River Research Institute

ANNUAL REPORT

2021

Providing technical assistance to develop country's water resources in a sustainable manner

RIVER RESEARCH INSTITUTE, FARIDPUR
Ministry of Water Resources
Government of the People's Republic of Bangladesh

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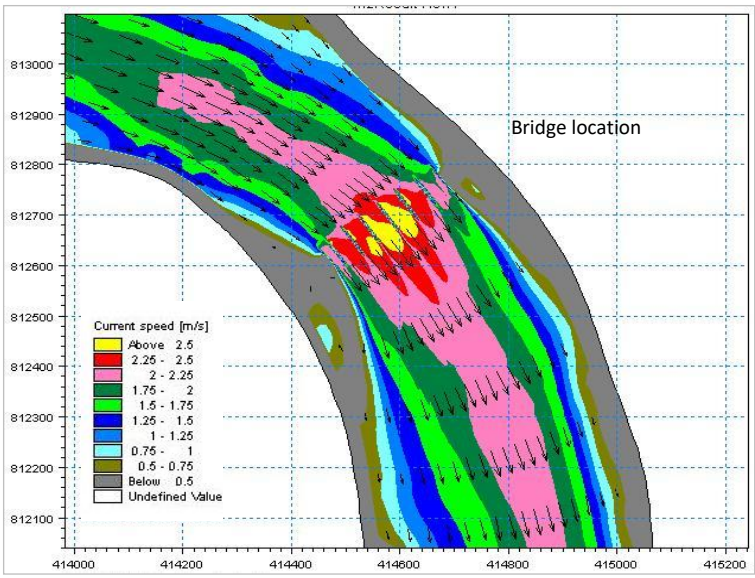

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RIVER RESEARCH INSTITUTE, FARIDPUR
MINISTRY OF WATER RESOURCES
GOVERNMENT OF THE PEOPLE'S REPUBLIC OF BANGLADESH

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EDITORIAL NOTE

Like others, the normal day life has come to a virtual standstill across the country this year as a result of COVID-19 pandemic so has our usual office activities. The disruption is enormous. Country-wide offices remain closed entirely for three months, projects have been mothballed, fieldwork interrupted, and meetings with officials are on pause. We had taken all-out preparation to commemorate the 100th birth anniversary of Father of the Nation, Bangabandhu Sheikh Mujibur Rahman. However, we are celebrating the birth centenary of the state's founder President on a limited scale owing to worldwide nCoV outbreak.

This annual report includes overall account of the institute, activities performed by its different directorates and monetary management in the last (2020-2021) fiscal year. It also highlights the background, objectives and outcomes of different physical as well as numerical model studies and the testing conducted for various properties of soil, concrete, water and sediment as well. Furthermore, this report encompasses the human resource development, research and development activities, development and future prospects etc. which will assist in rendering useful information to the organizations as well as individuals employing in the water sector.

The Editorial Committee likes to express its sincere thanks and gratitude to Chief Advisor Mr. Md. Alim Uddin, Director General of RRI for his invaluable suggestions, necessary guidelines and assistance in publishing this report. The committee sincerely recognizes the guidance provided by the advisors for making this report informative and comprehensive. The committee is also indebted to the relevant person who extended their efforts and co-operation in preparing and publishing this report in time.

RRI BOARD OF GOVERNORS

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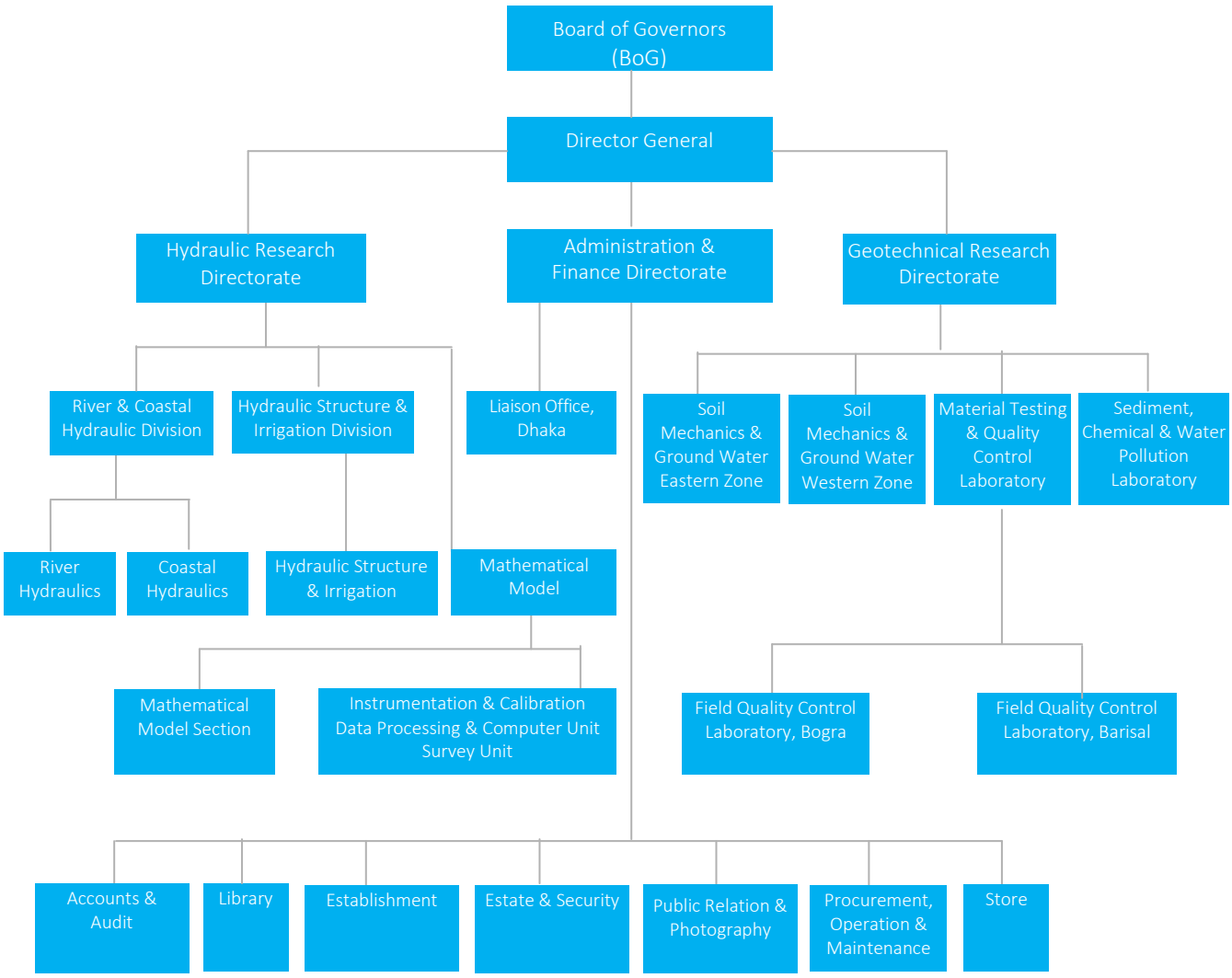
Note: BOG is provided here as of July, 2021

RRI'S ORGANIZATIONAL STRUCTURE



WHAT RRI DO

The activities of RRI as per Act 53 of 1990 are directed towards the achievements of the following objectives:

- To carry out studies for design supports in river training, riverbank protection, flood control, irrigation & drainage works and to conduct research in river engineering, sediment control, estuary and tidal effects by means of physical model.

- To conduct mathematical model studies on river flow & regional flow network, hydrology, surface & ground water utilization and environmental issues with special attention to salinity intrusion & water quality with a view to develop the water resources.

- To perform tests on construction materials required for river training, riverbank protection, flood control, irrigation & drainage structures and to inspect & evaluate the quality of the construction works thereof.

- To conduct training program on the above-mentioned subjects and to publish reports &periodicals related to technical aspects.

- To advise the Government, Local Authority or any organizations regarding the problems and best approach towards the solution on the above mentioned subjects.

- To co-operate & conduct joint ventured research work with other similar local or foreign organizations.

- To take any necessary steps for performing the above mentioned works

WHAT KIND OF SERVICE CITIZENS CAN EXPECT FROM RRI

- Providing consultancy services for viable technical solutions to the problems related to riverbank erosion, flooding, drainage and irrigation.
- Assisting in development of water resources by devising appropriate technological solutions for maintaining river flow, use of surface and ground water, environmental protection and reducing salinity.
- Testing and assessment of quality of soil, sediment, water as well as materials used for construction of water infrastructures for water resources development and river management.
- Conducting applied research on river management, sediment control of river, coast and estuary management etc. using physical and mathematical modeling technology and publishing the research results in report form as well as in periodicals and journals.
- Field level implementation of research outcomes in limited form to assess its effectiveness.
- Conducting basic research to develop understanding of river and coastal processes for the sake of applied research works.
- Taking up problem oriented research and studies as to decrease in dry season flow of the rivers, sedimentation in river bed, loss of navigability of rivers, increase in flooding, long-term water logging etc. to furnish the outcomes to the planners and decision makers.
- Taking up projects for capacity building of the institute as well as human resource development and conducting joint venture multi-disciplinary studies.
- Determining the physical, chemical and engineering properties of sediment along with various chemical properties of surface and ground water such as arsenic, iron, calcium, magnesium, sulphate, carbonate, potassium, salinity, etc.

INTRODUCTION

River Research Institute (RRI) is a national research organization in Bangladesh. It is working as a statutory public authority under the Ministry of Water Resources (MoWR), Government of the People's Republic of Bangladesh. RRI has a Board of Governors (BoG) comprising ten members chaired by the Hon'ble Minister, MoWR, Government of the People's Republic of Bangladesh which reviews and evaluates the activities of RRI and approves important proposals so that it can run with all its activities properly. Director General is the Chief Executive of the institute and responsible for implementation of the decisions approved by the BoG. The activities of RRI are conducted by three directorates namely, Hydraulic Research Directorate, Geotechnical Research Directorate, and Administration and Finance Directorate. The first two directorates operate the research activities while the last is responsible for the overall administration and financial activities of RRI and works for its development.

RRI is set up with a view to devising plans and actions to develop water resources in a sustainable manner to meet the development needs of Bangladesh. Since its establishment, RRI has been conducting multi-disciplinary and problem oriented tests and researches in the field of River Hydraulics, Hydraulics of Structure and Irrigation, Coastal Hydraulics, Soil Mechanics, Material Testing and Quality Control, Sediment Technology, Hydro-chemistry, Geo-chemistry and Instrumentation. The results of such tests and research are playing a vital role in providing information and recommendations regarding different water resources development plans and interventions.

RRI has been conducting physical modelling in the field of water resources since its establishment. RRI has also been involved in Mathematical modelling since 2009. Physical and mathematical modelling tools are complementary to each other. Both physical and Mathematical model have been proved very essential for sound engineering judgments to find out solutions for different water resources development projects. In view of this, RRI has adopted hybrid-modelling approach by using physical as well as Mathematical modelling to improve the understanding of different water systems, which may lead to safe and less expensive solutions for engineering problems. RRI has the mandate for conducting hydrodynamic and morphological study of the river mainly to derive and verify the design parameters of any hydraulic structures, bank protection and river training works.

