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Institute of Water Modelling (IWM) is a Trust established by the Government of Bangladesh in December 1986 to function as a Center of Excellence and Learning in the field of Computational Hydraulics, Water Modelling and Allied Sciences. IWM owes its genesis to UNDP-DANIDA aided Surface Water Simulation Modelling Programme (SWSM) carried out during 1986-1996.

IWM since then has developed numerical models of rivers, estuaries and Bays covering entire Bangladesh and applied in national important projects.

IWM offers a wide range of specialist state-of-the-art services in enhancing the quality of water resources planning and management as well as Hydrometric measurements, hydrographic and topographic surveys and monitoring.

**Areas of Services**
- Integrated Water Resources Management
- Climate Change Modelling
- Wetland and Lakes Management
- Irrigation Management
- Ground Water Management
- Urban Water Management
- Water Quality & Ecology
- Fluvial Hydraulics and River Morphology
- River Engineering
- Flood Management
- Integrated Coastal Zone Management
- Coastal Hydraulics and Morphology
- Port and Coastal Structure Management
- Estuary and Marine System management
- Offshore Structure and Pipelines
- Water Quality Investigation
- Software management and IT Solutions
- Hydro-Geological Investigations
- Topographic & hydrographic survey, sediment transport, water quality and hydrological, meteorological field measurements, necessary laboratory analysis and data management and mapping;
- Any other field of area which may be conveniently and beneficially done through the facilities of IWM.

All our services are supported by HRD Programme and ICT based DSS

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**Organogram of IWM**

![Organogram of IWM](image-url)
It is a great pleasure to convey my best wishes to Institute of Water Modelling (IWM) on publication of its Annual Report 2011. I am very pleased to observe that IWM has been continuing to proceed to be a reference centre in Asia in the field of water management and modelling. One of the remarkable achievements of IWM in 2011 was opening of the IWM branch office in Malaysia. IWM has successfully passed another year of achieving greater height with more skilled human resources and better organizational strength.

The Institute is dealing with the complex technology of mathematical modelling, computational hydraulics and allied sciences, and addressing numerous water-related problems of the country and abroad. The area of IWM service has now further widened in the field of applied research. I am happy to learn that in the year 2011 IWM continued its on-going research projects and ventured new opportunities with foreign Institutes and Universities.

The success behind IWM is its strength of the human resources of highly motivated and skilled professionals working dedicadely for achieving result-oriented solutions to complex hydrological, hydraulic and morphological problems of the river systems of the country. I am happy to know that IWM revised and updated its organogram to cope with the necessity of present days as the Institute has expanded significantly in terms of human resources and annual turnovers.

IWM’s linkage with other educational and research institutions in the country and abroad is continuing and opening up new frontier of collaboration. These famed institutions include BUET (Bangladesh), DHI (Denmark), Wageningen University (Netherlands), Tennessee Technological University, (USA ), AIT (Thailand), HR Wallingford (UK) and UNESCO-IHE, (Netherlands). IWM held its annual User’s Conference in 2011 after a few years break, wherein the Institute received feedback from its users at home and abroad on ways to improve its capacities. It is encouraging to note that IWM has been continuously pursuing for better HRD to improve its staff resources to maintain its edge in the competitive market.

It is heartening to note that IWM has been allocated a piece of land of 20 katha in Uttara 3rd Phase where IWM will construct its own office complex. I eagerly look forward to the day IWM would start its activities there.

Finally, I would like to thank the members of the Board of Trustees of IWM for their wholehearted contribution and continuous support over the years for the development of the Institute as a successful entity to address the challenging needs of the country. I also extend my best wishes to the staff of IWM for their untiring efforts in strengthening the Institute and in enhancing the image of the country. I wish IWM a prosperous and bright future.

Shaikh Altaf Ali
Senior Secretary
Ministry of Water Resources
&
Chairperson
IWM Board of Trustees
From the Desk of the Executive Director

It is a great feeling to reflect the achievements and the performance of IWM during the year 2011. IWM passed another year of success in 2011 with more credibility from its valued clients and service users. Climate Change and Water Supply in the urban area of the country and Flood Forecasting and coastal safety at home and abroad were our prime areas of continued market expansion. International consultants and development partners as well as local users continued to entrust IWM for mathematical modelling services.

We also gave more emphasis on new areas of knowledge through research and studies. IWM coordinated Delta Alliance Bangladesh wing and the launching of Bangladesh wing was a big achievement of the Institute in the year 2011. We are also grateful to our valued service users for their generous feedback on IWM services in the Users Conference 2011.

A short account of the activities by various Divisions of IWM is given below.

Coast, Port and Estuary Management (CPE) Division was involved in a number of national and international projects on risk assessment of storm surge, salinity and floods in the changing climate for community risk assessment and devising adaptation measures.

Water Resource Planning (WRP) Division carried out modelling for the feasibility study and design of prestigious projects on Ganges Barrage, Scheme Information Management System (SIMS), Master planning of water supply, drainage, sanitation and solid waste management in 148 Pourashava Projects for DPHE, Rehabilitation of water distribution network of Dhaka city for improved water supply, etc.

Flood Management (FMG) Division contributed to various projects of national and international importance on Flood Risk Management in Tajikistan, FCDI projects in Gazner Beel, Tarail-Panchuria, Gopalganj, Sureswar FCDI and Upgrading of Flood Forecasting and Warning System under CDMP-II, Bangladesh. This division is involved in projects in Nepal and India.

Irrigation Management (IRM) Division carried out the ongoing projects namely (i) Joint Action Research on Salt water Intrusion in groundwater in the coastal area, (ii) Barind Integrated Area Development Project for Rajshahi”, BMDA Phase-III, HYSAWA, etc.

Some important projects of River Engineering (REN) Division are Mathematical Modelling Study of the Meghna River in connection with Preparation of Ashuganj Power Station Master Plan, Future Planning Study for the Re-excavated Chandana-Barasia River System and, Pilot Capital Dredging of the Jamuna River and also a number of projects of national importance.

Survey and Data (SDT) Division carried out both topographic and bathymetric surveys for the ongoing mathematical modelling projects of various divisions.

HRD unit organized a good number of training and technology transfer programmes for its clients and for the capacity development of IWM staff. Other disciplines/units e.g. ICT, Business Development, Accounts & Finance provided necessary support to the smooth operation of IWM for keeping the standard of service of IWM.

As in the past, IWM continued its training program with NAHRIM of Malaysia on the hydraulic modelling of coastal infrastructure. IWM also provided training in Phillipines, Nepal and Tajikistan during the year 2011. In the country, IWM provided support to national agencies as a part of technology transfer to BWDB, DPHE, BMDA and DWASA. A milestone achievement of IWM in the year 2011 was setting up of IWM branch office in Malaysia.

I would like to express my gratitude to all the valued clients, associates and partners for their continued support. I like to express sincere thanks and gratitude to the respected Chairperson and members of the Board of Trustees of IWM for their support and guidance. I also thank and congratulate all IWM staffs who have taken the challenge of keeping IWM commitments towards maintaining high standards and bringing innovative means in facing the challenges of various uncertainties in the water sectors of Bangladesh and abroad.

Prof. Dr. M. Monowar Hossain
Executive Director
Coast, Port and Estuary Management

Coast, Port and Estuary Management (CPE) Division provides its services for risk assessment and disaster management, climate change, Sea Level Rise and adaptation measures, planning & design of coastal infrastructure, planning and design of navigation channel, jetties and harbour. Integrated coastal zone management, salinity intrusion and zoning map, tidal river and drainage management of coastal area, land reclamation, coastal morphology, erosion management, dredging and sediment management for navigability improvement of river and estuary are also under its arena of activities. Planning and Design of coastal polders/embankment, Tidal River management, island and char development involving participation of local communities, temperature plume dispersion for selection of intake and outfall of power plants are also included in its major disciplines.

During 2011, CPE was involved in a number of national and international projects on risk assessment of storm surge, salinity and floods in the changing climate for community risk assessment and devising adaptation measures. The feasibility studies for planning and design of drainage and sediment management measures of Chitra and Atharobanki rivers and Polders 34 and 36 have been carried out involving multi-disciplinary team and local communities. Professionals of this division are working in a 3-year project namely Ganges Basin Development Challenge, which is an international, multi-institutional research initiative for improving water management and food production in the fresh-brackish water coastal zones of the Ganges delta.

CPE division uses state-of-the-art mathematical modelling tools for finding the solutions of coastal zone management issues at present and future, viz; MIKE21 Classic, MIKE21 FM and Delft3D for tidal hydraulics, wind and wave generated current and storm surges, cohesive and non-cohesive sediment transport, dredging and back filling rate, erosion and deposition pattern and morphological changes in the coast, estuary and tidal rivers, MIK21AD, MIKE11AD for salinity intrusion in the estuary and tidal rivers, temperature dispersion for inlet and outlet location of power plant and water quality in the coast and estuary, MIKE21 SW is used for wave climate and wave statistics for design of polder embankments and navigation channels, shore line protection measures. CPE has earned a good reputation in the national and international institutions namely, Tanahasia Consultants, NAHRIM, Zaaba consultant and DID Malaysia, GMAPS Singapore, IWMI, IRRI, World Bank, ADB, DFID, CDSP, BWDB, DMB, DOE, BIWTA, Mongla Port Authority, Chittagong Port Authority and local NGOs.

Climate change and sea level rise poses new threat to the water management of coastal zone, coastal communities and existing coastal infrastructure. Occurrence of cyclone and cyclonic storm surge would be more frequent and intensive. The challenge of decision makers also includes assessment of potential impacts of climate change and sea level rise and devising adaptation measures in a macro and micro scale for ensuring social and economic development of coastal zone. CPE is planning to expand its services in forecasting cyclonic storm surge inundation at local level for disaster management, assessment of impacts of external drivers of change on water resources like population growth, sea level rise on coastal resources, salinity intrusion, devising of potential adaptation measures.

In 2011, CPE organized a number of workshops on drainage and sediment management, risk zoning for storm surge, salinity and coastal flooding and restoration of fish habitat. The division also supported Master’s thesis of students of Dhaka and Chittagong Universities and BUET.
Water Modelling for Assessment of Hydrological and Morphological Characteristics for Restoration of the Natural Breeding Habitats of the Halda River

Halda is the third main river of Chittagong district after the Karnaphuli and the Sangu. It is believed to be the richest natural spawning ground of Indian major carps, including Catla fish (Catla catla), Ruhit fish (Labeo rohita), Mrigal fish (Cirrhinus marigala) and Kalbaoush (Labeo calbasu) in Bangladesh. Over the years this natural spawning ground has deteriorated and reduced mainly due to human interventions. Oxbow-bends in the Halda river are the suitable ground for spawning of major carps but all the major oxbow-bends were canalized to protect public property. As a result, fertilized eggs decrease by each day. Statistics shows that in 1946 over 2470 kg fertilized fries were collected (Khan and Azadi, 2006) whereas in 2011 only 150 kg was collected. In view of the above Department of Fisheries has planned to restore the natural spawning ground of fish in the Halda river and engaged IWM to carry out the hydrological and morphological model study for the restoration of the natural breeding habitats of the Halda river. IWM carried out a detailed field survey and developed dedicated hydrological, hydrodynamic, salinity and morphological model to present the existing condition and assess the impacts of proposed interventions for restoration of the spawning ground.

To restore the spawning ground, three different potential options were selected based on the available data, model results and discussions with the officials of Department of Fisheries and local stakeholders. Considering all relevant issues of importance, Option-3 is selected as the best suited option. However, fisheries experts are against the dredging option from Peshkarhat to Nazirhat at the upstream stretch of the Halda river as it may have negative impacts on the spawning ground. In view of the above, it is recommended to implement all the following suggested measures to restore the spawning ground of Halda river.

1. Restoration of Garduara Loop and management of existing loops
2. Dredging of eleven potential khals and construction of embankments on both the banks
3. Dredging of Shikalbaha and Chandkhali river for a stretch of 10 km from Anwara khal outfall to 2km downstream of Murali point, under Patia thana.
4. Design and implementation of fish friendly structure adjacent to every existing regulators at the outfall of the natural khal.
5. Establishment of monitoring stations in the Halda river to observe hydrological conditions and water quality parameters.
G4: Assessment of the Impact of Anticipated External Drivers of Change on Water Resources of the Coastal Zone

The CGIAR Challenge Program on Water and Food (CPWF) has taken up research projects in six river basins across the world including the Ganges Basin. CPWF initiated 5 projects (G1 to G5) under the Ganges Basin Development Challenge to reduce poverty and improve food security through improved water governance and management, and more productive and diversified agricultural-aquaculture systems for more resilient communities in the fresh-brackish water coastal zones of the Ganges delta. IWM has been entrusted by CPWF on 25 May 2011 to lead the project "G4: Assessment of the impact of anticipated external drivers of change on water resources of the coastal zone".

