperature of Coastal region in Bangladesh
- Surface water Abstraction
- Thana-wise Irrigation Water Requirement
- Water use by Thana and by sector
- Relative Sea level rise in Bangladesh
- National Piezometric Centre
- Climate change and damage related data
- World Heritage site
- Mangrove forest species
- Aquatic Species
- Biodiversity in Sundarbans
• Marine pollution prevention
• Coral ecosystem and coastal polder
• Information of Shipping industries
• Information of ship breaking industries
• Fish, Shrimp, Dry fish processing Industries
• Earthquake damage information
• Major tourist spot
• Bio gas information
• Wetland information
• River Discharge to Bay of Bengal
• Information of shallow and Deep aquifer
• Damage due to different natural disaster
• Source of drinking water
• Information of Natural Ecological park
• Information of SAARK agricultural Centre
• Catchment delineation in Mouza level
• Rice variety Vs, Yield
• Polder information
• Heavy metal concentration in river water
• Information on endangered species
• Administrative unit of forest department
• Coastal Forest land
• Water Quality parameter
• Contour Map
• Coastal Geomorphology

Inaccessibility of few data layers
Some data layers in NWRD such as Forest land (District 64), Forest location (LGED), Forest Location 1984, Forest range of Sundarbans 1998, Wildlife sanctuaries and Natural park, Regional Arsenic survey 1998, Regional Arsenic survey 1998 with locations etc. are inaccessible. Therefore the demand of data users is not fulfilled.

Unavailability of updated data
Although the data layers are updating by WMIP project, but still now (March, 2014) the most of the hydro-meteorological data are beyond 2009. WMIP project will be end on June, 2014. Within this little time, it is very difficult to update all the data layers specially the Hydro-meteorological data.

Additional data layers
At present there are 478 data layers are available in NWRD (http://www.warpo.gov.bd/pdf/nwrd_Data_list.pdf, access in March 2004). It is a question that, should it be contain all the 478 data layers or more in NWRD. We think that few base data such as rail stations, freight commodities, rail network etc. and few Socio- Economic data such as parameters of disease and Health 1995, 1996, 1997 etc. need not stay in NWRD. To main huge layers of NWRD is a time consuming and at the same time is a matter of cost. It is not credit of NWRD to contain all the near related of Water Resources data, but it is important to maintain NWRD with updated data. Extensive stakeholder consultation is required for finalizing the data layers of NWRD.
SWOT Analysis

Strength point of NWRD
- NWRD is the largest geo-spatial database in the country.
- Centralized database
- Contains more than 450 layers of spatial and temporal datasets.
- The growing acceptance of GIS technology in different organizations has led to the availability of a substantial amount of spatial data on various themes produced in different GIS platforms.
- NWRD is one of the tools for Integrated Water Resources Management.

Weak point of NWRD
- Shortage in manpower
- Lack of updated Technology
- Budgetary constraint for maintaining NWRD
- Less care has given comparatively other sector.
- In sufficient legal framework
- Fewer co-operations from data collecting agencies.

Opportunity of NWRD
- Useful tool for Collaborative research and Development Project
- Extensive use for student and researchers
- Series of B.Sc. M.Sc. & PhD thesis are possible by using NWRD.
- Useful for Publication and Seminar.

Threat for NWRD
- If the Dissemination system is not easier for NWRD and if updated data are not available in NWRD, the users will fell no more interest for using NWRD.
- Due to lack of budget, technology, manpower in WARPO, the other Organizations such as CEGIS, IWM etc. may create database for utilizing their own resources.

Recommendations

Water Resources Management Plan for Bangladesh is urgently required to meet the great challenges of resolving diverse problems and issue in water sector. NWRD is an effective tool for managing the water related problems of Bangladesh. Hence all the data in NWRD should be authentic or reliable, compatible and readily accessible. After detail analysis it has shown that lot of drawback are existing in NWRD. WARPO has to take initiative for resolving these drawbacks. Major recommendation for updating NWRD can be summarized below:

Allocation of Revenue budget
First of all, WARPO has to maintain the revenue budget in every year for maintaining and updating of NWRD. Cost of data collection, field visit, technology for update the data will be meet up by revenue budget as well as project cost.

Incorporate new technology and fill up the vacant post
Updated Technology has to be incorporated for suitable management of WARPO. At the same time the vacant post has to fill up immediately. It is true that, the existing set up in IT section of WARPO is not enough for maintaining NWRD. Therefore, manpower can be managed by outsourced.

Extensive Stakeholder Consultation
WARPO, in accordance with direction of Bangladesh Water Act- 2013, NWPo- 1999, Water Resources Planning Act-1992, NWMP-DDS-2001, has to arrange extensive consultation among the stakeholder for data management issue. However, the Data dissemination policy has to be brought Under Act.
Web enabled NWRD and linkage with other database
NWRD has to be brought fully web enabled, so that the user can purchase their data electronically. It is a debatable issue that, the data should be free for public use or not. We recommend that the data should free based on purpose and departmental principle. Actually, the Government of Bangladesh has to set up role for using the data. NWRC have to take role in this regard. NWRD should have linkage with Megna Estuary Study (MES), Coastal Embankment and rehabilitation Program (CERP) database; so that it can be more web enabled. NWRD can be auto updated by linkage with Primary Data Collecting Agencies

Quality Control
Quality of data has to maintain strictly. All the Data Collecting agencies have to follow the Quality control guideline (‘Guidelines on NWRD Spatial Data Quality’ and ‘Time Series Data Quality Control Guideline’) designed by WARPO. WARPO has to take initiative for the extensive publication for these quality control guideline.

Strengthening of Monitoring and Evaluation
Monitoring and Evaluation of Database has to maintain regularly by WARPO.

Functioning of Memorandum of Understanding (MoU) and More MoU with other Organizations
Existing MoUs have to be finalized and More MoU is needed with other organizations. In fact, the MoUs have to be brought under legal framework.

Incorporating new layers and updated data
New data layers that have been discussed in previous chapter have to be incorporated as a routine work. Also WARPO has to take care about the updated data. As mentioned earlier, for doing this, revenue budget is must along with project budget.

Permanent Office Building for WARPO
From the creation of WARPO there is no permanent office building of it. IT has shifted more than six times in different places. Many data have been lost for these activities. Permanent office building is very much necessary for proper archiving and storage of data.

More advance study and systematic analysis
This study has been done based on analytical framework and questionnaire survey. For more advance study, extensive consultation with primary data collecting agencies is needed. Comparative analysis can be done with other database system with neighboring country such as in India and China etc. Also this data base can be compared with ISO standard. Extensive analysis is needed by using NWRD tools from WARPO. In depth analysis of existing data with meta data for all data layers are needed as well.

CONCLUSION
NWRD is a planning tool and management instrument for effective implementation of IWRM in Bangladesh. Therefore data should be updated and authentic in NWRD. It is the largest geospatial database in the country. After creation of NWRD, this database is playing vital role for water resources planning, development and management in Bangladesh. Not only in water sector, but also in other sector such as in agriculture, fisheries, environment, this database is contributing a lot. Still there is a lot gaps in this database. For proper functioning of NWRD, these drawbacks have to be removed. As WARPO is the ownership of NWRD, therefore he has to take decision for its maintenance and update. Government (such as NWRC) has to take vital role in this regard. Although the gaps in NWRD, by containing more than 450 layers, it is the central database in Water Sector Bangladesh and a asset not only for WARPO but also in other sector who deals in Water Resources project in Bangladesh.
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