During fiscal year 2020-21, four research investigations are being carried out at RRI. In addition to these studies, one pilot project having 3-year duration for bank erosion mitigation, land reclamation and maintaining navigation route using Bamboo Bandalling structures and one project having 3-year duration for Institutional Development and Capacity Building (IDCB) (phase-II) have been completed in this fiscal year. In addition to that, one innovation project entitled "Anaerobic Digestion for Waste Management and Biogas Production for making RRI campus clean" is in progress. Short description of the on-going research works, completed bamboo bandalling project as well as IDCBP (phase-II) project, Innovation project are furnished under the section "Research and Development"

RRI has conducted ten in-house training and three seminars in 2020-2021 fiscal year for skill development of its scientists and engineers as well as other officials. Most of the trainings and seminars have been arranged under the on-going projects in that fiscal year in RRI. A list of in-house trainings and seminars appears in section 4. Moreover, a number of officials and staffs are trained out-side training. Details description of in-house training, out-side training and seminar are summarised under the section "Human Resource Development"

As per requirements of different clients, some proposals have been submitted for model studies and correspondence with the relevant organization is going on. A good number of soil, water, sediment and construction material samples are received from different projects of Bangladesh Water Development Board (BWDB) and other organizations. These samples are tested with the sophisticated laboratory equipment of RRI as routine works of Geo-technical Research Directorate. The results and findings are sent to the project authorities concerned. Recently, many pieces of equipment have been procured under IDCB project (Phase-II) for Geo-technical Research Directorate as well as Hydraulic Research Directorate.

In addition, the operation and maintenance activities of office and residential buildings, roads, rest house, vehicles, water supply system, sewerage system, power distribution system including power generator etc. are routinely done as presented under section "A & F Directorate"

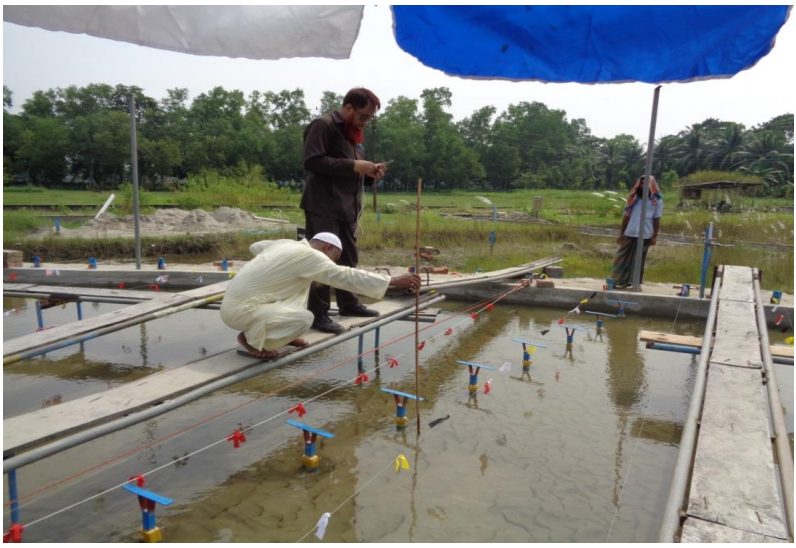
Qualified and trained personnel are very much essential to meet the objectives of RRI and maintain

its standard to the international level. For this purpose a number of officials have already been completed their higher studies and obtained training in the related fields at home and abroad. Many others are expected to be trained in the near future. At present RRI has shortage of junior officers to undertake more responsibilities. For this reason recruitment of junior officials is under consideration. The existing manpower is, however, well experienced and well trained in the field of hydraulic, geotechnical and environmental engineering. Detailed list of existing scientists, supporting and managerial staffs are shown in Annexures. List of abbreviations is shown in the Annexures.

RRI has also been publishing journal named 'Technical Journal' yearly since 1991. RRI's technical journal got recognition in 2000 by ISSN - International Centre, 20, rue Bachaumont, 75002 Paris - France and its serial has been registered as ISSN 1606-9277 with key- title: Technical journal - River Research Institute, abbreviated key- title: Tech. J. - River Res. Inst. Multidisciplinary research activities and case studies of different water resources projects are published in the journal.

RRI undertakes sports and cultural activities and observes all national days. RRI officials and staffs along with their families take part spontaneously in the sports and cultural activities. In addition, RRI takes part in different world and international days such as "world water day" and different national program taken by the government such as National Development Fair (Jatio Unnayanmela), Information Fair (Totthomela) etc. Celebrated of national days and memorable moments for RRI officials appeared in Annexures.



HYDRAULIC RESEARCH DIRECTORATE

The Hydraulic Research Directorate (HRD) has three divisions such as (i) River and Coastal Hydraulics (ii) Hydraulic Structure and Irrigation and (iii) Mathematical Model. These three divisions carry out studies and research work in the field of flood control and drainage, river training and bank protection, coastal engineering, hydraulic structure and irrigation etc. by means of physical and mathematical modelling along with other laboratory testing and studies. This directorate is well equipped with physical and mathematical modelling facilities.

Physical Modelling

Physical modelling is an authentic tool, which can be used confidently to verify the effectiveness of any structural intervention in the river and coastline protection works by reproducing the natural phenomena of river and coastal hydro-morphology at a reduced scale. The causes of any river and coastal engineering problems are identified and its mitigation measures are investigated through physical modelling. Local scour, 3-dimensional flow phenomena like eddy and vortex, morphological processes and developments etc. are possible to reproduce well in physical model. The important design parameters such as local scour around the structure, flow field, maximum velocity, appropriate location, dimension and orientation of hydraulic structures, spacing between groyne/spur like structures etc. can also be obtained by physical modelling. The physical process/phenomena, which are not possible to describe well by empirical formula and mathematical expression, can be easily reproduced precisely in physical modelling. Moreover, the real phenomena that are happening in the field are only possible to visualize by physical modelling. RRI has sufficient physical modeling facilities including Indoor and outdoor model areas. Other available facilities include various measuring instruments, tide generator, wave generator, sediment feeder, power generator, workshop etc.

So far, more than two hundreds of Physical model studies of different projects have been conducted by Hydraulic Research Directorate since 1948. Some of the important Physical model studies carried out at RRI are as follows:

Important Physical model studies conducted at RRI and achievement in the past

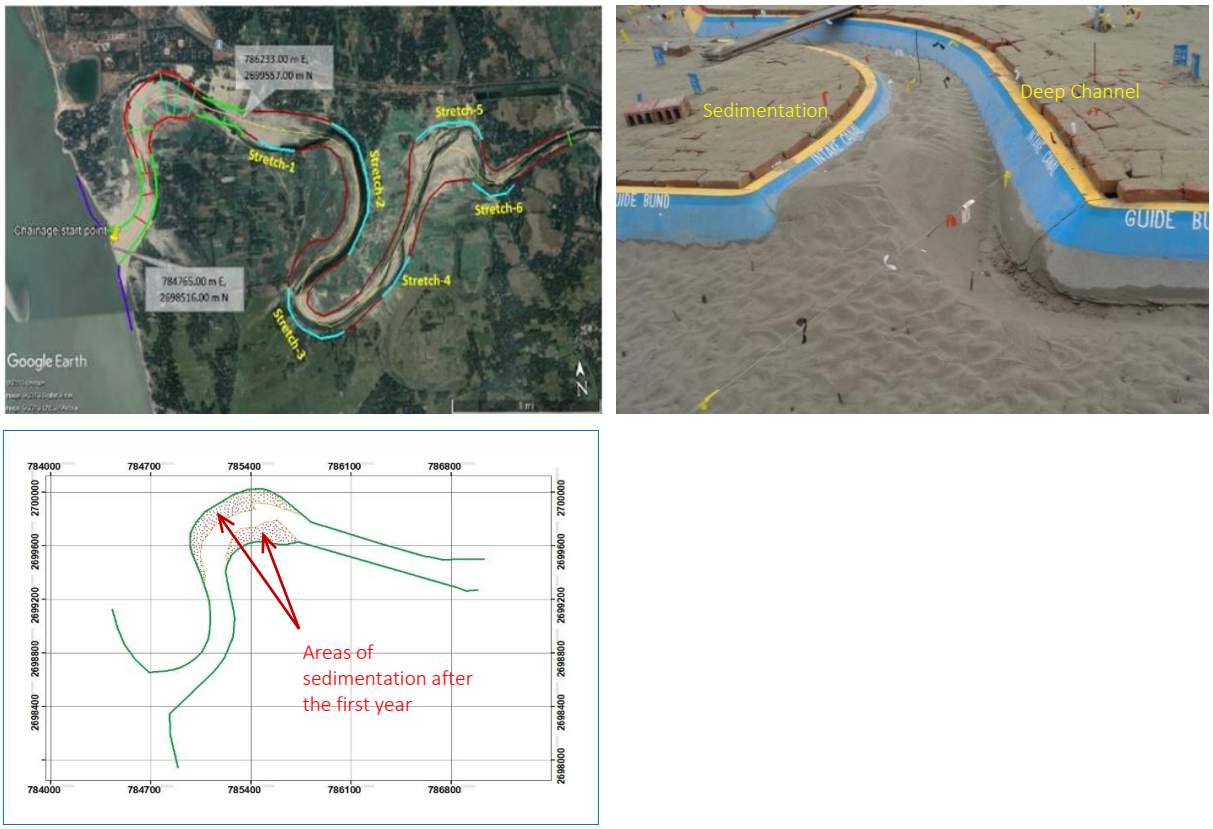
Name of the project	Year of completion	Objectives of the Physical modelling
Sustainability of the Buriganga River Restoration Project (Revised)	2021	To augment 141 cumec dry season flow in the Buriganga river by diverting 245 cumec water from the Jamuna river through the New Dhaleswari-Pungli-Bangshi-Turag-Buriganga river system.
Padma River Dredging Management Project	2019	To investigate the efficacy of dredging options, strategies and spoil disposal plan
Sustainability of the Buriganga River Restoration Project	2019	To finalize the layout of the off-take structure such as guide bund, intake canal and sedimentation basin in order to get required discharge in Dhaleshwari River.
Bangabandhu Railway Bridge Project	2018	To determine the local scour around the proposed Bangabandhu Railway Bridge pier and to check the efficacy of the existing RTW with proposed railway bridge pier.
Laboratory Based Study Using Concrete Block Mats to control River Bank	2018	To determine the cost effectiveness and sustainability of Concrete Block Mats compared to traditional method of river bank protection
Paira Bridge Project	2016	To finalize the type, location, dimension and hydraulic design parameters of the proposed river training works
Ganges barrage project	2013	To finalize the location, effectiveness and design parameters of the proposed barrage.
Padma multipurpose Bridge project	2013	To check the efficacy of river training structure.
3rdKarnaphully bridge project	2006	To decide the effectiveness and design parameters of bridge piers.
Gorai river restoration project	2001	To find out the suitable options for sustainable measures.
Bangabandhu multipurpose bridge project	2000	To find out the efficacy of river training structure and to solve instantly arising any difficulties during the period of erection.
Paksey roadway bridge project	1996	To verify the efficacy of river training structure.
Silt trap model for Teesta barrage project	1994	To finalize the effectiveness and design parameters of the barrage component.