The project G4 aims at assessing the impacts of external drivers of change on performance of alternative strategies for water governance and water & crop management in different kinds of polders in the coastal zone of the Ganges basin. The objectives of the project are:

- Identify the key external drivers that influence water resources of the coastal zone of Ganges delta;
- To assess the effect of key external drivers on:
  - River water flow
  - Salinity
  - Water availability
  - Flooding and Drainage congestion
  - Storage capacity of khals
  - Storm surge
- Upscale and out-scale the research results

The water resources in the coastal zone of the Ganges basin are vital for crop production and livelihoods. These resources are largely shaped by tidal dynamics and upstream flows and are affected by changes in the natural, socio-economic and institutional systems. Several field visits have been made for stakeholder consultation and focus group discussions (FGD). FGDs and interviews indicate that drainage congestion, polder overtopping and breaching, availability of fresh water during dry periods, salinity intrusion, absence of an effective institutional arrangement for water management, conflict between ‘gher’ owners and farmers, pricing and distribution of fertilizers and depletion of natural fish are the major problems. Population growth, drainage canal encroachment, khal-leasing, reduction in freshwater flow due to upstream interventions, sedimentation of river beds, destruction of natural fish habitats have caused these problems.

This project has developed a comprehensive list of external drivers based on past researches, literature review, interaction with major stakeholders and peers. This list has been put under a priority and ranking criteria for identification of the key drivers contributing to the anticipated changes. The preliminary results show that population growth, climate change, water management practice, water sharing between riparian countries and water infrastructure development are the most significant external drivers. The effect of these external drivers on water resources will be assessed using the modelling technology.
The Storm Surge Levels at the Potential Locations of School-cum-cyclone Shelter in the Coastal Region

Islamic Development Bank (IDB) commissioned Institute of Water Modelling (IWM) to carry out the study titled “Storm Surge Modelling Study for Construction of Cyclone Shelters in the Coastal Region of Bangladesh under FAEL KHAIR PROGRAM, IDB” in August 2010. During the course of the study IWM delivered all cyclone-induced storm surge height data for baseline and climate change conditions at the potential locations of school-cum-cyclone shelter specified by the FAEL KHAIR PROGRAM office.

In this study cyclone-induced storm surge levels at four zones (demarcated by IDB) of the coastal region are being assessed based on the simulation results of historical severe cyclones that occurred during the period 1960 - 2009. In total 19 severe cyclones hit the coast of Bangladesh at different tidal conditions. In order to carryout statistical analysis the number of cyclones has been increased considering the time of landfall in opposite tidal conditions. Three additional tracks of cyclone have been generated in the gaps of cyclone tracks in order to increase the coverage of inundation. The meteorological parameters of cyclone Aila and cyclone Sidr have been considered for these three additional cyclone tracks. In total 44 cyclones have been simulated to develop baseline conditions for the whole coastal region, where 19 are for real cyclone, 19 for opposite tidal condition and 6 for three additional tracks. In this study climate change scenario for 2050 has been developed through consultation with the main consultant and the officials of IDB. For simulation of climate change scenarios sea level rise of 0.5 m and 10% increase in maximum wind speed of the cyclones have been considered.

For simulating the storm surge and associated flooding, Bay of Bengal model based on MIKE21 modelling system has been applied. Storm surge model comprises Cyclone model and Hydrodynamic model. In the hydrodynamic model simulations, meteorological forces in a cyclone is given by wind and pressure field derived from the analytical cyclone model. The MIKE 21 modelling system includes dynamical simulation of flooding and drying processes, which is very important for a realistic simulation of flooding in the coastal area for inundation.

Maximum storm surge level data at the potential locations of school-cum-cyclone shelter for each cyclone event have been extracted from the model results and used for statistical analysis. The statistical analyses has been done using "HYMOS" software considering the storm surge levels at the potential locations of school-cum-cyclone shelter during the period from 1960 to 2009 (50 years) and these were fitted to an exponential frequency distribution in order to get the storm surge level data for different return periods. Land levels at the potential locations of school-cum-cyclone shelter have been extracted from the existing Digital Elevation Model (DEM) available with IWM. These land level data were deducted from the corresponding storm surge levels in order to get the storm surge height at the potential locations of school-cum-cyclone shelter.
Mathematical Modelling Study for Integrated Water Resources Management Project of Polder 34/2 in Bagerhat District

Polder 34/2 is located in the southwest coastal region of Bangladesh under the administrative jurisdiction of Bagerhat and Khulna districts. River siltation, drainage congestion, salinity intrusion and degradation in agricultural production are the major problems of the study area. Sedimentation of the rivers in and around the polder is the main cause for the drainage congestion. Most of the rivers/khals are silted up and have significantly lost their conveyance capacity. The Old Pussur river, the major drainage artery of the study area, has become a seasonal river. Sedimentation mainly occurs in the river since sediment laden tidal flow can not spread over the flood plain due to human interventions and construction of polders and there is no upland water flow into the river system during the dry season to flush out the incoming sediment.

Another major cause of drainage congestion is encroachment of the rivers and khals for shrimp culture. The width of the Mongla Nulla and Kumar rivers are becoming narrow day by day and has also lost the depth of flow. The Daudkhali river, which is another drainage route of the project area, has already lost its conveyance capacity. The internal khal system which drains out the water to the main river, has also lost their conveyance capacity due to siltation for various reasons such as encroachment of khals, closure of the mouth of the khals for fish culture and tidal meeting point. At present, the internal drainage khals and canal are not sufficient to drain out the monsoon water to the main river system. Also the peripheral rivers have lost their drainage capacity. As a result, most of the areas remain water logged during monsoon and post monsoon seasons. As a result of shrimp cultivation by emponding saline water in the flood plains and low lying areas, top soil salinity has become very high. In addition less fresh water flow during the dry period has intensified the problem. In this context Institute of Water Modelling was assigned to carry out the study and the present modelling study has been carried out to support the decision makers and the feasibility study to understand and determine the causes and intensity of the drainage congestion and devise drainage improvement measures.

In order to identify water-logged areas, inundation depth map has been prepared for existing condition for different flood events using drainage model results and field studies. The inundation depth maps have been made for 3-day duration for average (2.33 flood frequency) and 1:30 year flood event. Only 40% area remains flood free for normal condition and for 1:30 year flood event about 30% area remains flood free in the existing condition.

The drainage congestion in the project area will further deteriorate in the future if improvement measures are not adopted. Considering the issues of sediment management, mitigation of drainage congestion and reduction of flood risk, initially 4 drainage improvement options were devised in consultation with officials of BWDB, the main consultant and other stakeholders in order to improve the situation. Based on the model results and consultations with local stakeholders, one option was selected for detailed investigation. The effectiveness of the potential option has been assessed considering the decrease of flood level, inundation area and depth compared to the existing condition and resiltation rate in the dredged channel. It is important to examine the proposed drainage system in an integrated way to explore whether the project can be drained within three days through the system to save the agricultural crops and to avoid the prolonged water-logging. This investigation was made by preparing inundation depth maps for 3-day duration based on integrated drainage model results for monsoon season. The design drainage channel and proposed regulators have been included in the base model in an integrated way. The evaluation has been made considering 5 days rainfall storm of 30-year frequency of occurrence following the criteria of 5% inundation of the incremental area that cannot be drained by gravity to greater depth than 0.3m for a period of 3 days since these criteria have been considered in the feasibility study. The model results shows that about 81% area becomes flood free in the proposed drainage improvement option, whereas in existing condition only 37% area remains flood free. It implies 44% more area becomes flood free with the proposed option. For 1:30 year rainfall event, about 67% area remains flood free with the proposed option and in the existing condition it is only 29%. Result analysis shows that implementation of the proposed option will increase the flood free area significantly for both hydrological events.

Finally the study recommended to consider the entire project area as one polder system, 13 new regulators at different locations, re-excavation of internal khals, stop the encroachment, monitor regularly on project implementation and for long term solution implement TRM after 2 years based on monitoring results.
Port and Logistic Efficiency Improvement Project- ADB TA 7384

In November 2010, the Asian Development Bank (ADB) commissioned a consortium of the Consultants to carry out study for the Port and Logistics Efficiency Improvement in Bangladesh (TA No. 7389 - BAN). Global Maritimes and Port Services Pte Ltd (GMAPS), was the lead consultant and the other members of the consortium were Drewry Maritime Services (ASIA) Pte Ltd (Drewry), IDRG Consultancy Services (IDRG) and the Institute of Water Modelling (IWM). CPE division of IWM carried out the River engineering and morphology study of the project to assess navigability improvement of Pussur River. Mathematical model was used to assist the study in defining the prevailing situation, in establishing base line condition on the navigability of the channel and in simulating hydrodynamic and morphologic characteristics of flow in Pussur channel.

The study reveals that the access channel has deteriorated in the recent years and it has been identified that navigational problems has extended several kilometres downstream of Joymonirgol From Joymonirgol to Hiron Point except for about a kilometre at Harbaria khal (Figure 1), the river possesses a more stable navigable channel having depth of more than 8 m below CD. Till March 2011, the reach up to Harbaria khal had sufficient depth for navigation of more than 8.0 m draft vessel (Figure 1 & Figure 2). Below Hiron Point in 2009 at Outer Bar in the open sea down to Fairway Buoy, the condition of the channel looks improved compared to the condition in 2004 (Figure 3).

The canalization through structural intervention (Figure 4) will constrict channel width and thereby increase velocity in the navigable channel. The increased velocity will eventually increases the depth of the channel and as such the river bed level will maintain sufficient levels to navigate vessels of draft for at least 7.5 m at the constricted reaches. However, the constriction may cause bank erosion at the upstream of the jetty and the western bank of inner bar and therefore revetment has been suggested at those locations. At the outer bar area, capital dredging at 2 locations at Zulfikar channel has been suggested to accommodate 9 m draft vessel (Figure 5). Maintaining navigability at outer bar with frequent maintenance dredging would be required.

The tidal river management in Pussur River in combination with canalization has been suggested (Figure 4). The combined effects of these two will increase the velocity in the navigable channel from Sabur Beacon to downstream of inner bar. The construction of tidal basin will generate increased tidal volume at and around jetty area. Due to the increased tidal volume, the flow velocity in the navigable channel will be increased and will deepen the channel sufficiently to navigate vessels for drafts of at least 7.5 m. At the outer bar area in Zulfikar Channel (approach channel) at two locations, capital dredging followed by maintenance dredging to accommodate 9 m draft vessel has been suggested (Figure 5).
Flood Management Division

Flood Management Division (FMG) provides support in hydrological assessments, designing of hydrological monitoring networks and information systems, flood mapping, flood risk and damage assessment, real-time flood forecasting and operational water management systems, land use and climate change studies and flood mitigation planning including design and operations of hydraulic structures. The division has cutting edge technology, modelling tools on flood management, flood forecasting and climate change issues. The main strength is its sound experience in maintaining and updating of all Regional Models including the General Model developed earlier in the three phases of Surface Water Simulation Modelling Programme. One of the strengths of the Division is its technical capacity to support the FFWC of BWDB in its routine flood forecasts in the past decades. The Division developed the Ganges Brahmaputra Meghna (GBM) basin model capable of increasing the lead time of flood forecasts as well as a tool to assess the climate change impacts and make water resources assessments on a regional context.

Modelling tools such as MIKE 11, MIKE GIS, MIKE FLOOD, MIKE BASIN, FLOOD WATCH, MIKE CLIMATECHANGE which are widely accepted world-wide, are being used in the Division to address a range of water management issues.

During the year 2011, among many of its undertakings, FMG contributed to five projects of national and international interest namely, i) Flood Risk Management in Khatlon Province, Tajikistan ii) Gazner Beel FCDI Project, Pabna iii) Tarail-Panchuria FCDI Project, Gopalganj iv) Sureswar FCDI Project v) Upgrading of Flood Forecasting and Warning System under CDMP-II, Bangladesh. In addition, the Division devoted time and resources to train number of its professionals in the field of disaster risk reduction, climate change modeling and advanced mathematical modeling technology for flood management applications at home and abroad e.g. India, Nepal, Philippines, Denmark, Thailand etc.

The main objective of the modeling study for Gazner Beel FCDI Project was to improve the socio-economic condition of the area by increasing agricultural production through removing drainage congestion and providing irrigation in about 27,900 ha irrigable area. This project was designed to support the decision makers to understand and determine the cause and intensity of flooding and identify suitable measures to manage drainage and irrigation problem in the Gazner Beel area in a comprehensive and sustainable way using mathematical model. The study investigated the options for flood control and irrigation improvement and determined the optimum design parameters of structures like drainage pump, control and check structures for irrigation, irrigation canal etc. In order to ensure monsoon as well as post-monsoon drainage, submersible type of drainage-cum-irrigation pump with 40 m3/s capacity at Talminagar on the Badai River was proposed and found most feasible. In addition to this, 142km Irrigation canal, re-excavation of Badai River and construction of 27 Irrigation structures was recommended. The main objective of the modeling study for Tarail-Panchuria FCDI Project was to devise flood and drainage improvement plan in an integrated way along with improvement of irrigation facilities from surface water during dry season and protection of crop from saline water intrusion. Under the project, renovation of 38 existing structures, 192Km embankment, 66 new control structures and 6 new boat passes were proposed. Furthermore, a monitoring program for sedimentation and salinity was suggested.

During the year, FMG division organized several project based workshops to disseminate the study findings, option results to the end users for obtaining feedback from the stakeholders. The Division organized technology transfer training programs for Engineers of Bangladesh Water Development Board (BWDB) and professionals in Tajikistan working under the Khatlon Province Flood Management Project.
Mathematical Modelling Technique for Drainage and Irrigation Improvement of Gazner Beel Area in Upazila Sujanagar, District Pabna

The Gazner Beel Flood Control, Drainage and Irrigation Project is located in the Northwest region of Bangladesh in Pabna District. The problem of the project is the reduction of drainage capacity of the Badai River by sedimentation, and anthropological intervention of the natural drainage system. Agricultural and fisheries resources are being reduced due to drainage congestion, sedimentation and embankment. In order to resolve these issues, a contract agreement between Bangladesh Water Development Board and Institute of Water Modelling was signed in September, 2010. The main objective of the study is to improve the socio-economic condition of the area by increasing agricultural production by removing drainage congestion and providing irrigation in about 27,900 ha irrigable area.

Based on the topographic survey data procured from this project, Digital Elevation Model (50m resolution) was developed. A base map of the project area, and a set of topographic maps (Scale: 1:20000) showing contour lines at 0.3m interval were also developed. Assessment of surface and groundwater resources was done using surface & groundwater model. Detail design of Talimnagar Drainage-cum-Irrigation Pump was done including civil and electro-mechanical components. Furthermore, detail design of control structure for irrigation was also done. Agriculture, fisheries, social, environmental, economic analyses were also carried out.

To control the entrance of water flows from the Jamuna River during high water level, a drainage regulator has been constructed at the outfall location of the Badai River. The 6-vent Talimnagar regulator has the capability to drain out excess water through gravity drainage from the Badai River basin when the water level on the Jamuna River is lower than that of the Badai River. Usually during the monsoon & post-monsoon, water levels in the Jamuna River is higher than that of the Badai River. So that gravity drainage is not possible through Talimnagar regulator for the above mentioned period. Sometimes drainage operation is also impeded, especially during post-monsoon due to sedimentation of the drainage routes like the Badai River, and other internal khals. In order to ensure monsoon as well as post-monsoon drainage, drainage pump with 40 m3/s (8nos@5m3/s) capacity at Talimnagar on the Badai River has been proposed and found most feasible. The water level higher than the design level (7.50 mPWD) needs to be drained out within 3-days from monsoon & post-monsoon flooding. Considering the design level, drainage performance of the Badai River basin was assessed. It depicts that flood free area increases by about 4,000ha due to operation of the pump during peak flood situation. Furthermore, re-excavation of the Badai River has also been recommended. Moreover, estimated Irrigation Water Requirement for dry season is 20m3/s which can be made available from the Jamuna River at Kazirhat. Proposed Drainage Pump has been suggested to be utilized as Irrigation pump.
Mathematical Modelling Technique for Hydrological and Morphological Study for the Proposed Itna Mithamain Austagram Road under Kishoreganj District

The hydraulic modelling study titled "Hydrological and Morphological Study for the Proposed Itna-Mithamain-Austagram Road under Kishoreganj District" was undertaken by Institute of Water Modelling (IWM) through a formal contract signed in September 2011. It aims to assist Roads and Highways Department, Kishoreganj in determining hydraulic design parameters of 28 km long proposed Itna-Mithamain-Austagram road and its cross-drainage structures for smooth passage of flood water without generating any drainage congestion. At present there is no link road among the three Upazilas. The proposed road will enhance the communication facilities for the people of these three Upazilas.

The main objective of this study is to determine the suitable alignment of the proposed road, design crest level corresponding to highest flood level (HFL) along with determination of design parameters of cross-drainage structures and protection measures for the proposed road.

The study is based on a combination of field survey and appropriate mathematical modeling practice. MIKE FLOOD, a dynamically coupled modelling approach integrating one-dimensional (1-D) river model (based on MIKE 11) and two-dimensional (2-D) floodplain model (based on MIKE 21) is being used for the study. The frequency analysis of historical water level data indicates that 2004 was a 100-year return period flood year in the project area. Considering 50-yr flood levels which is 7.48 meter PWD at Itna water level station and taking 1.0 m freeboard, the design crest level is considered as 8.5 m for the proposed road. Two bridges will be required to be constructed for the proposed road while different options are being examined for the proposed cross-drainage structures. The proposed road traverses through Humaipur Haor and may hamper the environment; hence environmental impact assessment is being carried out in this project.
Mathematical Modelling Study of Sureswar Flood Control, Drainage and Irrigation Project

The Sureswar Flood Control, Drainage and Irrigation Project is located in the Southwest region of Bangladesh mainly in Shariatpur District, placed at the lower part of the connecting area of Ganges-Padma & Meghna Rivers. It covers Shariatpur Sadar, Janjira, Bhedorganj, Noria, Damudya & Goshairhat upazila of Shariatpur district, part of Kalkini upazila of Madaripur, and part of Muladi & Hizla upazila of Barisal district. The project area is bounded by the Meghna River to the east, the Arial Khan & the Joyanti River to the south, the Padma River to the north and Arial Khan River to the west. As per recommendation of FAP study the project area was divided into 3 separate polders namely Upper Polder, Middle Polder and Lower Polder. Bangladesh Water Development Board (BWDB) and Institute of Water Modelling (IWM) signed a contract agreement of this project on 21st September, 2010. Mathematical model study is one of the three components of the total study; other two components are Main FS component and EIA/SIA component. Presently the study is almost at its final stage.

The project area suffers from frequent crop losses due to occurrence of early floods in un-protected area and remains flooded during a substantial part of the year. Shortage of surface water for irrigation during post-monsoon and dry period is another problem causing drought strains to Aman/Rabi crops. Moreover existing khals and drainage channels inside and around the project area are being silted up which causes drainage impediment. To improve the situation the present study has been initiated by BWDB. The objective of the mathematical model study is to support the decision makers and the feasibility study to understand and determine the cause and intensity of flooding and identify suitable measures to overcome/ reduce the problems of floods and also flow availability in dry period in a comprehensive and sustainable manner. A project model has been developed based on south west region model for the study area. Detailed information of internal khals and drainage channel has been surveyed and incorporated into the project model. Land level specially along the periphery has also been surveyed and the data has been utilized to update the DEM.

Several development options for flood control, drainage improvement and irrigation development have been devised on consultation with local people and beneficiaries. It is evident from field investigations and model study that the main source of flood water comes from Padma river over-spilling the land during floods. As substantial part of the area is low-lying, specially towards south; it is not possible to make the area flood free using flood embankment due to high water levels in the peripheral rivers. Considering the issues several options have been tested using project model and consulted with different groups, discussions are being carried out for finalizing the option to get the optimum benefit.

The mathematical modeling study was also carried out for the purpose of morphological assessment and dry-period water assessment. A sediment transport model has been developed for the sedimentation study. The rivers/khals connected to the Padma is facing significant sedimentation specially near the offtake. The study identifies the yearly sedimentation rate at the offtake of rivers/khals. It is evident that the sedimentation rate are very high near the offtake compared to the downstream. Excavations of internal khals have been proposed for quick drainage as well as for water storage during the dry period. The increment of storage due to re-excavation of the internal khals has also been estimated.
Assistance to Climate Change Adaptation and Disaster Risk Reduction in the Northeast Region of Bangladesh

The Northeast Region comprising of about 17.5% of the total area of Bangladesh has special natural features called the Haors which are large bowl-shaped flood plain depressions. There are altogether 366 no of Haors which are enriched with various aquatic biodiversities along with about 140 species of fish. There are also source of abundant of Boro rice which are cultivated in the pre-monsoon months (January-May). The Haor areas are frequently affected by the flash floods which spill on to low-lying lands, inundating crops, damaging infrastructure by erosion and shift channel which often cause loss of lives and properties. Different agencies have implemented 118 water managements projects for flood control, drainage improvement and irrigation facilities most of which are administered by Bangladesh Water Development Board (BWDB).

Warming of the climate system is now evident from observations of increase in global average atmosphere and ocean temperatures, widespread melting of snow and ice and rising average global sea levels which are expected to be responsible for increased flooding both in terms of extent and frequency. This may necessitate in rehabilitating the submersible embankments of the Haor projects. This project relates to the provision of Danida support to the CCA and DRR in the North East Region of Bangladesh to cope with the anticipated impacts of Climate Change and devise appropriate adaptation & mitigation measures. The development objective of the study is "Contribute to establish a sustainable national capacity for Climate Change Adaptation and Disaster Risk Reduction in Bangladesh through application of developed tools and technology in linking the present flood forecasting by BWDB to the operation and management of the Flood Control and Drainage (FCD) projects in the North East Region of Bangladesh".

The project consists of three components: i) GCM model result downscaling using RCM, ii) Implications of climate change in the NE Region of Bangladesh and iii) Dissemination of Adaptation Options and Documentation.

The specific outputs of the project are as follows:

1. Prediction of climate change impacts on pre-monsoon flooding in the NE region with special focus on the timing and magnitude of the floods in future which is critical for flood protection embankments;
2. Reassess and redesigning of the submersible embankments in line with climate change impact;
3. Flood forecasting by FFWC to be linked to the submersible embankments of different projects with GIS application tool;
4. Dissemination of flood forecasting in the Haor projects through web application;
5. Trainings of IWM & FFWC staffs and attaining capability of preparing downscaled rainfall and temperature in the future climate change conditions.
Water Resource Planning Division

Water Resource Planning (WRP) Division is involved in broadly four areas: (i) water resources assessment, planning and management at macro level, (ii) urban water management including water supply, sewerage and storm-water drainage, (iii) wetlands and lake management and (iv) water quality and ecology including conservation of bio-diversity and sustainability of the water eco-system.

Experts in the division include: urban water management specialists, water quality and environmental specialists, water resources specialists, modelling specialists and groundwater experts. These experts have advanced training and work experience in water resources planning and management studies including field investigations. Working with multi-sectoral teams has facilitated the experts to develop a holistic view on the water resource management in both urban and rural areas.

WRP Division uses a wide range of state-of-the-art modelling tools for its work. These include: (i) MIKE Basin - for river basin planning, (ii) MIKE Urban - for water distribution system modelling, sewer system modelling, (iii) MOUSE - for stormwater drainage system modelling and analyses, (iv) MIKE 11 - for hydrodynamic and water quality modelling in surface water systems, (v) MODFLOW - for groundwater modelling.

WRP Division has been involved with the installation and maintenance of groundwater monitoring networks in Dhaka and other areas of Bangladesh. IWM is also involved quite extensively in hydrogeological investigations, aquifer vulnerability mapping, assessment of DTW performance, system metering, design and supervision of District Metering Areas (DMA), resource assessment, water distribution system modelling etc. Some of the notable works of IWM include development of water supply, sewerage/sanitation and drainage master plan not only for Dhaka but also for 148 other municipalities in Bangladesh including the divisional head quarters of Barisal and Sylhet.

WRP Division carried out modelling for the feasibility study and design of the Ganges barrage. The model study contributed in fixing the location of Ganges barrage, defining the design discharge, study of options for flow diversion to the Ganges dependent areas, and generates hydraulic design parameters of the barrage, river training works, diversion structures, and distribution system. The study also investigated the impacts of climate change on salinity intrusion in the with- and without-barrage conditions.