Physical Model Study for Sustainability of the Buriganga River Restoration Project (Revised)

The Buriganga is the main river flowing beside Dhaka, capital city of Bangladesh. Over the last several decades the flow of Buriganga, Turag, Shitalakkha and Balu River has been reduced drastically. As a consequence, the water quality of the river Buriganga has been severely deteriorated due to insufficient river flow, solid waste, tannery and disposal of contaminant effluent from different types of industries. In addition, continual growth of population and changes of the socio-economic perspective have severely encroached the once famous inland navigation route of Dhaka and Narayanganj. In view of the above circumstances, Bangladesh Water Development Board (BWDB) undertook a project entitled "Buriganga River Restoration Project (BRRP)" with a view to ensure sufficient dry season flow in the river Buriganga by diverting flow from the Jamuna river. Institute of Water Modelling (IWM) carried out a full-scale

feasibility and mathematical model study (2008) from which it was revealed that in order to augment 141cumec dry season flow in the Buriganga river, 245cumec of the Jamuna flow has to be diverted through the New Dhaleshwari river. It was also understood that without sustainable management of the New Dhaleshwari off-take it would not be possible to augment flow in the Buriganga river during dry the season due to large scale sedimentation at the off-take and in the distributary river bed. In order to ensure diversion of 245cumec of Jamuna flow structural interventions at the off-take in the form of guide bunds, sediment basin and dredging would be needed. Sediments that enter into the New Dhaleshwari river from the Jamuna should be allowed to settle at a specified location to facilitate maintenance dredging and to let more or less sediment-free water to enter into the river system. The planning and design of appropriate structural measures at off-take need decision support by the physical model investigation. Under the above circumstances, an agreement has been signed between BWDB and RRI on 13th June, 2017 to carry out the physical model investigation for sustainability of Buriganga River Restoration Project.

The overall objective of physical model studies is to augment 141 cumec dry season flow in the Buriganga river by diverting 245 cumec water from the Jamuna river through the New Dhaleswari-Pungli-Bangshi-Turag-Buriganga river system. The model would confirm the adequacy of hydraulic design of sedimentation basin and revetment. It would fix up the proper alignment and optimize the dimension of sedimentation basin as well as the location of revetment at the intake canal.



Location of erosion prone stretches within the study reach (top left); Final bed configuration at the off-take after sedimentation in the dredged channel in Test T2 (top right); Areas of sediment deposition within the sediment basin in the first year (bottom left).

Study outcomes in brief

There exists, sedimentation problem at the New Dhaleshwari off-take. The mean bed level as well as the minimum bed level at the mouth of the river is much higher than the dry season water level of the parent river (Jamuna). As a result, no flow situation occurs during dry season in the New Dhaleshwari river. The rivers surrounding the Dhaka city receive flow from the Jamuna river through New Dhaleshwari river. Due to adverse morphological developments at the off-take of the New Dhaleshwari river and large-scale sedimentation in the river bed downstream of the off-take these rivers virtually get no flow from the Jamuna for a considerable period of a year. In order to restore the polluted Buriganga river, a flow of 141 m3/s has to be added to bring up the dissolved oxygen level to a tolerable limit. It could be done by augmenting 245 m3/s of flow from the Jamuna river through new Dhaleshwari river.

In order to augment the targeted flow from the Jamuna river a sustainable solution of the sedimentation problem at the off-take and in the river channel downstream of the same is essential; The New Dhaleshwari river originates from the Jamuna river at about 3km downstream of the Bangabandhu bridge. It was a small channel prior to the construction of the Bangabandhu bridge. During construction of the bridge the mouth of the Old Dhaleshwari river was closed and as a result, the mouth of the New Dhaleshwari river opened up. Since then, the river has undergone large scale morphological changes. Analysis of recent field data indicates that the off-take of this river is still unstable and the river is yet to attain its dynamic equilibrium state. The proposed interventions at the off-take in the form of guide bunds, intake channel, sedimentation basin and exit channel could be a solution of the existing problem if properly planned and implemented with provision for long-term monitoring and maintenance dredging.

Model results suggest that targeted flow augmentation of the New Dhaleshwari river is possible with the proposed interventions at the off-take and dredging as per design. However, river channel downstream of the interventions has also to be dredged to a level of 0mPWD with sufficient width for smooth passage of dry season flow. The extent of such dredging should be determined based on field data as in the model study only 10km stretch of the New Dhaleshwari river has been reproduced; Implementation of the proposed structural interventions with dredging only within the interventions as per design will increase the flood discharge through the New Dhaleshwari river.

Discharge of the New Dhaleshwari river corresponding to the dominant discharge of the Jamuna river will be more than two times higher compared to that in base condition. However, this increased discharge is not sufficient enough to lower the bed level of the downstream channel to a level that allows for the smooth conveyance of targeted dry season flow.

The dredged channel will tend to get filled up gradually. It is unlikely that the sedimentation will occur only within the sediment basin as thought before. In fact, sedimentation will occur throughout the dredged channel including sediment basin at the intervention locations. Several sand waves will move from upstream to downstream during the filling up process. It may take about 4 to 5 years for the river to reach its dynamic equilibrium state by filling the dredged channel if no maintenance dredging is carried out. Dredging within and beyond the intervention area will cause a fourfold increase in the New Dhaleshwari discharge corresponding to the dominant discharge of the Jamuna river compared to base condition. However, in the beginning this increase in discharge is found to be five-fold higher than that in base condition. If no dredging is done it would continue to decrease with time until a more or less dynamic equilibrium state is reached.

Within the sedimentation basin, a sand bar would tend to form along the right-side bund and the deep channel would tend to shift towards the left side; In the intake channel the deep channel will remain along the right bank. There is potential for forming deep scour hole at the off-take mouth on the right side, at the starting point of the sedimentation basin on the right side and at the end point of the sedimentation basin on the left side. These locations should be protected well against local scour and developments there should be monitored closely.

Total volume of sediment deposited at the intervention locations (intake channel, sedimentation basin and downstream channel is estimated to be 36 ft3 in the model which is equivalent to 2228941 m3 in the prototype. It has taken about 80 hours of model run to attain this state. The 2D morphological time scale of this model is estimated to be 113. It means it would take several years (4 to 5 years) in the prototype for similar development to occur. Of the total volume of deposited sediment within the

intervention location within four years, 59% will get deposited in the sediment basin. On the other hand, the percentage of deposited sediment in the intake and exit canals will be 33% and 8% respectively. If no dredging is done the average thickness of sedimentation in the intake canal and sediment basin will be 3.84m and 4.13m respectively.

In the first year, the volume of net sedimentation in the intervention location may be 653242m3 of which 16% may be deposited in the intake canal, 76% in the sediment basin and 8% in the exit canal. The average thickness of sedimentation after the first year varies spatially. In the sediment basin, the average thickness of sedimentation could be 1.57m; If no dredging is done in any year particularly in the sediment basin and at the immediate upstream and downstream of the same there may arise uncertainty in having targeted dry season flow of 245m3/s to some extent.

The model covers 10km stretch of the New Dhaleshwari starting from the off-take. Therefore, it is not possible to furnish any indication as to what may happen elsewhere in the whole river system in terms of sedimentation. It appears from the model results that the rate of sedimentation may decrease towards the downstream from the exit point of sediment basin. However, the unprotected banks in the downstream of the intervention location may experience erosion/accretion. Also, there may occur bed erosion at different locations. The cross-sectional shape of the dredged channel may undergo changes. However, the cross-sectional area may not change much after the first year compared to the initial condition (just after dredging). Proposed structural interventions at the off-take and dredging within and beyond the structural interventions will ensure targeted dry season flow through the New Dhaleshwari river. The planning for annual maintenance dredging should be made based on monitoring survey data. Monitoring of developments may be made in the light of depositional.

Due to increased flood discharge and consequent increased flow velocity bank erosion potential may increase in the entire river system particularly at the bend locations. In order to cope with this situation outer bank of the eroding bends may be stabilized by undertaking appropriate bank protection measures. There is a sharp bend in the immediate downstream of the intervention location. The cut-off ratio of this bend is very high. An imminent natural cut-off is not unlikely under increased flood discharge condition. After the occurrence of an artificial or natural cut-off a river takes quite some time for self-adjustment against such a development/intervention. It may result in increased bank erosion in the downstream of the cut-off. Since the results of this model investigation are indicative, it would be wise to use the given information in combination with results from numerical model studies and detail model studies (if any) to assist in developing the final design for the structural interventions.

The findings from this model investigation may be used in combination with results from numerical model studies and detail model studies (if any) in developing the final design for the structural interventions and dredging. Since the New Dhaleshwari off-take and river morphology undergo constant changes, it is recommended to consider the most recent morphological conditions during the planning and design of the proposed interventions. Dredging up to the recommended level (0.00mPWD) downstream of the interventions should be considered. The stretch of the river over which dredging to be carried out should be determined based on the most recent field data.

The need for annual maintenance dredging should be determined based on monitoring survey data analysis and monitoring may be conducted in the light of the depositional trend as revealed from this study. The volume of sediment (653242m3) that may get deposited in the intervention location during the first year as revealed from this model study should be considered indicative. Dredging every year in the sediment basin and at its immediately upstream and downstream may be considered to make sure availability of targeted dry season flow of 245m3/s.

The implications of dredging on flooding potential, bank erosion potential and safety of the existing structures in the river system should be taken into account and appropriate measures should be taken where and when necessary to reduce potential damages to an acceptable limit. The proposed structural interventions should be implemented as per plan and design. A technically sound dredging strategy and phase wise implementation plan may be devised. Use of physical modeling tool for technical assistance during implementation and monitoring phase of the project may be considered.

Mathematical Modelling

At present time, Mathematical modelling tool is being widely used all over the world for research and studies in the field of water resources engineering. It has become an important tool for decision support in planning and management of water resources and sustainable water infrastructure development. In many cases Mathematical modeling is complementary to physical modeling to arrive at sound engineering judgment as to planning, design and implementation of water infrastructure projects. In view of this fact, the GoB has equipped RRI with mathematical modeling facilities (MIKE Series) to enhance its quality of works. It is expected that RRI will play a vital role in water sector as well as in other related sectors to make the water resources development cost effective and sustainable. It can be mentioned here that RRI has already completed a number of mathematical model studies from 2009 to till. Some of the Mathematical model studies conducted by RRI are mentioned hereafter. Recently, one mathematical model study entitled "Topographical, Hydrological and Morphological Study using mathematical model for Madanpur-Dirai-Sullah (Dirai-Sullah Portion) Road under Sunamganj Road Division during the year 2018-19 has been completed.