WRP is also involved with development of a comprehensive Scheme Information Management System (SIMS) for BWDB under the World Bank financed Water Management Improvement Project (WMIP). GIS maps of over 200 BWDB schemes including inventory of each schemes are being developed through this work.

WRP study for DWASA on the Padma water treatment plant (900 MLD capacity) and Singair wellfield (300 MLD capacity) have been highly appreciated by all concerned including international financing institutions. WRP is presently working with its JV partners for DWASA in the rehabilitation of water distribution network of Dhaka city for improved water supply.

WRP is involved in some of the major research projects funded by DWASA, the World Bank, the European Union and IUCN. These research projects are mainly concerned with urban water logging, rainwater harvesting, ecosystem sustainability and climate change.

Apart from conducting studies for various clients, WRP has also successfully organized several training programmes for engineers and other resource personnel of BWDB, KWASA, DPHE and DWASA. WRP during the last year has supported four Masters and a PhD research.
Safe Drinking Water Source Identification in 148 Pourashavas

Over the last three decades, significant improvement is seen in water supply and sanitation in Bangladesh. However, potential source of water is still unidentified in most parts of the country. Arsenic contamination, high iron concentration, salinity intrusion, industrial pollution, mining of groundwater, scarce rainfall, inadequate study on water resources management etc. restricts the availability of sustainable water source. Besides, the country is going through a rapid growth of urbanization and providing urban utilities is one of the major concerns to the planners nowadays. In this regard, Department of Public Health Engineering (DPHE) has taken up a project in 2010 for groundwater management and feasibility study in upazilla and growth centre level Pourashavas. The project is very much pertinent to the national water and sanitation policy of Bangladesh and complies with the Millennium Development Goal (MDG) as well.

To address the situation, 148 Pourashavas from different regions of Bangladesh have been selected for the study. Each region differs in topography, population density, life standard and livelihood of the populace. Most of the Pourashavas have acute problems in water and sanitation sector. The project aims at feasibility study and identification of safe water source with regard to quality especially arsenic contamination. Master plan preparation of water supply, drainage and sanitation, economic and industrial analysis of Pourashavas, environmental impact assessment are the salient features of the project.

The project is divided into 4 distinct phases. Already 2 phases have been completed and Phase-III is on-going. In the study, mathematical models for surface water and groundwater source are developed to investigate the options for sustainable water source. Alternative options like rainwater harvesting, Pond Sand Filter and Infiltration Gallery are proposed where found to be appropriate. Pipe network and drainage models are developed for preparation of corresponding master plan. This study also establishes surface water and groundwater monitoring system and recommends measures for maintenance and rehabilitation of water supply, sanitation and drainage system. It also includes capacity building of DPHE and Pourashava officials through technology transfer through comprehensive training programmes. For data management and decision support, Management Information System (MIS) in selected Pourashavas will be installed. After project implementation, the Pourashava will run the corresponding scheme with the help of active assistance from DPHE. The honorable Mayor of the Pourashavas will be the Chief Executive during the operation and transparency of work will be ensured through maintenance by digital DSS and MIS. Local governance within the project area will flourish in this manner.

Consequences of the study in previous phases were far reaching. The project ushered new avenues for undertaking of further development projects. It differs from conventional project approach and changes the vision of the concerned officials. Apart from being concentrated on isolated planning, the officials are now more focused on integrated water resources planning. The Pourashava officials are directly involved in data collection process and performance of developed models are being improved by each day through updating, upgrading and further development of the models in accordance to the feedbacks from them. Informative decision making for planners are now possible in these Pourashavas. DPHE considers this study as a pioneering project towards further development of more projects in future in terms of integrated planning, developed knowledge base, informed DSS and MIS. This project is assisting the development of urban utilities and infrastructure in concerned study areas. In brief, this study will improve the health and quality of life in the rural townships of Bangladesh.
The Sewerage Masterplan of Dhaka City: Decentralization by 2035

Dhaka is the capital of Bangladesh with an approximate area of 560 km². With an estimated population of about 12.5 million, it is arguably the fastest growing megacity in the world. Unfortunately, this rapid and unprecedented growth could not be matched with similar growth in sanitary infrastructure. Only 2.4 million of the population is actually served by the sewerage system. The collector system service area gap, which equates to 10.1 million people, is addressed through a combination of individual and communal septic tanks, pit latrines and direct connection to storm water drains. The objective of the master plan is to achieve elimination of pollution arising from unhygienic disposal of wastewater; of all industrial, commercial and domestic origin and thereby ensures improved health and safety by the year 2035. The extent of area considered in the Master Plan is the entire 1528 km² of the Dhaka Metropolitan Development Plan (DMDP) area with focus on Dhaka Water Supply and Sewerage Authority (DWASA) Service area (392 km²).

The Masterplan aims to provide sanitation to every citizen through individual or community facilities. A strategy to decentralize the system to smaller catchments delineated around an urban centre will be adopted. This will lead to new infrastructure to service the greatest number of people per unit of investment. Due to decentralized, smaller collection networks; more affordable treatment infrastructures will be developed. Beyond the urban centres, on-site sanitation system such as septic tank is suggested for rural-sparingly populated localities and informal settlements. For the resultant septic tank sludge, the treatment plants should have provisions for reception, treatment and disposal. Private land developers will be responsible for facilitating sanitation service to their clients. Industrial wastewater must be pre-treated at source before discharging to the sewerage system.

The prioritization of Infrastructure development focused on high density urban centres. Due to prioritization, the Masterplan is divided into three phases. The immediate priority investments in Phase 1 (2011 - 2015) focus on rehabilitating the existing DWASA infrastructure. Major works include i). Replacement of existing Eastern (Madhubagh-Bashabo-Pagla) trunk main and Construction of new trunk sewer from Tejgaon, Gulshan to new Hatirjheel-Dasherkandi WTP system ii). Replacement of four pump stations along eastern trunk main and iii). Increased treatment capacity at Pagla using Trickling Filter technology. Space conservation, reliability, economy and simplicity of operation are the primary criteria considered for design and expansion of the treatment plant and pump stations. Phase 2 (2015 - 2025) will lead to construction of new sewage collection systems, transmission mains and sewage treatment plants for catchments (STP) within DWASA service area and Purbachal. In Phase 3 (2025 - 2035), the same activities of Phase 2 will be replicated for the urban centres of Greater Dhaka, i.e. Savar Pourashava, Tongi/Gazipur Pourashava and Keraniganj. In addition to infrastructure development, the Masterplan will be made sustainable through non-structural measures such as gradual revision of water rate, improvement of operations and maintenance etc. Increasing public awareness to adopt sanitation, legal and institutional reform to empower DWASA will be required to effectively implement the Masterplan’s vision. In brief, this masterplan will provide a roadmap for the growth of the city in accordance with its sewerage infrastructure capabilities.
River Engineering Division

River Engineering (REN) Division operates in the field of river engineering and management and uses state-of-the-art mathematical modelling technology in the following areas:

- Fluvial hydraulics and river morphology
- Erosion management (river training and bank protection works)
- Offtake management
- Navigational route management
- Road/bridge infrastructure management
- Hydraulic structures including dam, barrage and regulator
- Cooling water intake for Power Plants

The division inherits its strength from its involvement, for more than 15 years in the past, in the field of morphological modelling of more than 1,500km of large, meandering and braided rivers of Bangladesh including three major rivers - the Ganges-Padma, the Brahmaputra-Jamuna and the Meghna.

To realize most of the beneficial uses of rivers and to minimize damages, offering technical assistance with the aid of state-of-the-art mathematical models is the core activity of REN Division. Since establishment of IWM, REN has been playing vital role in dealing with the most unpredictable rivers of Bangladesh. The services have also entered into the International arena providing world-class analyses in river engineering.

REN with its expertise and experience involved itself in many projects during 2011, the notable ones are:

- Mathematical Modelling Study of the Meghna River in connection with Preparation of Ashuganj Power Station Master Plan
- Future Planning Study for the Re-excavated Chandana-Barasia River System
- Pilot Capital Dredging of the Jamuna River.

However, REN’s remarkable involvement in 2011 has been in some projects, which are considered nationally important ones. These are:

- Ganges Barrage Project
- Gorai River Restoration Project Phase-II
- Buriganga River Restoration Project
- Sustainable River Management of the River System of Bangladesh

In 2011, REN provided useful services with Bangladesh Bridge Authority (BBA) on updating of monitoring program and forecasting of critical hydraulic and morphological condition of the Jamuna River in the vicinity of Bangabandhu Bridge for safety of the bridge during monsoon 2011.

Besides the projects mentioned above, REN contributed in a number of important bridge projects in 2011. Major outputs of the bridge projects were to determine suitable bridge location and alignment, impact on hydro-morphological condition of the rivers due to implementation of the bridges and recommendation for mitigative measures like bank protection/river training works, if any adverse condition were apprehended to take place.

With a view to provide support to the managers of the rivers, and designers of road, rail and bridges, REN has to work extensively. As such, basic and applied research programs are continuously conducted in order to maintain a high level of technical expertise. A set of highly skilled professionals are engaged in sophisticated numerical modelling at REN. As such, their expertise and knowledge are continuously being updated and upgraded through on-the-job training, seminars and workshops at home and abroad.
Mathematical Morphological Modelling for the Ganges Barrage Project

Bangladesh is located in the delta of the three great rivers, the Ganges, the Brahmaputra and the Meghna. The Ganges Dependent Area (GDA) in the south-west region of Bangladesh constitutes about 37% of the total area of the country. About one-third of the population of the country lives in this area. In order to utilize the Ganges water, for the benefit of the people living in the Ganges dependent area and to offset the negative impact of the continuous withdrawal of water upstream of Farakka on the agriculture, fishery, and ecology of the south-western region for a long time, it is imperative to construct a barrage across the Ganges within Bangladesh.

In context of the above, Bangladesh Water Development Board (BWDB) initiated the Feasibility Study and Detailed Engineering of the Ganges Barrage Project from May 6, 2009. The Main Consultant of the Study contracted Institute of Water Modelling (IWM) as sub-consultant to carry out mathematical modelling for the feasibility study and detailed engineering design of the Ganges Barrage. The contract for modelling was signed on 9 June 2009.

The main objective of the feasibility study and detailed engineering design of the Ganges Barrage is to conduct a detailed feasibility study, socio-economic environment and other hydraulic and hydro-morphological survey and study and a detailed engineering design for the construction of a Barrage across Ganges River and associated engineering infrastructure on other rivers, drainage and irrigation systems. Objectives of the mathematical modelling study are to apply appropriate mathematical modelling tools to achieve the above mentioned objectives at planning, design and implementation stages.

Having decided with the location of the Barrage at Pangsha site, application of this model was made to generate the following outputs:

- necessity, extent and location of RTW/Guide bund at the upstream for confinement of the flow towards the barrage
- vulnerable location of bank erosion at the downstream of the barrage that might be affected due to sudden release of water from the barrage, and thus determine the location, alignment and extent of bank protective measures
- possibility of formation of shoal at and around the barrage and recommendation for removal of the same for smooth operation of the barrage
- potential options for effective management of sediment transport
- hydraulic design parameters of different components of the barrage
- identification of critical reaches of the Ganges at immediate upstream and downstream of the barrage, and thus to assess requirement of mitigation measure
- hydraulic design variables for the suggested mitigation measures.
Mathematical Morphological Modelling and Investigation in connection with the Sustainable River Management Plan for Main Rivers, Distributaries and Tributaries in Bangladesh

The Ganges-Brahmaputra-Meghna (GBM) river system carries probably the largest total sediment discharge of all rivers of the world. All major rivers of Bangladesh carry huge sediment loads from large catchments, which have been estimated at about 1.0 to 1.1 billion tons annually. The increase in river bed levels due to the huge sediment inflow on the major river system of Bangladesh has introduced the numerous problems:

Under these circumstances, Bangladesh Water Development Board has initiated a study titled "Study for Sustainable River Management" to devise river management plan of major rivers and distributaries in next 15 years for flood and erosion management, to improve navigability and to augment dry season flows in the distributaries considering capital dredging and river training works. The study consists of primarily 3 components of which IWM carried out one component.

The study component of IWM mainly aims to formulate solutions to the problems identified through river modelling and prognosis forecasts, which would enable "intelligent" implementation of dredging, realignment of navigation routes, protection of vulnerable erosion or flood prone areas, and mitigation measures to keep off-takes open, etc.

The specific objectives of mathematical modelling are to support the Main Consultant in devising river management plan of major rivers for flood and erosion management, improve navigability, and augment dry season flow in (major) distributaries considering capital dredging and other suitable interventions.

The study commenced after signing of a Contract Agreement between IWM and BWDB on 8 February 2011.

The approach of the study is to develop and apply fully dynamic hydro-morphological models for the selected major river system for conducting all relevant study with respect to flow volume, flow pattern and river morphology incorporating projected impacts of climate change and sea level rise.

Followings are the expected outputs of the study concerned:

- Location, length and alignment of river dredging and river training works for eight major rivers and distributaries
- Volume of intelligent dredging (both initial and maintenance) at critical locations
- Backfilling/re-siltation rate in the dredged channel
- Frequency and volume of maintenance dredging
- Potential bank erosion for different flood events in the eight major rivers and distributaries
- Potential improvement of navigability in the eight major rivers and distributaries
- Plan for augmentation of flow in the distributaries during dry season (in consultation with the Main Consultant)
- Planning and design of erosion and flood mitigation measures (in consultation with the Main Consultant)
- Conceptual channelized forms of the Ganges-Padma and Brahmaputra-Jamuna river systems.

The Rivers/River Systems included in the study

The Ganges-Brahmaputra-Meghna (GBM) river system includes:

- West Bengal
- Meghalaya
- Assam
- Myanmar
- Tripura
- West Bengal
- Bay of Bengal

BANGLADESH RIVER SYSTEM

The Rivers/River Systems included in the study
Mathematical Modelling, Survey And Investigation For Future Plan Development After Excavation of Chandana-Barasia River

The River Chandana-Barasia originates from the Ganges River near village Gautampur of Rajbari District. Flowing through Pangsha and Baliakandi Upazila of Rajbari district and Modhukhali, Boalmari and Alfasgandga of Faridpur district, it falls into the Modhumati River near Bhatiapara Bazar of Kashiani Upazila of Gopalganj District. Total length of the river is about 113.00 km. Part of the river (56.04km) from Chandana regulator to Arakandi Bridge is called Chandana River whereas the remaining 56.96km from Arakandi Bridge to the outfall near Bhatiapara is called Barasia River.

A DPP titled Excavation of Chandana-Barasia River with an estimated cost of Tk.5952.49 lakh was approved by the ECNEC in July 2010. The main objectives of the project are:

- to provide irrigation facilities to a gross area of 29,155 ha, net 22,050 ha for increasing agricultural production;
- to make sweet water reservoir into the Chandana-Barasia River for using domestic purposes and supplementary irrigation;
- to increase sweet water flow by dredging/excavation of the off-take canals.

The project is under implementation by Bangladesh Water Development Board (BWDB) through Rajbari and Faridpur O & M Divisions with a target to complete the re-excavation of the river by June 2012. IWM signed a contract with BWDB on the project in April 2011.

The following are the expected outputs of the study:

- Upgraded digital elevation map with existing topography around the offtake area
- Suitable plan to make sweet water reservoir in the Chandana-Barasia River for expanding irrigation facilities.
- Performance of present excavation and future hydro-morphological impacts in Chandana-Barasia River and at the downstream of the river as well as to the coastal area.
- Back-filling rate of the dredged channel and mechanism to manage the incoming silt in a systematic way for maintaining perennial flow.
- Assessment of agricultural water demand/crop water requirement (CWR) and projection of future requirement
- Location for the water control structure in the main River and in the lateral canal
Irrigation Management Division

Irrigation Management (IRM) Division of IWM provides services in the field of irrigation & drainage, groundwater and GW salinity, for judicious and sustainable management of land and water resources of the country. Its services are targeted towards enhancement of agricultural productivity, while at the same time retaining the environmental integrity and sustainability. The division mainly draws it strength from a group of qualified, efficient and dedicated professionals, having expertise in the field of irrigation management, groundwater modelling and host of renowned modelling software like MIKESHE, MODFLOW, MIKE11, MIKE-GIS, FEEFLOW, CROPWAT, HYMOS etc.; supported by GIS, ICT, and sophisticated data collection system.

During the year 2011, IRM Division concentrated on delivering the services of the ongoing contracts, signed earlier, as well as in procuring new assignments. Notable on-going projects were (i) Joint Action Research on Salt water Intrusion in groundwater in the coastal area, (ii) Water Supply, Drainage and Sanitation in 148 Pourashava along with WRP Division, (iii) Barind Integrated Area Development Project for Rajshahi", BMDA Phase-III. Some of important new contracts signed during the year includes (i) Groundwater Resources Study and IIS Development for 8 Districts of Rajshahi Division, BMDA Ph-2, (ii) Bangladesh Integrated Water Resources Assessment Project (GW part), (iv) Establishment of Monitoring Network and Model Study to Assess Saline Water Intrusion in Groundwater in the Coastal Area of Bangladesh due to Climate Change, Package I, II and III; under Climate Change Trust Fund.

Climate change is the greatest environmental challenge facing the world today. Bangladesh, specially the coastal area, is the most vulnerable area facing the impacts of climate change, like sea-level rise, salinity intrusion, frequent cyclone etc. To investigate impacts in surface and ground water BWDB initiated a study for establishment of monitoring network and mathematical model Study to assess salinity Intrusion in Groundwater in the Coastal Area of Bangladesh due to CC. The study is being conducted under three separate components namely Package I, II & III. Under Package I the main objective is to assess the surface water resources in selected rivers, assess the upazill-wise groundwater resources of pilot areas and assess changes in GW distribution due to increased withdrawal of groundwater in the pilot areas. Package II concentrates on how to develop representative surface and ground water models in two selected pilot areas to understand the behavior of salinity intrusion in coastal belt. Under Package III, a network of ground water monitoring in the coastal belt has been established and data collection is continuing. Collected information includes aquifer properties through borelogs, aquifer pumping test, geophysical survey, water quality analysis etc. Training of BWDB personnel concerned is an integral part of this component. Under the total package surface and ground water models have been developed and are being updated using collected data under the project.

The study ‘Groundwater Management and Feasibility Study for 148 Pourashavas having no piped water supply’ addresses safe drinking water supply based on long term water availability and demand for an efficient planning and management of water resources. To ensure the integrated management of water resource, a physically based distributed modelling system is developed for long-term sustainable water resources planning and management for both the surface water and groundwater, determination of safe yield from different aquifer units and quantification of impacts of water abstraction. The modelling areas have been selected based on the availability of data and requirement of outputs. The modelling works is going on and a simple water balance to quantify the available resources for Madhupur Porashava is developed as shown in the Figure.
A comprehensive model study was carried out earlier for groundwater resource assessment covering 25 Upzillas of Rajshahi, Chapai Nawabganj and Naogaon districts with an area of 7500 km² (Figure 1) (IWM, 2006). The study findings were limited within geological structures up to 80 m depth; beyond this depth, geological information was not available.

Considering the above facts, this project was conceived to carry out deeper aquifer characteristics and groundwater model study including deeper strata for bringing more area under irrigation in the resources constraint areas. In this regard, a contract was signed between BMDA and IWM on May 05, 2009. The main objective of the study is to explore groundwater potential below 80.0 m in resource constraints and high Barind areas of Rajshahi, Chapai Nawabganj and Naogaon Districts to bring more area under irrigation using mathematical modelling techniques.

Accordingly a model upto the depth of 300m is being developed for the high Barind area which is being updated with the data from recent hydrogeological investigations and a new model for 10 upazilas of high Barind area incorporating the deeper aquifer is being developed.

The expected outputs from the study are given below :

- Potential recharge and groundwater resources of deeper aquifer in high Barind area;
- Spatial distribution map of hydro-geological parameter for deeper aquifer i.e. hydraulic conductivity, specific yield, transmissivity etc in high Barind area;
- Lateral and vertical extent of deeper aquifer in high Barind area;
- Hydrostratigraphic cross sections including deeper strata;
- Geo-referencing of all non geo-referenced DTWs and observation wells;
- Calibrated and validated integrated surface water-groundwater model including deeper aquifer in resource constraint and high Barind area;
- Upazilla wise surface and groundwater resources in all districts (except Thakurgaon, Panchagarh, Dinajpur and Joypurhat) in North West region;
- Updated Management Information System (MIS);

The objectives of the MIS (Figure 3) are as below:

- store, view and analyse all types of groundwater relevant data.
- To generate dynamic report from MIS database on user's criteria.
- To introduce a GIS based project management information system.

Considering the functionalities and characteristics of data, the modules developed under MIS was i) GIS Interface for navigation through spatial data, ii) General for navigation through non-spatial data, iii) MIS Report for dynamic report generation tools and iv) MIS Update tools to update or edit MIS.
Strengthening BMDA's Capacity on Water Resources Management

Strengthening BMDA's Capacity on Water Resources Management Project covers 31 Upazilas of Rajshahi, Chapai Nawabganj, Noagaon and Natore districts with an area of 9852 km² (Figure 1.1). In view of that, groundwater resource should be assessed for optimum utilization as well as to check the further deterioration of groundwater table for future groundwater development. At the same time, it is also necessary to assess the impact of groundwater development on surface water as surface and groundwater are interlinked. This is why Hygiene, Sanitation and Water Supply Fund (HYSAWA) engaged IWM for assessment of groundwater of the study area using modern technique of mathematical modelling tools.

The main objective of this study is to Strengthen BMDA's capacity to improve its understanding of the water resources and to develop a sustainable management of surface and groundwater resources in the project area. Out of many specific objectives are

- Assessment of Upazila wise groundwater resource and recharge potential
- Upazilawise required nos. of DTW
- On the job and formal training to BMDA Officials for the development of groundwater flow model using MIKE SHE, surface water model using MIKE 11 and data collection and processing for smooth operation and maintenance of IIS, groundwater monitoring system etc

To achieve the objectives IWM collected various types of hydrological, hydro-geological and hydro-meteorological data both from secondary as well as primary sources. Among these, installation of 30 nos groundwater observation wells, 3 nos aquifer test, 5 nos test drilling upto 200m depth (Figure 1.2), cross section survey, surface water level and discharge measurement etc are important.

Under HYSAWA Project, IWM updated the existing model developed under another study under BMDA for Rajshahi, Chapai Nawabganj, Naogaon and developed a new model for Natore Districts.

The important outputs from the study are; i) Upazila wise groundwater resources along with renewable recharge volume. ii) Water requirements for different users i.e. agricultural, domestic and industrial use. iii) Zoning map based on groundwater depth/level for Chapai Nawabganj, Naogaon, Rajshahi and Natore districts. iv) Interactive Information System (IIS) for the project authority to store, review and analyze both spatial and time series data. v) Upazilawise required nos. of DTW. vi) Updated Website with relevant data and vii) Formal training to BMDA officials on (a) Hydro-geological data collection, (b) Mathematical modelling and its application and (c) Operation of Interactive Information System (IIS).
Mathematical Modelling Study on Saline Water Intrusion to Assess Salinity Intrusion, Salinity Level, Sea Level Rise due to Climate change, Movement of Salinity & Development of MIS

Bangladesh is likely to be one of the most vulnerable countries of the world in the event of climate change. Considering the facts, a study for assessing the salinity intrusion in groundwater and also surface water will be conducted for two pilot areas of coastal region of Bangladesh. Firstly, an area spreads over Barisal, Patuakhali, Pirozpur, Barguna and Jhalokha district covering an area of about 4867 sq. km where as another pilot area lies within Chittagong district is characterized by withdrawal of huge quantity of groundwater for industrial and Chittagong city water supplies. This area is near about 946 sq km.

The major outcomes from the study will be as follows:
- Assessment of the groundwater salinity and extent of salinity intrusion of aquifer system.
- Assessment of the impact of sea level rise in the groundwater salinity distribution.
- A Management Information System (MIS) based on collected data.
- Initial Environmental Impact Assessment for salinity intrusion due to sea level rise.

To achieve the expected output, firstly coastal water salinity along with its impact to river water will be investigated using the Bay of Bengal Salinity Model. Investigation on the interaction of river /coastal water salinity to adjacent aquifer water and spatial-temporal variation will be assessed by using groundwater salinity intrusion model (FEEFLOW). A process flow diagram is shown in Figure 3.

Under this study, lots of hydro- geological and meteorological data from the secondary sources have been collected. A fence diagram based on the data from the secondary sources for the study area - 1 is shown in Figure 4.