Important Mathematical model studies conducted at RRI in the past

- Detail Engineering Design of Kurigram Irrigation Project (South Unit).
- Wazed Miah Bridge project in Rangpur District under Rangpur Road Division of RHD.
- Road Bridge over the Banar River on Mymensingh-Goffargaon-Toke Road in Mymensingh District under Mymensingh Road Division of RHD.
- Road Bridge over the river Lohalia at Boga in Patuakhali District under Patuakhali Road Division of RHD.
- Hydro-morphological Study for Pagla-Jagannathpur-Raniganj-Aushkandi Road Project in Sunamganj District under Sunanganj Road Division of RHD.
- Road Bridge over the Kalni River in Habiganj District under Habiganj Road Division of RHD.
- Road Bridge at Nalua-Baherchar over the river Pandab-Paira in Patuakhali District under Patuakhali Road Division of RHD.
- Road Bridge over the Monu River in Moulvibazar District under Moulvibazar Road Division of RHD.

Recently Mathematical model studies conducted at RRI

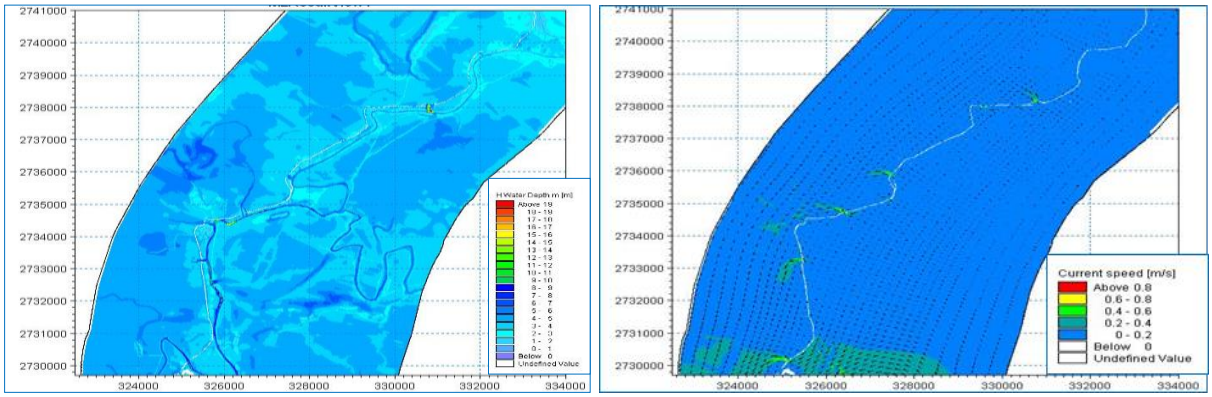
- Hydro-morphological Study using Mathematical Model for New Sachna-Golakpur Road Project under Sunamganj Road Division of RHD.
- Proposed Sonahat Bridge over the river Dudhkumar under Kurigram Road Division of RHD.
- Proposed Kaharol Bridge over the river Punarbhaba River under Dinajpur Road Division of RHD.
- Improvement of Nikli – Soharmul - Karimganj Road &Gunnodhor GC - Mojlishpure GC Road under Rural Infrastructures Development Project of Kishorgonj District of LGED.
- Hydro-morphological Study using Mathematical Model for Madanpur-Dirai-Sullah (Dirai-Sullah Portion) Road under Sunamganj Road Division of RHD.

Hydro-morphological Study for Madanpur-Dirai-Sullah Road

Shunumganj district is located in the north-east region of Bangladesh. Dirai and Sullah are two upazilas under Sunamganj district. These upazilas are naturally resourceful with rice and fish cultivation. At present, there is no smooth road communication between these upazilas as the road link between the Dirai and Sullah upazila headquarters is not yet suitable for vehicular movement. While the Dirai upazila headquarter is connected with national road network by RHD zila road most of the people of these two upazilas can not avail this opportunity easily. The LGED upazila roads that connect the upazila headquarters with different markets, growth centers and other important places are submersible

and remain operational only for light weight vehicles during dry season. With the advent of monsoon season the low-lying haor area where these two upazilas are situated start to get filled by floodwater coming from from the transboundary catchments of the Meghalaya, the Barak and the Tripura situated to the north, east and southeast respectively across the border in India. By the month of July most of the areas in these two upazilas get deeply flooded. As a result, people of this region have to solely depend on waterway communication to move from one place to another. Therefore, in order to connect these isolated upazilas to national road network, it is essential to construct and improve the Madanpur-Dirai-Sullah road. If this road is constructed and improved to the status of RHD zila road, it will be easier to transport agricultural products from these upazilas to other parts of the country, and people of this region will get transport facilities throughout the year. It will connect Sullah upazila headquarter to the district town and rest of the country. Schools, madrasas and small cottage industries will reap benefit from this roadway communication. As a result, socio-economic condition of the people will improve. With a view to connect Sullah upazila headquarter with Dirai upazila headquarter and to enhance the existing communication facilities, Road Division, RHD, Sunumganj has taken initiatives to construct and improve the existing Dirai-Sullah portion of the Madanpur-Dirai-Sullah road. It is to be noted here that construction of road embankment of the proposed road link has been completed by and large although there are a number of occurrences of damage to road and road embankment slope protection works. Most of the bridges and culverts have already been constructed. However, a number of road structures have lost connection with the roadway due to damage of approaches fully or partially. Sustainability of the road that runs through a low-lying region with complex hydrological setting is, therefore, a vital issue to be addressed properly in deciding about the appropriate road alignment, road structure type, location and dimension as well as stretches of the road that need protection against overtopping, parallel current and wave action.

Under this background, Road Division, RHD, Sunamganj has decided to conduct a comprehensive hydro-morphological study using mathematical model for assessing the existing Madanpur-Dirai-Sullah road (Dirai-Sullah portion) and road structures to determine the appropriateness and adequacy of the existing road alignment and road structures in terms of their sustainability under different hydrological scenarios, to suggest appropriate road alignment and type, location, dimension and hydraulic design variables of the road structures, to assess the need for river training/protective works and to provide type, location, dimension and hydraulic design variables of the river training/protective works. The study was completed in FY 2019-20.



Flood depths in the study area and at and around the road for 50-year discharge in Option-3 condition (left); Velocity field in the study area under Option-3 condition for 50-year discharge (right)

Proposals for model study

During the 2020-21 financial year, RRI has submitted a number of technical and financial proposals to different clients for physical and mathematical model studies. Besides, RRI is in constant contact with different organizations for taking up studies to address different water related problems and to devise sustainable solutions. Some of the proposed studies have been mentioned hereafter.

1. Physical modeling study for dredging and bank protection works along Tetulia river at Bakerganj and Bauphal upazillas under Barisal and Patuakhali districts

2. Physical Model Study to Support Sustainable Management of the Lower Meghna River (Between the Padma-Meghna Confluence and Haimchar)

3. Large Scale Physical Hydraulic Modeling Tests on Falling Apron Behavior Considering Geotechnical and Hydraulic Factors

4. Hydro-Morphological Study of proposed proposed Bridge over the Kushiyara River at 18th Km of Moulvibazar (Rajnagar)-Sylhet (Balaganj) (Z-2017) Road

5. Hydro-Morphological Study of proposed 2nd Manu Bridge site at Mirpur – Sreemongal – Moulvibazar – Sherpur (N-207) Road

Recently procured some equipment (supported by IDCB Project, Phase-II) to enrich the RRI's hydraulic lab

3D Bed Profiler (HR Wallingford, UK) (left) used for physical model study and ADCP (Sontek, Xylem, USA) (right) used for hydrographic survey

Radar water level sensor (Sontek, Xylem, USA) (left) and Dual Channel Echo-Sounder (Teledyne, USA) (right) used for hydrographic survey

2D Wave Generator (HR Wallingford, UK) (left) and Tide Generator with 3D Wave Maker (HR Wallingford, UK) (right) used for coastal physical model study




GEO-TECHNICAL RESEARCH DIRECTORATE

Geo-technical Research Directorate comprises of three divisions. These are Soil Mechanics and Groundwater Eastern & Western Zone division (Soil mechanics division), Material Testing & Quality Control division and Sediment, Chemical & Water pollution division. The scope of works and facilities available in each division are narrated in the following sections.

Soil Mechanics and Ground Water Eastern & Western Zone (Soil Mechanics Division)

Soil Mechanics and Groundwater Eastern and Western Zone of Geo-technical Research Directorate is an utmost important wing of RRI. It has been conducting tests and research work for the determination of different physical parameters of soils which are required for planning and design of the infrastructures of flood control, irrigation, drainage, water development and other development projects. Ground Water Circle (GWC) of BWDB and other organizations explore site and complete their boring and collect soil samples from different project sites in connection with construction of hydraulic structures like bridges, dams, barrages, regulators, Sluices, weirs, flood control and river training works and other relevant works. Site investigation and boring logs are prepared by them are sent to RRI with collected samples. RRI has developed sufficient laboratory facilities for testing of soil samples received from the clients. The soil samples of these zones are tested with great care by the scientists and trained / skilled soil technicians. Finally, the reports on the tested soil samples are prepared based on field investigation and laboratory analysis of data. The reports focus on the engineering characteristics of the soil samples according to the foundation needs. Then the approved report is sent to the respective clients along with bill. The works executed in connection with soil testing, analysis and publication of reports during 2020-2021 have been discussed briefly in this section.

Receiving procedure of soil samples

The disturbed soil samples were collected by driving split spoon sampler and undisturbed soil samples in Shelby tubes by the clients and sent to the Soil Mechanics and Groundwater laboratory of Geo-technical Research Directorate of RRI. A total 696 nos. of samples from GWC of BWDB and other organizations in fiscal year 2020-21 were received in the laboratory. All the samples were tested and reports were sent to the respective clients.

Testing of soil samples

At first all the soil samples are visually examined in the laboratory and representative samples are selected for necessary testing. Generally, tests are conducted for determining Natural Moisture Content (NMC), Grain Size Distribution, Atterberg Limits, Density (γ), Void Ratio (e), Compression Index (Cc), Unconfined Compressive Strength (q_u), Shear Strength (cohesion c and angle of internal friction Φ), by Direct Shear, Tri-axial Shear with or without pore pressure, California Bearing Ratio (CBR) value and Permeability value etc. As per planned schedule, different tests are performed simultaneously in order to work out all necessary parameters quickly within the shortest possible time. Other necessary soil parameters are also tested according to client's requirements.