The pilot area 1 covers an area of about 405 Sq. km. The model has been discretized having total mesh elements of 32148 where as the total number of nodes is 19530 as shown in Figure 5. The preliminary model is developed considering 6 geological layers with time varying head boundary has been defined as boundary conditions for groundwater flow model.
Climate change is the greatest environmental challenge the world is facing today. Rising global temperatures will bring changes in weather patterns though Bangladesh plays very little role in greenhouse gas emissions, leading to climate change and Sea Level Rise (SLR). SLR contributing to saline intrusion or inundation of coastal area is probably the most direct impact of climate change in Bangladesh. The natural equilibrium between saline water and fresh water is also susceptible to SLR associated with climate change. To assess the likely impact of anticipated SLR on the salinity in the coastal area, GoB has undertaken a research program under Climate Change Trust Fund. The present study is being executed by BWDB. A contract was signed with IWM on 9th June, 2011 and the expected completion date is June, 2013.

The main objective of the present study is to determine different hydro-geological parameters in the coastal area to assist in assessment of the extent and intensity of salinity, presently prevailing and likely to happen due to anticipated climate change.

The project area covers 19 districts and 140 Upazilas lying in the coastal area of Bangladesh. Major activities planned under this study includes (i) establishment of a monitoring network, (ii) determination of aquifer properties through borelogs, aquifer pumping test, geophysical survey etc. (iii) water quality analysis and (iv) training of concerned personnel. The notable outcomes are (i) characterization of the aquifer, (ii) a functional GW level monitoring network, (iii) a data set on GW level, (iv) baseline condition of SW and GW quality etc.

The outcomes of this study would be extensively used in modelling activities that aims to assess the present and anticipated extent of salinity intrusion in the river system as well as in the groundwater aquifer of the study area. Furthermore, data generated through this study would help to minimize the data scarcity of the area which is a pre-requisite for any development activity.

Field data collection are being done using modern equipment and technology e.g. EC meter, data logger, auto GW level recorder etc. The collected data are analysed in the field as well as in the laboratory. The collected data are being analysed using various software. Necessary training for use of the equipments and data collection procedure has been imparted to the field staffs.

It is anticipated that if the project is completed as planned, the information collected from the study in this region would help in formulating plans and policies to cope with the changing situation due to climate change and thereby contributing to sustainable development of the coastal region.
Survey And Data Division

Survey and Data Division (SDT) of IWM conducts hydrographic and topographic surveys including collection of water quality and sediment data to support scientifically based management of river erosion, flood and irrigation, water supply and sewerage system. SDT also supports planning and implementation of infrastructure in the communication sector, urban development, industry and energy sectors.

The specific areas of SDT activities are: hydro-morphological survey including water quality and sediment in the rivers and estuaries, flood plain topography, engineering survey and benchmark connection for the above surveys.

SDT uses the latest survey equipments like Total Station, RTK-GPS, DGPS, Echosounder and Acoustic Doppler Current Profiler (ADCP) along with the specialised computer software and facilities to conduct the surveys. The surveyed data is promptly processed and analysed in the field and thus maintains a near-online quality control procedure. In the office the data is further verified by the senior professionals before transmitting it to the users and archived in the database for future applications. In addition to collecting data to support modelling activities, SDT also supports different Government Agencies in implementation of dredging activities in the major rivers.

A set of motivated staff comprising highly skilled professionals and field surveyors are engaged for the jobs. The knowledge and skills of the staff are continuously updated and upgraded through on-the-job training, discussions, seminars and workshops at home and abroad.
Hydrographic Surveys in the Jamuna River under Proposed River Bank Erosion Risk Management Program

Bangladesh Water Development Board (BWDB) has implemented Jamuna-Meghna River Erosion Mitigation Project with financial assistance of ADB from 2002-2003 to June 2011.

On successful implementation of JMREMP with cost effective sustainable river erosion system, the donor agency (ADB) as well as Bangladesh Government is paying interest for possible replication of the same within Bangladesh. As a follow-up program, a Consultation Mission from ADB (HQ) requested BWDB to conduct some specific survey works. In this regard, Bangladesh Water Development Board engaged Institute of Water Modelling to carry out some portion of hydrographic surveys in the Jamuna and Padma River near Bangabandhu Bridge and Baruria in the district of Tangail and Manikganj. IWM successfully completed the data collection campaign from June 2011 to November 2011. The important features included in the survey are discharge observation, float tracking, bathymetry and bankline alignment surveys.

Hydraulic and Morphological Modelling Study to Aid Technical Feasibility Studies & Detailed Design for Coastal Embankment Improvement Project (CEIP)

In order to increase agricultural production by preventing the land of coastal area of Bangladesh from frequent tidal flooding and salinity intrusion in the Coastal Embankment Project (CEP) was implemented in accordance with Master Plan adopted in 1964. Under this program, Bangladesh Water Development Board (BWDB) built a series of polders enclosing the low-lying coastal areas. After the development of polders, for more than 30 years the existing peripheral rivers gradually silted up from the incoming sediments with high tide due to decrease in flushing fresh water flow from upstream during the last few decades and consequently losing their drainage capacity significantly.

At present, climate change and sea level rise also pose new threat to water management in the coastal polders. At this stage, the Government of Bangladesh (GOB) obtained an IDA/credit for Emergency Cyclone Recovery and Restoration Project (ECRRP), 2007 and proceeds from this credit would be used to meet the expenses for the proposed Coastal Embankment Improvement Project Phase - I (CEIP - I). The Joint Venture of four technical firms: 1) Consulting Engineering Services (India) Pvt. Ltd. (CES) being the lead firm, 2) Dev Consultants Ltd Bangladesh (DEVCON), 3) Kranti Associates Ltd Bangladesh (Kranti) and 4) Design Planning & Management Consultants Ltd (DPM) have been appointed for consultancy services for “Technical Feasibility Studies and Detailed Design for Coastal Embankment Improvement Project (CEIP)”.

To support the feasibility study, Institute of Water Modelling (IWM) has been assigned to carry out the Hydraulic and Morphological Modelling Study. In this regards, a huge data collection campaign was conducted for 17 selected polders from September 2011 to January 2012 by using state-of-art equipments like RTK GPS, total station and digital levels instrument. The important features included in the survey are cross-section of surrounding embankments and internal drainage canals, detail structure inventory and installation of bench mark pillar around the polders.
Pre-Post Survey for Dredging Operation of Surma River for Lafarge-Surma Cement Ltd.

Lafarge-Surma Cement Ltd. has its cement factory located on the right bank of the Surma river near Chattak in the Sunamganj District. For its operation, materials to and from the factory is transported by barge along the Surma river. Lafarge-Surma Cement Ltd. required to improve the navigability of the river by dredging operation during the dry seasons through BIWTA or private parties. The work to be done needs monitoring by a well equipped hydrographic survey unit along with experienced staff for monitoring the dredging. Institute of Water Modelling has been entrusted for providing necessary survey support to access the dredging requirement and also monitoring the dredging operation. In the year 2011, the survey works were conducted in February and October. The field activity during the survey campaign included- BM Fly and Bathymetric survey including bank topography, water level, discharge, velocity and bed sampling.
Development of Scheme Database Inventory and Mapping

Institute of Water Modelling has been assigned to develop a Scheme Database Inventory and Mapping is one of the component of Water Management Improvement Project (WMIP). The Scheme database and mapping will support planning, estimating, budgeting, and monitoring the rehabilitation/improvement works for O&M Schemes.

Under the consultancy services of Scheme Database Inventory and Mapping, two hundred scheme maps have been developed from Satellite Imagery such as Quick Bird, collected Topographic Maps from Survey of Bangladesh (SoB), limited topographical survey results conducted by the consultant, collected hard copy maps, drawings and reports from BWDB used as the guidance of mapping, and other suitable data sources (Figure-1).

The contents of the scheme maps include the existing physical features such as roads, embankments, channels, hydraulic structures, bridges, culverts, homestead areas, water bodies, important establishment, important places, hat/bazaar growth centers, etc. and also includes the representative spot levels, land contours in selected maps. The contents of the maps features and the composition of map legends, symbols and colors etc have been chosen as per standard specifications and practices by BWDB. These map sheets have been produced in different sizes of A1, A2 and A3 at various scales using ArcGIS Software. A typical Scheme map is shown in Figure 2.
Mathematical Modelling Study to Assess Upazila-wise Surface Water and Groundwater Resources and Changes in Groundwater Level due to Withdrawal of Groundwater Pilot Areas of Coastal Belt

A proposal "Establishment of Monitoring Network and Mathematical Model Study to Assess Salinity Intrusion in Groundwater in the Coastal Area due to Climate Change" was prepared by BWDB and was submitted to Climate Change Trustee Board under the Ministry of Environment and Forestry. After approval from the Ministry, IWM has been assigned through a contract agreement with BWDB to carry out mathematical modelling study to assess upazila wise surface water and groundwater resources and changes in groundwater level due to its abstraction for two pilot areas of coastal area. The pilot area-1 spreads over Bakergonj upazila of Barisal district, Patuakhali Sadar, Mirzagonj, Dasmina, Galachipa, Kalapara and Bauphal upazila of Patuakhali district, Bhandaria and Mathbaria upazila of Pirozpur district, Barguna sadar, Bamma, Betagi, Amtali and Patharghata upazila of Barguna district and Kathalia upazila of Jhalokathi district. The area is about 4867 sq km characterized by withdrawal of groundwater for agricultural and domestic purposes. Another pilot area lies within Anwara, Chandanais, Patiya, Boalkhali, Chittagong Sadar, Panchlaish, Double Mooring, Chittagong Port, Rangunia and Rawgan upazila of Chittagong district which is characterized by withdrawal of huge quantity of groundwater for industrial and Chittagong city water supplies. This area is near about 946 sq km.

The study period of 2-year duration is based on collection of primary data surveyed by IWM and the secondary data from different sources. IWM carried out cross-section survey at selected locations and made water level and tidal discharge measurements along with salinity at some key locations. For addressing surface water model, MIKE 11 software would be used whereas for groundwater flow MIKE SHE software will be used.

The activities to be carried out under this study are:

- Primary data collection on tidal water level, discharge and river cross section
- Collection of secondary data relevant to the study theme
- Measurement of seepage and percolation rate
- Geo-referencing of important features
- Computation of irrigation, domestic and industrial water requirements for present and future condition
- Development, calibration and verifications of groundwater flow model. Also coupling with river flow model
- Investigate effects of climate change on the pattern of groundwater hydrology
- Investigate combined effects of human impacts and climate change on the pattern of groundwater hydrology

Pilot Area-1 (left) and Pilot Area-2 (right) of the Study
Joint Action Research with a Contributory Partnership on Groundwater Salinity Intrusion in the Coastal Area

Due to the national interest in groundwater in the coastal region, IWM carried out a study on salinity intrusion in groundwater in the coastal area of Bangladesh. It is a joint contributory partnership among the organizations namely DPHE, HYSAWA, Policy Support Unit (PSU), ITN - BUET and IWM, among which DPHE will monitor the study on behalf of the five collaborating agencies. The main objective of the joint research is to study i) the movement of saline front upland due to increase in human activities, reduced dry period flow and climate change and ii) the movement of the saltwater interface in response to water-management factors. In this regard, a MoU has been signed among the collaborative agencies on September 16, 2010. Subsequently a contract was signed between DPHE and IWM on September 30, 2010.

An area of 1577 km2 covering part of Khulna, Jessore and Satkhira districts was selected for the study. The area covers Dumuria Upazila and partly Phultala, Khan Jahan Ali, Batlaghat, Dacope and Paikgacha Upazilas of Khulna district; partly Abhaynagar, Manirampur and Keshabpur Upazilas of Jessore district; and partly Tala Upazila of Satkhira district (Figure). The Khulna City Corporation along with its adjacent area was included in the study area for defining the model boundary with river on the eastern part.