Visual inspection and scrutinized disturbed soil samples for simultaneous testing (left) Consolidation triaxial testing using Electro Mechanical Triaxial Testing machine (right)

List of samples received (project-wise in chart), billed amount and volume of work executed during 2020-21 in Soil Mechanics & Ground Water Division

Sl No.	Report No.	Name of Division / Client	Name of Project/Work	No. of Sample Received & Tested	Billed amount (Taka)
01	01 (2020-2021)	Executive Engineer Cox's Bazar O&M Division BWDB, Coxs Bazar.	Determination of various parameter for undisturbed soil samples of Polder No. 70 at Matarbari-Dhalghata Under Maheshkhali Upazila in Coxs bazar'.	04	239968.00
02	02 (2020-2021)	Sub-Divisional Engineer Anowara O&M Sub-Division BWDB, Chattogram.	Height Raising work of Sea-Dyke from km 37.000 to km 38.942 at Gohira of Raipur Union, Upazila Anowara under Polder No. 63/1A.	01	5550.00
03	03 (2020-2021)	Executive Engineer Faridpur O&M Division BWDB, Faridpur.	Protective work along the Right Bank of Arial Khan River from km 0.000 to km 0.300 = 300m (with U/S Endtermination) at Chandrapara in C/W Bank Protective Work & Dredging Project in Arial Khan River in Upazilla- Sadarpur Distict-Faridpur during the FY 2018-2019 & 2019-2020.	06	58350.00
04	04 (2020-2021)	Director CEGIS, Dhaka.	Rehabilitation of Polders 67/A, 67, 67/B & 68 along the border river of NAF for Improving Bangladesh-Myanmar Security Project at Cox's Bazar (km 10.000 to km 14.000 in Polder No. 68).	01	11250.00

05	05 (2020-2021)	Sub-Divisional Engineer Sandwip O&M Sub-Division BWDB, Chattogram.	Testing of Soil of Existing Embankment including slope protection work from km 0.00 to km 21.500 in between 9.800 km in connection with Rehabilitation of erosion prone area with slope protection work in polder No-72, Sandwip, Chittagong, (1st Revised)" under Chittagong O&M Division-2, BWDB, Chittagon.	03	18000.00
06	06 (2020-2021)	Sub-Divisional Engineer Anowara O&M Sub-Division BWDB, Chattogram.	Protective Work along Sea-Dyke from km. 35.150 to 36.460 (length = 1310.00 m) at Barawlia in Raipur Union under Polder No. 63/1A, in connection with Rehabilitation of Coastal Polder No. 62 (Patenga), 63/1A (Anowara), 63/1B (Anowara & Patiya) in Chittagong District in Upazila: Anowara, District: Chittagong, during the year 2017-2018. Tender ID- 211693 & Package No. e-GP-49/ADP/Barawlia/ PW/2017-2018 under Anowara Sub-Division, BWDB, Chittagong	01	6000.00
07	07 (2020-2021)	Sub-Divisional Engineer Tangail W.D. Sub-Division-1 BWDB, Tangail.	Construction of Extended L/B Guide bundh of Bangabandhu Bridge with protection around the mouth of New Dhaleswari offtake channel U/S from km 0.300 to km 0.750 = 450m in connection with Buriganga River Restoration Project Under Tangail O&M Division, BWDB, Tangail during the year 2017-2018	01	6000.00
08	08 (2020-2021)	Sub-Divisional Engineer Tangail W.D. Sub-Division-1 BWDB, Tangail.	Construction of Extended L/B Guide bundh of Bangabandhu Bridge with protection around the mouth of New Dhaleswari offtake channel U/S from km 0.750 to km 0.900 = 150m & km 0.000 to km 0.178 = 178m Total 328m in connection with Buriganga River Restoration Project Under Tangail O&M Division, BWDB, Tangail during the year 2017-2018	01	6000.00
09	09 (2020-2021)	Sub-Divisional Engineer Tangail W.D. Sub-Division-1 BWDB, Tangail.	Construction of Extended L/B Guide bundh of Bangabandhu Bridge with protection around the mouth of New Dhaleswari offtake channel U/S from km 1.2085 to km 1.500 = 291.50m & End termination 78.50m Total 370m in connection with Buriganga River Restoration Project(2nd Revised) Under Tangail O&M Division, BWDB, Tangail during the year 2019-2020	01	6000.00

10	10 (2020-2021)	Sub-Divisional Engineer Tangail W.D. Sub-Division-1 BWDB, Tangail.	Construction of Extended L/B Guide bundh of Bangabandhu Bridge with Protection around the mouth of New Dhaleswari offtake channel U/S from km 0.000 to km 0.1785 = 178.50m Turning 78.50m, Wings 125m total = 382.00m in connection with Buriganga River Restoration Project Under Tangail O&M Division, BWDB, Tangail during the year 2017-2018.	01	6000.00
11	11 (2020-2021)	Sub-Divisional Engineer Tangail W.D. Sub-Division-1 BWDB, Tangail.	Protection work for the Protection of Sediment Basin by C.C. Block for the Length of 1493m from erosion of the left bank of New Dhaleswari River in Upazila Kalihati District Tangail Under Tangail O&M Division, BWDB, Tangail during the year 2017-2018	01	6000.00
12	12 (2020-2021)	Sub-Divisional Engineer Tangail W.D. Sub-Division-1 BWDB, Tangail.	Construction of Extended L/B Guide bundh of Bangabandhu Bridge with protection around the mouth of New Dhaleswari offtake channel U/S from km 0.300 to km 0.750 = 450m in connection with Buriganga River Restoration Project Under Tangail O&M Division, BWDB, Tangail during the year 2017-2018	01	11250.00
13	13 (2020-2021)	Sub-Divisional Engineer Tangail W.D. Sub-Division-1 BWDB, Tangail.	Construction of Extended L/B Guide bundh of Bangabandhu Bridge with protection around the mouth of New Dhaleswari offtake channel U/S from km 0.750 to km 0.900 = 150m & 0.0000 km to 0.178 km = 178m Total 328m in connection with Buriganga River Restoration Project Under Tangail O&M Division, BWDB, Tangail during the year 2017-2018	01	11250.00
14	14 (2020-2021)	Sub-Divisional Engineer Tangail W.D. Sub-Division-1 BWDB, Tangail.	Construction of Extended L/B Guide bundh of Bangabandhu Bridge with protection around the mouth of New Dhaleswari offtake channel U/S from km 1.2085 to km 1.500 = 291.50m & ent termination 78.50m Total 370.00m in connection with Buriganga River Restoration Project(2nd revised) Under Tangail O&M Division, BWDB, Tangail during the year 2019-2020	01	11250.00
15	15 (2020-2021)	Sub-Divisional Engineer Tangail W.D. Sub-Division-1 BWDB, Tangail.	Construction of Extended L/B Guide bundh of Bangabandhu Bridge with protection around the mouth of New Dhaleswari offtake channel U/S from km 0.000 to km 0.1785 = 0.17850m Turning 78.50m, Wings 125.00m Total 382.00m in connection with Buriganga River Restoration Project Under Tangail O&M Division, BWDB, Tangail during the year 2017-2018	01	11250.00
16	15 (2020-2021)		Construction of Extended L/B Guide bundh of Bangabandhu Bridge with	01	11250.00

		Sub-Divisional Engineer Tangail W.D. Sub-Division-1 BWDB, Tangail.	protection around the mouth of New Dhaleswari offtake channel U/S from km 0.000 to km 0.1785 = 0.17850m Turning 78.50m, Wings 125.00m Total 382.00m in connection with Buriganga River Restoration Project Under Tangail O&M Division, BWDB, Tangail during the year 2017-2018		
	Total			26	425368.00

Field services

In order to assist the quality control of earth works of different projects, RRI sends experienced technicians on deputation to the field in response to the request from the project authority (mainly from BWDB). During the deputation period, technicians are involved in conducting in-situ tests for the on-going projects. During the fiscal year 2019-2020, two trained soil technicians were posted in the different working sites. Technicians are deputed in the field for several quality control works such as Field Compaction, Relative Density, Grain Size, Limit, Natural Moisture Content, Hydrometer, Field Quality Control, Loss-on-ignition etc. at different projects.

Recently procured equipment (supported by IDCB Project, Phase-II) for Soil Testing Laboratory: Menard Pressure Meter with GeoBox (Apageo, France) (left) and Hydraulic Rotary Drilling Rig (Massenza, Italy) (Right)

Material Testing and Quality Control Division

The Material Testing and Quality Control discipline of Geo-technical Research Directorate deals with the determination of physical and engineering properties of concrete and concrete materials normally used for different types of river training works, hydraulic structures and other infrastructures. It also involves 'Laboratory Trial Mix' and computation of concrete mix design to attend particular design strength with materials to be used in the construction works. At present this discipline has two types of working facilities viz. laboratory oriented testing & research facilities and the other is monitoring & evaluation of construction works by conducting field tests and investigations for quality control of concrete to the ongoing projects.

Laboratory activities in 2020-21 fiscal year

During the fiscal year 2020-21, a total of 361 number samples/specimens of cement, sand, shingles/stone chips, bricks, concrete cylinders were received from the different ongoing projects under the different divisions of BWDB and other Govt. and Non-Govt. organizations for conducting tests as specified by the clients.

Category-wise list of samples received from different BWDB Divisions and other organizations during the fiscal year 2020-21

Sl. No.	Name of division/ Other organization/ Field laboratory	Cement	Sand	Stone/ Khoa	Concrete cylinde/ Core	Block	Brick	Total sample
1	Faridpur O&M Division, BWDB, Faridpur.	10	17	9	69	0	0	105
2	Magura O&M Division, BWDB, Magura.	6	10	6	42	0	0	64
3	Kushtia O&M Division, BWDB, Kushtia.	4	10	14	21	0	6	55
4	Rajbari O&M Division, BWDB, Rajbari.	2	3	2	0	9	0	16
5	Shariatpur O&M Division, BWDB, Shariatpur.	5	40	20	3	5	0	73
6	SBC Consultant, Faridpur.	0	0	0	0	0	3	3
7	Mir Cement Co. Ltd, Faridpur.	1	0	0	0	0	0	1
8	Bogra O&M Division, BWDB, Bogra.	3	7	3	0	15	0	28
9	Specialized Division, BWDB, Faridpur.	0	0	0	3	3	0	6
10	IDCB, Phase-II, RRI, Faridpur.	4	2	1	0	0	0	7
11	Ruppur AKH Center, Rajbari.	0	0	0	6	0	0	6
	Total	35	89	55	144	35	6	364

Name of the Projects, total no. of samples received and billed amount & recovery amount of different BWDB Divisions and other organization during the fiscal year 2020-21.

Sl. No.	Name of division/Other organization/ Field laboratory	Total nos. of sample tested	Billed amount (in Taka)	Recovery (in Taka)
1	Faridpur O&M Division, BWDB, Faridpur.	105	231000.00	231000.00
2	Magura O&M Division, BWDB, Magura.	64	140550.00	140550.00
3	Kushtia O&M Division, BWDB, Kushtia.	55	132225.00	132225.00
4	Rajbari O&M Division, BWDB, Rajbari.	16	77250.00	77250.00
5	Shariatpur O&M Division, BWDB, Shariatpur.	73	209250.00	209250.00
6	SBC Consultant, Faridpur.	3	3300.00	3300.00
7	Mir Cement Co. Ltd, Faridpur.	1	11625.00	11625.00
8	Bogra O&M Division, BWDB, Bogra.	28	127200.00	127200.00
9	Specialized Division, BWDB, Faridpur.	6	17025.00	17025.00
10	IDCB, Phase-II, RRI, Faridpur.	7	52725.00	52725.00

Sl. No.	Name of division/Other organization/ Field laboratory	Total nos. of sample tested	Billed amount (in Taka)	Recovery (in Taka)
11	Ruppur AKH Center, Rajbari.	6	5250.00	5250.00
Total		364	1007400.00	1007400.00

Field services

For quality control of works, a few numbers of trained technicians were deputed in the field in response to the request from the project authority. During the fiscal year 2020-21, 04 (four) number of technicians were deputed in the different work sites of BWDB.

Recently purchased equipment (supported by IDCB Project, Phase-II) for Concrete and Material Testing Laboratory: Concrete crushing machine (Controls, Italy) (left) and Core cutter machine (Hilti, Switzerland) (right) used for cutting concrete block and extract core.