Following are the activities to be carried out:

- Hydrological data collection, i.e. tidal water level and discharge, river cross section
- Hydro-geological data collection, i.e., aquifer test, geophysical logging, resistivity sounding, EC survey.
- GW and SW salinity measurement
- Collection and review of secondary data
- Processing of collected data
- Monitoring of GW quality and level on newly installed observation wells
- Development, calibration and verifications of groundwater flow model. coupled with river flow model
- Development and calibration of two dimensional models of variable density in groundwater
- Baseline survey on socio-economic study
- Assistance to higher studies
- Training programme at home and abroad
Important Events

Guests in the Users Conference 2011

Mr. Ramesh Chandra Sen MP, Hon’ble Minister for Water Resources launching the website of Delta Alliance Bangladesh Wing

Guests in the Strategic Management Workshop in Sylhet

New BOT Chairperson welcomed at IWM

Shaikh Md. Wahid-uz-Zaman, Secretary, MOWR and Executive Director, IWM in Workshop on a research project of IWM

Guests in the Stakeholder Consultation Workshop
Water management projects immensely benefitted through the use of mathematical modelling tools — users in the IWM Users’ Conference

Mathematical Model is a useful tool to solve the complex water-related problems in the country and abroad. A large number of water management projects have been immensely benefitted through the use of mathematical modelling. The users came up with the view in the Users Conference organized by Institute Water Modelling on 24 September 2011 at BIAM Foundation, Dhaka.

Water Resources Minister Mr. Ramesh Chandra Sen MP graced the occasion as the Chief Guest while Al-hajj Md. Mahbubur Rahman, Hon’ble State Minister for Water Resources graced the occasion as Special Guest. Mr. Abu Alam Md. Shahid Khan, Secretary, Ministry of LGRD attended the conference as Guest of Honour. The conference was chaired by Water Resources Secretary Shaikh Md. Wahid-uz-Zaman. The conference was an august gathering of the water engineers, scientists, decision makers of the government, representatives from the national and international organizations and donor agencies.

The conference keynote paper titled ‘Challenges of the 21st Century and Role of IWM in Water and Climate” was presented by Prof. Dr. M. Monowar Hossain, Executive Director of IWM.

Speaking as the chief guest, Water Resources Minister Mr. Ramesh Chandra Sen said once there was a significant amount of water in the rivers, but in recent years, the rivers are drying up due to inadequate water flow. Expressing concern about the increasing population creating pressure on water and related resources, he urged the experts and researchers to find a sustainable solution to address the emerging problems. The government took initiative to restore the navigability of the rivers and save them from pollution. "Textile and leather industries in the capital must be relocated to save the Buriganga," he said. The minister suggested to the relevant agencies to rely on mathematical modelling for their water management projects as this tool had a proven track record.
In his speech of the Special Guest, State Minister for Water Resources Al-hajj Md. Mahbubur Rahman viewed that mathematical modelling nowadays is very important in different aspects for the benefit of our country. He thanked IWM for offering a wide range of specialist state-of-the-art services in mathematical modelling. He appreciated the applications of IWM modelling tools that covered a wide range of water related areas such as flood control, flood forecasting, irrigation and drainage, river morphology, salinity and sediment transport, coastal hydraulics, port, coast and estuary management, environmental impact assessment, bridge hydraulics and related infrastructure.

Shaikh Md. Wahid-uz-Zaman, Secretary Ministry of Water Resources and Chairperson of the IWM Board of Trustees who chaired the conference thanked all the users of IWM services. He appreciated IWM for the major breakthrough in the capacity development for Tsunami modelling and Climate Change Impact on monsoon flooding. He expressed that IWM would go for more research in the relevant field, and with the findings, this specialized organization would be able to guide the nation to right direction to address the present and future problems.

Guest of Honour of the conference Mr. Abu Alam Md. Shahid Khan, Secretary Ministry of LGRD congratulated IWM and appreciated IWM for the commendable works done through the use of mathematical modelling. He thanked IWM for the robust MIS developed by IWM for the DWASA. He also mentioned the Automatic Meter Recording (AMR) system modelled by IWM, which is taking us forward to achieve the dream of digital Bangladesh.

Professor Dr. M. Monowar Hossain, Executive Director of IWM through his keynote paper informed the audience about the IWM involvement in the large number of national projects including Ganges Barrage Modelling, feasibility of Padma Multipurpose Bridge, Safe drinking water source identification project in 148 Pourashavas, Sewarage Master Plan for Dhaka City, Teesta barrage project, Gorai River Restoration project, Morphological study for the safety of the Bangabandhu Bridge, Groundwater management and Zoning study etc. He also informed about IWM initiatives for the research as well has HRD programmes for technology transfer. More agencies are coming up to rely on mathematical modelling for improved water resources management.

A discussion by designated discussants and representatives from various IWM service users was held which was followed by an open discussion. The service users expressed their experience about the IWM services and discussed the unique modeling techniques developed by IWM, which have helped in the management of their projects.

A number of foreign guests from Denmark, Malaysia, Nepal, India and the Netherlands participated in the conference and appreciated IWM services in their countries specially in Malaysia. Director, NAHRIM Malaysia expressed his interest to enhance cooperation between the two organizations for future development in the water sector while Director of Jurutera Perunding Malaysia mentioned a number of their successful projects where IWM provided mathematical modelling service.

Mr. Abu Saleh Khan, Deputy Executive Director of IWM gave the vote of thanks to the participants for their participation and constructive criticism and hoped that IWM would be able to fulfill the aspirations of all in the days to come.
IWM Welcomed New BOT Chairperson

The management of IWM welcomed the new Chairperson of IWM Board of Trustees Shaikh Altaf Ali, Senior Secretary, Ministry of Water Resources during his visit to IWM on 29 November 2011.

Professor Dr. M. Monowar Hossain, Executive Director of IWM welcomed the new Chairperson and made a presentation on the different achievement and activities as well as future plans of the institute. Through the presentation, he demonstrated IWM capacity and its level of excellence. The Executive Director introduced the IWM Management Committee with the new Chairperson.

The Chairperson took keen interest on different models and projects which the institute has developed. IWM's contribution to the solution for various national water related problems drew his special attention. He appreciated IWM for its exposure to the international arena. The Chairperson visited different divisions of IWM and was briefed on the important projects of the divisions.

IWM Participates in the NARBO Seminar in Indonesia

Invited as Resource Person, Professor Dr. M. Monowar Hossain, Executive Director of IWM participated in the First Network of Asia River Basin Organization (NARBO) IWRM Executive Retreat on Leadership in River Basins & International Seminar on Corporate River Basin Organizations in Asia held at Malang and Solo River Basin in Indonesia during 20-24 June 2011. He presented a technical paper on Water Management in the Haor Basin in North-East Bangladesh. In his presentation and discussion, the Executive Director informed that the Haor basin being a very critical region both hydrologically and geologically and being endowed with rich biodiversity, variety of fish species, birds and other resources, need special attention while water resources management initiatives are implemented for the benefit of the local people.

The Executive Director also participated in the panel discussion as a panelist on issues related to River Basins in Asia. During the field visit at Brantas River Basin in Malang arranged by the organizer, the Executive Director planted a sapling of Genitri, a local variety tree in the reserve forest.

The seminar was attended by about 100 participants from Asian Regional Countries, ADB, Asia Pacific Water Forum, Academia and Researchers.
Executive Director participates in the International Water Week in the Netherlands

Professor Dr. M. Monowar Hossain, Executive Director, Institute of Water Modelling (IWM) participated in the International Water Week (IWW) held in Amsterdam, the Netherlands during 31 October-03 November 2011. The conference aimed to promote integration of knowledge about innovative solutions as regards improvements to technology, quality and water management.

Dr. Hossain participated in the Aquaterra Parallel Session on Bangladesh Delta on 2nd November 2011 as a Panel Member. He also participated and made a short and informative presentation on Inter-delta Comparison Session chaired by Ms. Catharien Terwisscha van Scheltinga. Ms. Catharien provided all out supports and cooperation for the Bangladesh delegation team. The Bangladesh team comprised Prof. Shamsul Alam, Member (GED), Planning Commission, Prof. Dr. Z. Karim, Prof. Dr. M. Monowar Hossain, Executive Director, IWM, Mr. Giasuddin Ahmed Choudhury, Executive Director, CEGIS and Mr. Nandan Mukherjee of BRAC University.

The team member of Bangladesh delegation also participated in the Second Dutch Delta Congress held on 3rd November 2011 in RAI Convention Centre of Amsterdam.

Seminar on Artificial Recharge by Rainwater Harvesting

Institute of Water Modelling co-organized a seminar along with Dhaka WASA on "Artificial Recharge to Dhaka Aquifer by Harvesting Rainwater from Rooftop" on Sunday, 12 June 2011 at Hotel Pan Pacific Sonargaon, Dhaka. Mr. Shajahan Khan MP, Hon’ble Minister, Ministry of Shipping graced the occasion as the Chief Guest while Mr. Abu Alam Md. Shahid Khan, Secretary, Local Government Division, Ministry of LGRD&C and Dr. Khondakar Showkat Hossain, Secretary, Ministry of Housing and Public Works attended the seminar as Special Guests. The Seminar was chaired by Dr. Engr. Gholam Mostofa, Chairman, Dhaka WASA.

The seminar focused on the different aspects of rainwater harvesting and how it can be an effective measure to mitigate the groundwater mining and present water supply crisis as well.

Mr. Mizanur Rahman, Senior Groundwater Specialist, IWM presented the keynote paper in the seminar and showed how rainwater can benefit Dhaka aquifer through artificially recharging it by injecting harvested rainwater. Prof. Dr. M. Monowar Hossain, Executive Director of IWM also spoke on the topic in the seminar. A lively question and answer session took place after the presentation.

The seminar was attended by high officials and experts from Ministries, including Dhaka WASA, DPHE, PWD, National Housing Settlement Authority, International NGOs, RAIN Forum and Experts from local consulting firms.
1st Stakeholder Consultation Workshop on Food Security, Water and Disaster Management Issues in Bangladesh

Institute of Water Modelling (IWM) and Partners of Delta Alliance Bangladesh Wing with the support from Dutch CIWK (Information Services on Water & Climate) organized the 1st Stakeholder Consultation workshop on 31 July 2011 at LGED Conference Room, Dhaka on Food Security, Water and Disaster Management Issues in Bangladesh for sectoral information requirements analysis for the Dutch CIWK partnership with Bangladesh.

Quamrun Nahar Khanam, Addl. Secretary, Ministry of Water Resources, graced the occasion as Chief Guest while H.E. Mr. Alphons Hennekens, Ambassador, Royal Netherlands Embassy attended as Special Guests. Prof. Dr. M. Monowar Hossain, Coordinator Delta Alliance Bangladesh Wing and Executive Director, IWM chaired the consultation program.

This stakeholder consultation is part of the on-going and long-term Dutch-Bangladesh collaboration in water management, Water Mondiaal, where currently new programmes are being formulated, based on public-private partnerships. This will lead to the formulation of new areas of collaboration, addressing the specific needs of Bangladesh in the field of food security, water and disaster management sectors.

In the stakeholder consultation workshop Dr. Z. Karim, Team Leader for Agriculture Master Plan development for the Southern Delta by FAO deliberated on Food Sector opportunities and challenges; while the presentation on Water sector opportunities and challenges was made by Mr. Abdul Wadud Bhuiyan, Addl. Director General, Planning, Bangladesh Water Development Board. Dr. Babar Kabir of BRAC presented on the business case example on Food Security Information services.

Experts and decision makers from the relevant ministries, development partners, representatives from different government and non-government organizations attended the workshop.

Seminar on Dhaka Case Study for Collaborative Research on Flood Resilience in Urban Areas (CORFU)

A comprehensive master plan is needed to address “urban flooding” in Dhaka, as it will become a major challenge for the mega city in the coming days, due to rapid but unplanned urbanization—the experts said in a seminar held on 21 September 2011. It will be a tremendous challenge for the city to remove water logging, they said.

Institute of Water Modelling (IWM) organized the workshop on ‘Dhaka Case Study for Collaborative Research on Flood Resilience in Urban Areas’ (CORFU), at BRAC Centre Inn in Dhaka. The experts said the city experiences water logging in its various parts during monsoon and it has become acute in recent years for lack of proper drainage system.

Shaikh Md. Wahid-uz-Zaman, Secretary, Ministry of Water Resources, Dr. Gholam Mostafa, Chairman, Dhaka WASA, among others, addressed the workshop. Prof. Dr. M. Monowar Hossain, Executive Director chaired the occasion.
IWM Branch Office in Malaysia Opened

Institute of Water Modelling (IWM) arranged the opening ceremony of its branch office in Malaysia on 06 October 2011 at Hotel Grand Seasons in Kuala Lumpur. The branch office in Malaysia has been named as Institute of Water Modelling Malaysia Sdn Bhd.