Sediment, Chemical and Water Pollution division

Sediment, Chemical and Water Pollution division is one of the testing and research discipline of Geo-technical Research Directorate of RRI. There are two laboratories under this division, namely Sediment Technology laboratory and Chemical and Water Pollution laboratory. Test and analysis of various kinds of sediment samples of different rivers of Bangladesh are being carried out in the Sediment Technology laboratory. The test results are used for planning and designing of hydraulic structures like barrages, drainage channels, irrigation canals, flushing sluices, closures etc. Sediment testing results are also used in physical and mathematical model studies. In the chemical and water pollution laboratory, samples of surface and ground water are being analysed for using water in different purposes.

Test activities during 2020-2021 fiscal year

A total number of 1222 samples including general suspended sediment, bulk suspended sediment, river bed and bank soil samples and water samples were received and tested in the sediment echnology laboratory as well as chemical laboratory during the fiscal year 2020-2021. The general suspended sediment and bulk suspended sediment samples were collected by the field personnel of 4 (four) measurement divisions under the Surface Water Hydrology Circle-I of BWDB. The samples were collected as a routine work by the Surface Water Hydrology Circle-I of BWDB. The river water samples were collected by research team of Bamboo bandalling project of RRI for research purposes. Moreover, the water samples were supplied by the research team of manganese research project of RRI.

Category-wise list of samples with the clients

Sl. No.	Name of client	Category of samples	Nos. of samples received and tested
1	Surface Water Hydrology Circle-I of BWDB	General suspended sediment samples	363
2	Surface Water Hydrology Circle-I of BWDB	Bulk suspended sediment samples	232
3	Surface Water Hydrology Circle-I & II of BWDB	Silt samples	06
3	Bamboo bandalling Pilot project RRI	General suspended sediment samples	371
4	Institute of Water Modelling (IWM), Dhaka	River bed and bank material samples	190
5	Others	Water samples	60
	Total samples		1222

Testing Facilities in Chemical and Water Pollution Laboratory

Chemical and Water Pollution laboratory is well equipped laboratory with modern instruments including Gas Chromatography-Mass Spectroscopy, Atomic Absorption Spectrometer, Spectrophotometer, Portable spectrophotometer, portable multi-parameter meter, Aquaculture testing kit, etc. These equipment are designed with cutting-edge technology and are ideal for a wide range of applications including environmental, materials, geological, food safety, clinical and petrochemicals purpose. Recently RRI has procured Total Organic Carbon (TOC) analyzer, Particle size analyzer and Carbon-Hydrogen-Nitrogen-Sulpher (CHNS) analyzer for Chemical Laboratory under Institutional Development and Capacity Building (IDCB) Project (Phase-II).

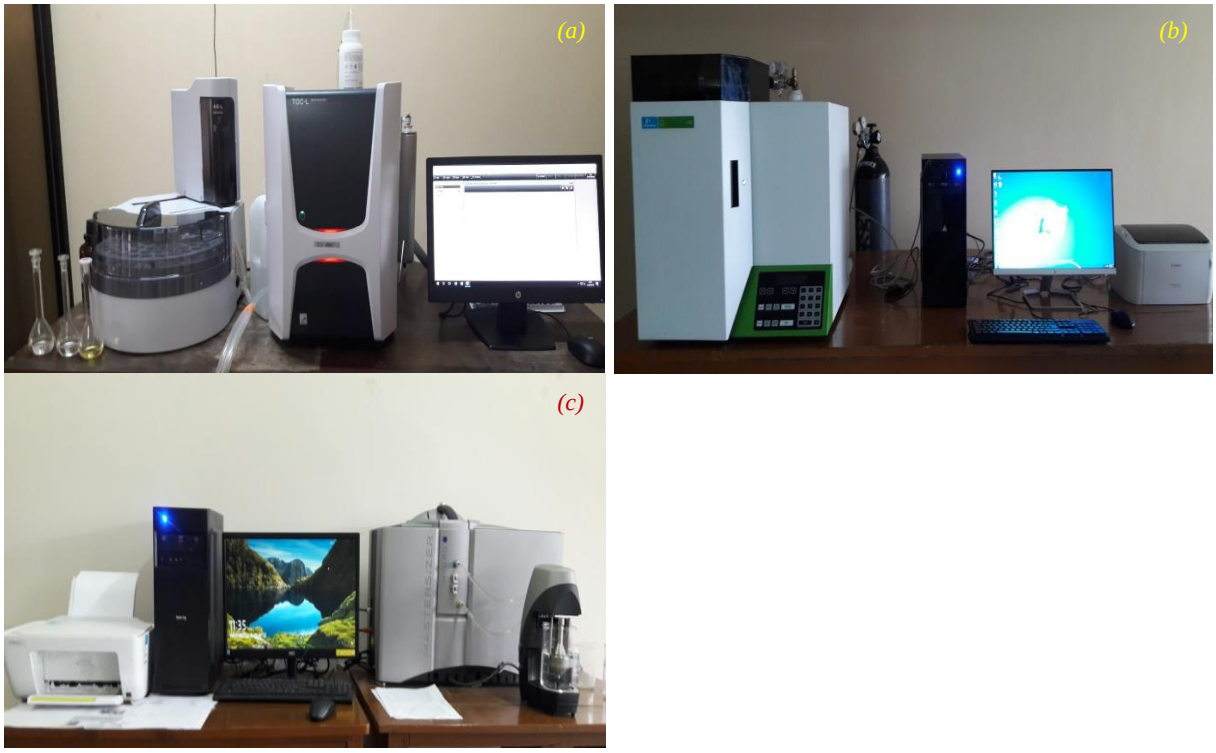
Portable Air Monitoring System with rain gauge (HAZ SCANNER, Model: HIM-600) is mainly used for EIA purpose. It is noticed that it is used specifically to determine Air particulate matters, humidity, temperature, wind speed with direction etc.
Computerized Microscope Stemi 305 is used to determine shape & particle size of soil, bio-physical organism of water samples such as Fytoplankton, Zoo plankton etc.

'Gas Chromatography Mass Spectroscopy' is used in Chemical and Water Pollution Laboratory for detecting volatile organic compounds, pesticide, insecticide, etc. in soil, sediment and water samples.

'Atomic Absorption Spectrometer' is used in this laboratory for determining metals like Na, K, Ca, Cr, Ni, Cu, Mn, Mg, Si, Ba, Fe, Zn, Co, Bi, Cd, Pb, As, Pt, Ag, Al, Sb, Se, Hg, B, Sn, Be, Mo, etc. in soil, sediment and water. Hach Spectrophotometer is used to detect substances such as Al, Ba, B, Cd, Cr, Mg, Fe, Cl, C, Ni, Fl, SO_4, etc. in soil, sediment and water samples. Hach portable colorimeter is used to detect substances in the field as Hach spectrometer does in the laboratory. Portable Multiparameter meter is used to determine pH, DO, EC, TDS, Salinity, etc. from the river. Aqua-culture kit is used to measure Ammonia, Cl^-, CO_2, Hardness, etc. Digital Turbidity meter can be used in this Laboratory to detect turbidity of water samples. TOC analyzer is used to determine the organic and inorganic carbon for water and wastewater samples in mg/l. Particle Size Analyzer is used to determine the particle size soil and sediment samples from 10 nm to 3500 mm. CHNS Analyzer is used to determine the percentage of soil, sediment and water samples.

Besides these, the following facilities also exist in the Chemical and Water Pollution laboratory:

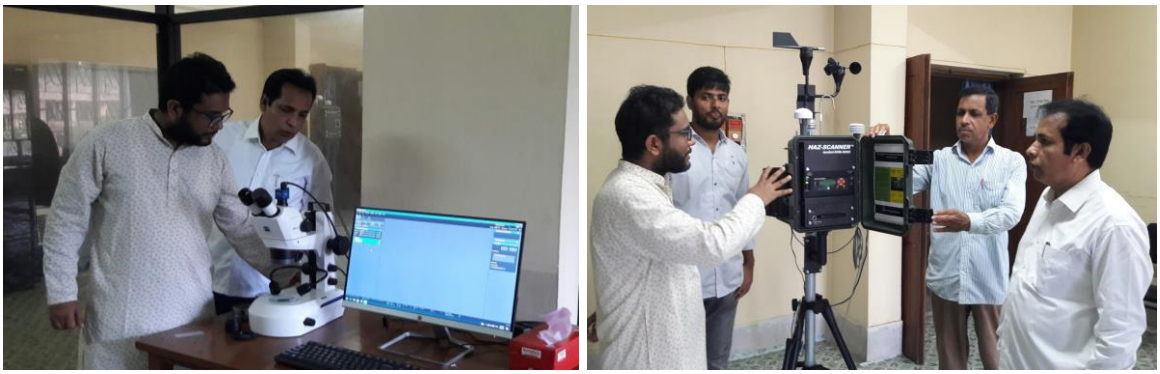
- Determination of p^H, arsenic, Salinity electrical conductivity, turbidity, free carbon di-oxide, bi-carbonate, sulphate, chloride, nitrate, sodium chloride, total solid content, hardness, calcium, magnesium, iron, silica, total dissolved solid, dissolved oxygen etc.



Recently procured equipment (supported by IDCB Project, Phase-II) for Chemical Laboratory: (a) TOC Analyzer, (Shimadzu, Japan) (b) CHNS Analyzer with air purifier, (Perkin Elmer, UK) (c) Particle Size Analyzer (Malvern Panalytical, UK).

Revenue earned from Sediment, Chemical and Water pollution division

A total of Tk. 1964853.00 has been billed during the fiscal year 2020-2021 for testing of sediment samples. In total Tk. 2045309.00 has been received in this fiscal year 2020-2021 and a total of Tk. 485612.00 is remaining unpaid up to June 2021 in which Tk. 410550.00 is in 2020-2021 fiscal year and remaining Tk. 75062.00 from previous fiscal years from different clients of BWDB and other organisation.



Scientists observed test activities with Computerized Microscope (Carl ZEISS, Stemi 305) (left) Mr. Md. Moniruzzaman, SO, briefing about function & operating system of Portable Air Monitoring System

ADMINISTRATION & FINANCE DIRECTORATE

This Directorate consists of several sections namely, i. Establishment, ii. Accounts & Audit, iii. Public Relation & Photography, iv. Library, v. Estate & Security and vi. Store. The other activities include procurement, operation & maintenance of physical facilities.

Activities of Administration & Finance Directorate

The activities of Administration & Finance Directorate include overall administration of RRI, establishment, human resources development, financial management, photography, public relations, internal security, storing of materials, plantation, arrangement of different kinds of training, publications of annual reports, journal, newsletters etc. The approved and existing manpower employing in this institute is 257 and 175 respectively. The details of manpower are given in the following table as shown below:

Class-wise approved and existing manpower in RRI

Sl. No.	Class	Approved manpower	Existing manpower
1	1st Class	68	38
2	2nd Class	03	01
3	3rd Class	122	79
4	4th Class	64	57
	Total	257	175

This directorate also collects a number of books both from home and abroad, journals, research reports, newsletter and many other publications every year for library. Many researchers, students and teachers from different institutions use this library for their necessary documents. The total number of reading materials (including books, journal, newsletter reports and publications) is 15997 nos. and The total expenditure under this directorate during the fiscal year 2019-20 is 1467.36 lakh.