Mr. AKM Atiqur Rahman, High Commissioner, Bangladesh High Commission, Malaysia graced the occasion as the Chief Guest while Ir. Hj. Ahmad Jamaluddin, Director General, National Hydraulic Research Institute of Malaysia (NAHRIM); Ir. Haji Hanapi Mohamad Noor, Director, Department of Irrigation and Drainage and Managing Director, Jurutera Perunding Zaaba Sdn Bhd attended the ceremony as Special Guests.

Professor Dr. M. Monowar Hossain, Executive Director, IWM Chair the occasion. Dr. A. F. M. Afzal Hossain, Director, Irrigation Management Division and now Deputy Executive Director (in-charge), P&D IWM welcomed the guests and participants and Mr. Zahir-ul Haque Khan, Director, Coast, Port and Estuary Management Division presented the completed and on-going project activities of IWM in Malaysia.

In his address, Mr Ahmad Jamaluddin emphasized on joint research, training and knowledge sharing on climate change projects, impact assessment and adaptation measures. The guests from the Malaysian side congratulated IWM for opening the branch office in Kuala Lumpur. All the participants opined that by opening the branch, IWM can now provide better services for devising solutions to address the complex water related problems in Malaysia.

IWM organizes Strategic Management Workshop

Institute of Water Modelling organized a two-day Strategic Management Workshop at Nazimgarh Resort, Sylhet during 25-26 February 2011. Mr. Shaikh Md. Wahid-uz-Zaman, Secretary, Ministry of Water Resources and Chairperson, IWM Board of Trustees (BOT) attended the programme as the Chief Guest while Mr. S. M. Al-Hussainy, Chairman, Swanirvar Bangladesh and Member, IWM BOT and Mr. Md. Habibur Rahman, Director General, BWDB and Treasurer, IWM BOT graced the occasion as the Special Guests. A total of 25 Senior Professionals and Management Staff of the Institute attended the programme where a preliminary draft report was presented by Mr. G. M. Chowdhury, Director, IBA as the management consultant appointed by IWM. Lively group discussions as well as group exercises was held during the workshop and the feedback from the exercises are expected to be incorporated in the final report. A detailed analysis & discussion on the current strengths, weaknesses, opportunities and threats (SWOT) of IWM was done in the workshop. The workshop was aimed to identify measures to strengthen IWM to meet the in house as well as external challenges of the future.
## Major Contracts signed in 2011

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<td>6</td>
<td>Monitoring and Hydraulic Investigation for evaluation the performance of Navigation Improvement work of Mongla Port.</td>
<td>MPA</td>
</tr>
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<td>7</td>
<td>Halda Water Modelling Study for Assessment of Sustainability of Restoration of Spawning Ground in the Halda River.</td>
<td>Fisheries Dte.</td>
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<td>8</td>
<td>CEIP: Feasibility Study for the Coastal Embankment Improvement Project</td>
<td>Consultant/BWDB</td>
</tr>
<tr>
<td>9</td>
<td>SW-KJDRP: Monitoring &amp; Evaluation of the Hydrological &amp; Morphological Conditions of Rivers &amp; Drainage Problems of Beels in the KJDRP area for the Planning of Drainage Improvement Measures</td>
<td>BWDB</td>
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<tr>
<td>10</td>
<td>CPWF: Assessment of Impacts of anticipated external drivers of change on water resources of the coastal zone</td>
<td>CPWF</td>
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<td>11</td>
<td>Water Modelling for Sungai Langat basin (river &amp; ground water) for water abstraction studies of Megasteel.</td>
<td>Malaysia</td>
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<tr>
<td>12</td>
<td>Sundarban: Bangladesh Climate Change Adaptation, Biodiversity Conservation &amp; Sustainable Socio-Economic Development of the Sundarban Area- Non-lending Technical Assistance</td>
<td>World Bank</td>
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<tr>
<td>13</td>
<td>Feasibility Study for Navigation Improvement and Sustainable Water Management of Bhairab River Basin</td>
<td>BWDB</td>
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<tr>
<td>14</td>
<td>IRRI: Increasing the Resilience of Agricultural and Aquaculture Systems in the Coastal Area of Ganges Delta</td>
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<td>15</td>
<td>Groundwater Resource study for 8 districts of Rajshahi Divison, BMDA Phase -2</td>
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<td>16</td>
<td>Package-1: Mathematical Modelling Study (Groundwater and Surface Water)</td>
<td>BWDB</td>
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<tr>
<td>17</td>
<td>Package – 2 Math Modelling Saline Water Intrusion – MIS</td>
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<tr>
<td>18</td>
<td>Package-3 Hydrological Study &amp; Modelling.</td>
<td>BWDB</td>
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<tr>
<td>19</td>
<td>Hydro-morphological Studies for LGED 9 Bridges in the SW Region</td>
<td>Consultant/LGED</td>
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<tr>
<td>20</td>
<td>Morphological Study for the Selected Offtake in Connection with the Buirganga Augmentation Project</td>
<td>BWDB</td>
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<tr>
<td>21</td>
<td>Mathematical Morphological Modelling in connection with Sustainable River Management Plan for Main Rivers, Distributaries and Tributaries in Bangladesh</td>
<td>BWDB</td>
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<tr>
<td>22</td>
<td>Mathematical Modelling for Future Plan Development – After Excavation of Chandana-Barasia River</td>
<td>BWDB</td>
</tr>
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<td>23</td>
<td>Mathematical Modelling in connection with Preparation of Master Plan for Ashuganj Power Station</td>
<td>Consultant</td>
</tr>
<tr>
<td>24</td>
<td>Hydrological &amp; Hydraulic Study and Environmental Impact Assessment for Bhangura-Naogaon GCM Road under Bhangura Upazila of Pabna District</td>
<td>LGED</td>
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<tr>
<td>25</td>
<td>National Hygiene Promotion Strategy for WSS’</td>
<td>DPHE</td>
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<tr>
<td>26</td>
<td>Future Assessment of Water Resources in Bangladesh</td>
<td>International Institute</td>
</tr>
<tr>
<td>27</td>
<td>Topographical &amp; Physical Feature Survey &amp; Mapping for Rooppur Nuclear Power Plant (RNPP)</td>
<td>BAEC</td>
</tr>
<tr>
<td>28</td>
<td>Quality control, Monitoring and Impact Assessment of Pilot Dredging of Jamuna River at 2 locations from Sirajganj Hardpoint to Dhaleswari Offtake (20 Km) and Near the Nalini Bazar (2 Km)</td>
<td>BWDB</td>
</tr>
<tr>
<td>29</td>
<td>Pre-Feasibility Study to Restore the Environment of the Kaptai Lake</td>
<td>BWDB</td>
</tr>
</tbody>
</table>
List of Major **Training programmes** during 2011

Training and Technology Transfer is a regular activity of IWM aims at updating its resources with the new knowledge and technology and to cope with the new challenges in water sector. Following is the brief on the HRD programmes conducted in 2011:

<table>
<thead>
<tr>
<th>Sl</th>
<th>Title of Training</th>
<th>Trainee</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Training on Flood Forecasting Model and its Application by Mike 11 Model</td>
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<tr>
<td>2</td>
<td>Training on Flood Estimation under Climate Change</td>
<td>8</td>
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<tr>
<td>3</td>
<td>Training programme on Basic ARC-GIS</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>Training programme on Bay Model (MIKE 21FM)</td>
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</tr>
<tr>
<td>5</td>
<td>Training on Salinity Modelling</td>
<td>10</td>
</tr>
<tr>
<td>6</td>
<td>Training on Climate Change and Storm Surge Modelling</td>
<td>3</td>
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<tr>
<td>7</td>
<td>Short course on Conservation of Riverine Ecosystems under Changing Environment</td>
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<tr>
<td>8</td>
<td>Workshop on Flood Resilience in Urban Areas (CORFU)</td>
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<tr>
<td>9</td>
<td>Training course on Linux System Administration and Server Configuration</td>
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<tr>
<td>10</td>
<td>Training programme on WRF and Storm Surge Modelling</td>
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<tr>
<td>11</td>
<td>Specialization Course on Facing the challenges of Climate Change: Impact, Issues and Adaptation Strategies for Bangladesh</td>
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<tr>
<td>12</td>
<td>Training course on Delft3D</td>
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<tr>
<td>13</td>
<td>Orientation Course for the Newly Recruited Junior Engineers (JE) – 2011</td>
<td>18</td>
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<tr>
<td>14</td>
<td>Capacity building training under DANIDA supported project ‘Assistance to climate Change Adaptation and Disaster Risk Reduction in the Northeast Region of Bangladesh’</td>
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<tr>
<td>15</td>
<td>Training programme on MIKE FLOOD</td>
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<tr>
<td>16</td>
<td>International Visitor Programme on “Transboundary Water Resources Management”</td>
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</tr>
<tr>
<td>17</td>
<td>Training on “Water Security &amp; Climate Change”</td>
<td>2</td>
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<tr>
<td>18</td>
<td>Training on Mathematical Modelling (part-3) and Interactive Information System (IIS)</td>
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<tr>
<td>19</td>
<td>Workshop on “ADPC-Bjerknes WRF Workshop”</td>
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<tr>
<td>20</td>
<td>International Symposium on “Preparing a Water Supply Master Plan for a Newly declared City Lacking land use guideline and Demographic Information”</td>
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<tr>
<td>21</td>
<td>Two-day long training workshop on “Statistical Downscaling for Developing Climate Change Scenarios”</td>
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</tr>
<tr>
<td>22</td>
<td>Training on Basic ARC-GIS</td>
<td>12</td>
</tr>
<tr>
<td>23</td>
<td>Training Courses on Hydrographic Survey using Hydro Pro Software</td>
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<tr>
<td>24</td>
<td>Training on Risk Modeling (CAPRA), Disaster Statistics, and Open DRI</td>
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</tr>
<tr>
<td>25</td>
<td>Training on Business English</td>
<td>20</td>
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</tbody>
</table>
Year-wise HRD programmes for staff development

Training for IWM Staff Development in 2011

**Yearwise Number of Professionals by Expertise**

<table>
<thead>
<tr>
<th>Sl#</th>
<th>Service</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
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<tbody>
<tr>
<td>1</td>
<td>Integrated Water Resources Management</td>
<td>8</td>
<td>9</td>
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<tr>
<td>2</td>
<td>Flood Management</td>
<td>7</td>
<td>7</td>
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<td>7</td>
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<tr>
<td>3</td>
<td>Irrigation Management</td>
<td>4</td>
<td>5</td>
<td>5</td>
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</tr>
<tr>
<td>4</td>
<td>Groundwater Management</td>
<td>6</td>
<td>7</td>
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<tr>
<td>5</td>
<td>Fluvial Hydraulics and River Morphology</td>
<td>7</td>
<td>7</td>
<td>8</td>
<td>8</td>
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<td>6</td>
<td>River Engineering</td>
<td>10</td>
<td>11</td>
<td>11</td>
<td>12</td>
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<tr>
<td>7</td>
<td>Water Quality and Ecology</td>
<td>5</td>
<td>6</td>
<td>7</td>
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<tr>
<td>8</td>
<td>Integrated Coastal Zone Management</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>7</td>
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<tr>
<td>9</td>
<td>Coastal Hydraulics and Morphology</td>
<td>3</td>
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<td>4</td>
<td>5</td>
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<tr>
<td>10</td>
<td>Port &amp; Coastal Structure Management</td>
<td>5</td>
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<tr>
<td>11</td>
<td>Software Management and IT Solutions</td>
<td>6</td>
<td>7</td>
<td>6</td>
<td>7</td>
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<td>12</td>
<td>Hydrographic Survey</td>
<td>6</td>
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<td>7</td>
<td>8</td>
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<td>13</td>
<td>Topographic Survey and Mapping</td>
<td>7</td>
<td>7</td>
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<td>8</td>
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<td>14</td>
<td>Computer System Management</td>
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<td>15</td>
<td>Climate Change</td>
<td>3</td>
<td>4</td>
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<td></td>
<td><strong>Total</strong></td>
<td>84</td>
<td>93</td>
<td>96</td>
<td>107</td>
</tr>
</tbody>
</table>

**Year-wise No. of Training and Participants**


**IWM Training Clients**

- IWM: Integrated Water Management
- CARE: Centre for Agricultural Research and Education
- NGO Forum: Non-Governmental Organization Forum
- Training Clients: RHD, BWDB, WARPO, ATM, M&E, MRC, DHE

**PS:** Principal Specialist, **SS:** Senior Specialist, **AS:** Associate Specialist, **JS:** Junior Specialist, **JE:** Junior Engineer