Total collection of items in the Library

Sl. No.	Description	Collection in 2020-2021	Total
1	Books	146	2461
2	Journal	6	2666
3	Reports	57	5640
4	Other publications	0	5232
	Total	209	15997

Total expenditure in establishment

Sl. No.	Description	Amount (Tk. In lakh)
1	Officers salary	236.25
2	Staff salary	364.83
3	Allowances	554.16
4	Supply and services	210.99
5	Capital expenditure	101.13
	Total	1467.36

Other activities

In addition to the above activities, this directorate also provides technical support services to the other directorates and divisions. This directorate is also responsible for procurement, operation & maintenance, and mechanical & electrical works of physical facilities. The work completed by operation and maintenance, and mechanical and electrical

section during the fiscal year 2020-21 is outlined below.

Works executed by Operation and Maintenance (Civil Engineering)

- Repair and maintenance of different office buildings such as administration, medical centre, mosque, ansar camp as well as residential buildings. The repair and maintenance works include stripping of old plaster and replacing by new plaster works, white washing, plastic painting, synthetic enamel painting to window gratings, door polishing, wood work in door frames and replacing of glass panes in window shatters and replacing of doors under establishment budget.

- Purchase & replacing of plumbing materials of different buildings with new ones.
- Purchase of stationery, plumbing, hardware and construction materials for general use as well as model use.
- Cleaning of water tank in all office and residential buildings.
- Cleaning and maintenance of surface drain of RRI campus.

Works executed by Mechanical Section

- Installation, repair & maintenance of pump, motors, tailgates, gate valves, foot valves, model bridges etc.
- Repair and maintenance of mechanical tools.
- Repair, fitting & fixing of grill, window etc at residential and office buildings.
- Repair and maintenance of all the vehicles of RRI.
- Purchase of raw materials for mechanical workshop of RRI.
- Repair and maintenance of photocopy machines, air cooler and refrigerators.

Works executed by Electrical Section

- Purchased of fuel & batteries for generator.
- Routine maintenance of computer, printers, UPS, IPS and other electronic equipment.
- Purchased of computer accessories, electrical materials.
- Purchased of electric wires of different sizes.
- Electrification in the model area.
- Purchased and installed the CC TV Camera in RRI Campus.

Newly constructed Generator house (left) for 350 KVA Diesel Engine Generator and Garage (right) for Truck-mounted Geotechnical Drilling Rig

RESEARCH AND DEVELOPMENT

Research plays a significant role to improve the quality of lives of the people and also the socio-economic development of the country. Quick and effective decision making by proper use of information contributes for upliftment of the society. Researches in the field of hydraulics, geo-technical and environmental engineering carry great importance for the development of water resources of the country. In view of the above mentioned facts, RRI takes up research projects every year. The two directorates of RRI, namely Hydraulic Research and Geo-technical Research conduct research and development activities in their respective fields. These activities are briefly described in this chapter.

Four research works have been conducted in 20120-2021 fiscal year, of which one is completed and other three are carried out at present fiscal year. Completed research work entitled "Development of Suitable Technologies for Removal of Manganese from Ground Water in Household, Community and Municipal Levels" and on-going research work entitled "Characterization of soils around the Arial Khan River of Bangladesh" is under Geo-technical Research Directorate. On the other hand, Hydraulic Research Directorate undertook a research project entitled "A study on coastal processes in Bangladesh and its socio-economic & environmental implications which is continuing at present. The undertaken two research projects, institutional development and capacity building (IDCB) project and four Bamboo bandalling pilot projects have been briefly described hereafter.

Research projects

(a) Characterization of Soils around the Arial Khan River of Bangladesh

The major part of Bangladesh is on the delta formed by three major rivers Brahmaputra, Ganges and Meghna. These rivers and many of the country's other minor rivers originate outside the national boundary of the country and make up the Ganges-Brahmaputra-Meghna river system. Over millennia, the sediments carried by the huge discharges of these rivers have built a broad delta, forming most of the large area of Bangladesh and the submerged delta-plain in the bay of Bengal. These huge sediments are the major sources of formation of 80% soils of the country. The remaining 20% of soils have been formed in Tertiary and Quaternary sediments of hills (12%) and in uplifted pleistocene terrace (8%).

In many areas, the soil surveys recognized active, young, and old floodplain landscapes. Active floodplains occupy land within and adjacent to the main rivers where shifting channels deposit and erode new sediments during the annual floods.

There is active bank erosion almost in all major rivers in the country causing damage to valuable land, settlements and infrastructures from year to year. Because of high density of population along the river banks a great numbers of people are also displaced due to this continuous bank erosion process. These poor displaced people migrate to nearby towns and cities and live sub-human life in the slump areas. This has created a great natural and social problem in the country. Bank protection is therefore, one of the prime necessities for poverty alleviation and national growth.

Arial Khan River is one of the main south-eastward outlets of the river Padma. Bifurcating from the Padma at 51.5-km southeast of Goalanda in Rajbari district, the river flows through Faridpur and Madaripur districts. Arial Khan maintains its link with the Padma through a number of streams and canals or khals. The river maintains a meander channel through its course and is erosional in nature. A number of settlements have already been destroyed due to severe riverbank erosion and the process is continuing.

A view of River Bank failure in the project area

Riverbank erosion occurs both for hydraulic and geotechnical instability. Stability analysis is an utmost important work for any of the bank protection. The undertaken study seems to meet up

the stability of riverbank of Arial Khan river as geotechnical characterization is an utmost important the issue may be the safety of lives, land & sustainability of the infrastructures against the forces acting in the rivers.

Over the last few decades, a many number of river bank are protected through many engineering ways. In this study, an attempt has been taken to draw the remedial measures of bank failure on the basis of geotechnical characterization at Sadarpur Upazilla of Faridpur district and Shibchar upazilla of Madaripur district.The present study aimed (i) To investigate the physical and index properties of the bank material of Arial Khan river located at Sadarpur Upazilla of Faridpur district and Shibchar upazilla of Madaripur district (ii) To measure the ground water level as well as surface water level iii) To characterize the soils through knowing its properties and iv) To draw the remedial measure of bank failure of Arial Khan river.

Generally river training and bank protection works are done by Bangladesh Water Development Board (BWDB). Even then it is a matter of thinking that any earthen structure is required to characterize its underlying soils prior to the design as well as construction. The scientists also expect that if the study is done through characterization of soils in this region properly then it will be easier to find out the ways of protection of failure of bank. The analysis of this study will associate with river engineering as a major tool to accomplish bank protection. As a result people will live and travel smoothly. In light of that major point of view, this research study has been undertaken and desiring that expected outcome will assist the implementing authority for protection of works as well as people.

engineering aspect for stability analysis. As a result,

Objectives

The main objective of the research is to find out geotechnical characteristics of soils and why bank failure occurs to relevant soils. The specific objectives of the study are as follows:

- To determine the geotechnical properties with hydrology
- Characterize the soils according to its properties
- Slope stability analysis
- Settlement analysis
- Social Impact Assessment
- Recommendations for remedial measure of bank failure

Key information

- Duration: Two years and four months (March/2020 to June/2022)
- Total Cost : 52, 45,000.00
- Funding : Research Fund of RRI (GoB)

Present status

The research has been approved in 23rd March'2020. By this time, study area and boring point have been selected through site visit and questionnaire and reconnaissance survey. Most of the soil sample has been collected and field investigation has been started. Now testing of collected soil samples are running. Literature Review and data analysis are on-going.

Soil boring works (left) and measuring groundwater level (right) in the study area

(b) Development of Suitable Technologies for Removal of Manganese from Ground Water in Household, Community and Municipal Levels.

The accomplished research work is consistent with GOAL 3: Good Health and Well Being and GOAL 6: Clean water and Sanitation of the 17 sustainable development goals (SDGs) to transform our world. The major objectives of the research work are to develop suitable technologies and design modifications of existing technologies by removing manganese and other harmful impurities from ground water in household, community and municipal levels so that people of all sorts of life can get potable water for drinking and cooking purposes.

Water is one of the most important things on earth. Every living thing needs water for its survival. But absolute pure water is not found in nature. As condensed water falls, it sweeps up other materials from the air, and becomes still more contaminated on reaching ground. Since water is a universal solvent, during percolation through the various strata of soil it dissolves various mineral (chemical impurities) compounds. When the mineral concentration is greater than the acceptable limit then the water becomes unsafe for drinking and not suitable for domestic use. The World Health Organization (WHO) has a provisional health based guideline value of 0.4 mg/l for manganese in drinking water (to protect against neurological damage. The WHO guideline value from consumer acceptability consideration is 0.10 mg/l. Bangladesh Standard for manganese in drinking water is also 0.10 mg/l. Groundwater is abundant in Bangladesh and the aquifers are highly productive. 90% of Bangladeshi depends on ground water for drinking purpose because much of surface water of Bangladesh is microbially unsafe to drink. Unfortunately, the vast area of Bangladesh's groundwater is naturally contaminated with arsenic, iron and manganese concentrations above the World Health Organization (WHO) drinking water guideline and even the Bangladesh drinking water guideline. Through this research several trial runs have been performed at laboratory to remove manganese, iron and arsenic simultaneously. At laboratory, it has been possible to remove 92% manganese, iron and arsenic from groundwater by contact oxidation method. At community level treatment plant the raw water manganese concentration was 0.87 mg/l, after treatment it became 0.014 mg/l that is the removal percentage is 98%. At household level treatment plant the raw water manganese, iron and arsenic concentration were 0.332 mg/l,12.75 mg/l and 95 microgram/l respectively and after treatment the effluent concentration were 0.018 mg/l,0.044 mg/l and 02 microgram/l that means the removal percentage of manganese, iron and arsenic are 94%,99% and 99% respectively. The research work has been completed on 30.06.2021.

Mr. Md. Matiar Rahman Mondol, Principal Scientist, engaged in manganese removal research activities in the geotechnical research lab.

(c) A study on coastal processes in Bangladesh and its socio-economic & environmental implications

Bangladesh has 710 km long coastline which is composed of the interface of various ecological and economic systems. The coastal area covers 32% of the total area of the country and consists of 19 districts. The population of the coastal area is 29% of the population of the country. Physical geography of the coastal area of Bangladesh is very diverse and dynamic as well as vulnerable to the impacts of climate change. The likely impacts of sea level rise are aggravated by anthropogenic activities and land subsidence. The western part of the coastal area belongs to Ganges tidal plain crisscrossed by numerous tidal rivers and creeks whereas the central part is very active with processes of erosion and accretion. The people of the coastal area are poor and prone to different natural disasters and manmade hazards. On the other hand, the area is full of natural resources that will be the main factor in national economy in upcoming years. In order to alleviate poverty of the coastal people through appropriate coastal management it is very important to have sound understanding of coastal processes and to recognize and their socio-economic implications. Coastal processes shape the physical environment, providing habitat such as turtle or seabird nesting beaches, reefs, coral or fish spawning and mangrove forests or seagrass beds.

The research is based on both primary and secondary data, maps and historical satellite images. The required data include bathymetry, topography, hydrology, hydrometry, sediment, surface and ground water as well as socio-economic and environmental data. Modeling (physical and

numerical) will be employed for representative study areas. Extensive site visits have been planned to gain understanding of the impacts of anthropogenic activities on coastal processes and coastal environment. Side by side efforts will be made to assess the impacts of coastal hazards on human lives, livelihoods, economy and environment. The existing means and methods for coping with coastal hazards will be reviewed and attempts will be made to devise innovative methods to deal with coastal problems. Modeling will form an important part of the study in order to build up capacity of RRI scientists in modeling of coastal systems and in applying modeling technology to investigate sustainability of different measures undertaken for coastal protection.

Objectives

The main objective of the research is to develop an understanding of the coastal processes in Bangladesh and modeling of the same in order to address coastal hazards aiming at devising innovative solutions. The research also aims to focus on socio-economic and environmental impacts of the coastal processes under the influence of different factors. The specific objectives of the study are as follows:

- To develop an understanding of the prevailing coastal processes in Bangladesh
- To enhance the capability of RRI scientists in modeling of coastal processes
- To observe erosion/accretion in the coastal area from sequential historical geo-referenced satellite images.
- To find out the causes and effects of coastal erosion
- To review the existing methods of coastal erosion protection
- To investigate the socio-economic and environmental conditions in the coastal areas
- To devise innovative approaches for coastal erosion mitigation and hazard risk management and
- To investigate salinity intrusion processes and its control.

Key information

- Duration: Three years (Jan/2020 to Jan/2023)
- Total Cost : 30, 00,000.00 (For the 1st year)
- Funding : Research Fund of RRI (GoB)

Present status

The research was approved in 20th Jan'2020. Extensive literature has been made and data collection is under process so far.

(d) Eco-hydrological status and impact assessment of Someshwari River in Netrokona and Shitalakhya River in Dhaka, Bangladesh

The river ecosystem is the complex interactions between physicochemical parameters and biological lifeforms including Phytoplankton in a natural environment and pathogenic bacteria. Phytoplankton is the first link in the food chain. They are known as primary producers, since they produce the first forms of food. Zooplankton and other small animals that graze on the phytoplankton are known as primary consumers. Plankton, on an ecological level is extremely important, as they make up the base of the food chain for the majority of the aquatic ecosystem on earth. On the other hand, the presences of pathogenic bacteria are very common in river environments and the concentration of the bacteria increase with the increase of pollution in the river. Urban parts of the rivers are more polluted than rural. Assessment of pathogenic bacteria is also very important as people around the river use river water for various purposes of their lives.

Someshwari, a transboundary river of Bangladesh originates from hilly area of Meghaloya, India. The river flows through Durgapur upazila of Netrakona District and finally ends with the Kangsha River at Jaria-Jhanjail point, which is a divider of Durgapur and Purbadhala upazilas. The total length of the river estimates about 25 km.

Shitalakshya River is a distributary of the Brahmaputra. In its initial stages it flows in a southwest direction and then east of the city of Narayanganj in central Bangladesh until it merges with the Dhaleswari near Kalagachhiya. A portion of its upper course is known as Banar River. The river is about 110 kilometres (68 mi) long and at it widest, near Narayanganj, it is 300 metres (980 ft) across. Its flow, measured at Demra, has reached 74 cubic metres per second (2,600 cu ft/s, Murshed 2012). It remains navigable year round. The river flows through Gazipur district forming its border with

Narsingdi for some distance and then through Narayanganj District. The river's maximum depth is 21 metres (70 ft) and average depth is 10 metres (33 ft). Shitalakshya River is one of the most polluted river around Dhaka city. Numerous industries are located along the river at Palash (north of Ghorashal) and at Siddhirganj along with other private industries. Industrial effluent dumped into the river resulting in high levels of pollution is a cause for concern.

The aquatic environmental quality is dependent on river hydrodynamics and physicochemical parameters of the flowing water. Therefore, hydrologic parameter: velocity, discharge, cross-section, etc., physicochemical parameters: pH, Dissolved Oxygen, Biochemical Oxygen Demand, Total Organic Carbon, Air Temperature, Water Temperature, Transparency, Total Dissolved Solid, Electrical Conductivity, Nitrate, Phosphate, Silicate, Salinity, Alkalinity, Heavy metals, Mineralogy of bank and bed materials, etc. will be assess along with ecological parameters. Phytoplankton and pathogenic bacteria count for correlating the seasonal variation of ecological environment of rivers with hydrologic, hydrodynamic and physico-chemical parameters.

A view of Concern Officials with Consultant of the study work after end of a meeting held in Dhaka University on 1st September, 2020.

The research proposal approved on April 30, 2020 and expected to end on June 30, 2022. Due to world-wide Covid 19 situation little progress of the project during 2019-2020 & 2020-2021 financial Year and expenditure during these two financial year is 6.17 and 6.72 lakh taka only respectively. We have already reviewed some research article. Concerned equipment related to this research has been procured, process of field visit, data collection and data analysis is in Progress. We are expecting to complete the research work within June 2022.

Innovation project

(a) Anaerobic Digestion for Waste Management and Biogas Production for making RRI campus clean

For anaerobic digestion system, the feedstock is collected, coarsely shredded and placed into a reactor with active inoculums of methanogenic microorganisms. Place wet organic waste/kitchen waste in a sealed chamber with no air inside. As it digests, the waste will release a gas which can be captured and used for cooking. The system needs to be airtight and the temperature close to 28- 40˚C. Firstly waste were separated at home according to Biodegradable /kitchen waste and Non-biodegradable waste. Biodegradable /kitchen wastes were kept in green bucket and non-biodegradable waste in red bucket. The buckets were provided at home through this project. Besides, two dustbins were constructed to keep Biodegradable /kitchen waste and Non-biodegradable waste at RRI Officer's campus. Non-biodegradable waste will be taken Faridpur Pourasava and Biodegradable /kitchen waste are using to gas production for cooking and by-products will be used as fertilizer. A gas production model has been innovated by the RRI innovation team.

Objectives

- Ensuring cleaner RRI campus using own strategy as a replacement of dumping solid waste at open place
- Building the skills of RRI personnel to deliver practical solutions to the waste management crisis in their own communities (RRI campus).
- Raising awareness of the benefits of proper waste management for greater positive change in the environment.

RRI's own strategy of Solid Waste Management is a great step forward for achieving Mujib Year's cleaner and greener motto. This technique could be followed by other organizations like DC office, Upazilla office, BRRI, BARI etc.

RRI Innovation Team observing kitchen waste digestion system Model

Pilot project

(a) The pilot project in different areas of Bangladesh using Bamboo bandaling Structure to reduce river bank erosion, land reclamation and increase navigation

Bangladesh is a riverine country. Agriculture is the main driving force of our economy. River bank erosion causes detrimental effect on our Agri-economy. This is because every year many villages, cities, towns, infrastructures, agricultural lands are engulfed by the rivers resulting in thousands of people unemployed. Not only that river erosion give rise to social and environmental imbalance. Considering this issue, RRI has conducted laboratory-based study to investigate the effectiveness of bamboo bandalling structures to protect the river bank erosion and increase of channel navigability. Laboratory based study suggest that, low cost bamboo bandaling structures could be an effective solution to combat bank erosion. After laboratory based study RRI has already implemented several pilot projects including The pilot project in different areas of Bangladesh using Bamboo bandaling Structure to reduce river bank erosion, land reclamation and increase navigation. The project has been implemented during the period from October 2017 to June 2021 in the rivers of the district Faridpur, Rajbari, Khulna, Barisal, Sirajgonj and Netrokona. The purposes of the project are i) Protection of bank erosion through diverging and controlling flow, ii) To reduce silt deposit at the middle of the river which makes it a braided river, iii) Improvement of drainage and navigational facility through deepening of the river bed at the middle of the river iv) To reduce natural environmental degradation as well as deleterious socio-economic impact due to bank erosion and v) Land reclamation near river bank.

Bandals are less expensive solution for the above mentioned problems over conventional methods.

- Bandals lateral interventions can be extended gradually that can not be possible using conventional structures, such as groynes and revetments
- Bandals protect river bank erosion through controlling of river flow
- Bandals increase navigational channel depth
- Bandals reclaim land near river bank
- Bandals are eco-friendly

To prevent river bank erosion hydraulic structures like guide bund, spar, groyn, revetment, cc block, geo-bag have been used usually. But these structures cost huge for getting the job done and used only for the protection of important places and infrastructures. Thus protection of roads, growth centres, crop lands, homesteads, infrastructures from bank erosion in the remote region needs low cost technology. Bamboo bandalling technology uses locally available bamboo and wooden bullah. Bamboo structures comprise of two vertical layers of bamboo. The first layer is constructed with 7.5m long vertical bamboos maintaining 30 cm centre to center distance from each bamboo. 4m of the bamboo is driven under river bed bamboo and 3m remain above of the river bed. The second layer is constructed with 6.0m long vertical bamboos maintaining 60 cm centre to centre distance from each bamboo. 3.5m of the bamboo is driven under river bed and 2.5m remain above of the river bed. 7.5m long inclined bamboo are attached with two vertical layers with 60 cm center to center distance from each inclined bamboo. There have been 5 horizontal rows of ≥ 6.0m long bamboos attached to the first vertical layer. The first row of horizontal bamboo is set 75cm above from river bed. Angle between bamboo layer and flow direction is about 30° to 45° (depends on river flow, depth, width). In addition 7.5m long wooden bullah is used for strengthening the bamboo bandalling structure. The centre to centre to distance between two bullah is 10m.

Bamboo bundaling structures through this project have been implemented in rivers such as old Brahmmaputra, Jamuna, Gorai, Dharla, Dosani, Atai, Vodra, Bhairab, Sondha, Nitai, Kongsha and Sumeshwari. Some of huge outputs through project are given below:


Reclaimed land due to bandall construction, Arial Khan river Chandrapara, Sadarpur, Faripur (left) and Gorai river Narua, Baliakandi, Rajbari (right).


Reclaimed land due to bandall construction, Sumeshwari river Jaria, Purbadhala, Netrokona. (left) and Vodra river Kharnia, Dumuria, Khulna (right).

Development project

(a) Institutional development and capacity building project (phase-ii)

Since its relocation to Faridpur in 1991 from Dhaka, RRI has gotten a vast campus having Model Sheds, Model Beds, Laboratory Buildings, Office Building, Workshops, Colony for officers and staffs, Guest House, Auditorium and ancillary structures like roads, utility services. Although these physical facilities were good enough, nevertheless requires updating and replacement of old equipment to carry out multi-disciplinary research and tests in the field of River Hydraulics, Hydraulics of structure and Irrigation, Estuarine and Coastal Hydraulics, Soil Mechanics, Material Testing and Quality Control, Sediment Technology, Hydrochemistry and Geo-Chemistry and Instrumentation.

RRI carries out tests, research and consultancy in the field of River Hydraulics, River Engineering, Coastal Engineering, Irrigation and Drainage Engineering as well as Geotechnical Engineering using test facilities and physical modeling. Consultancy works and applied researches are being assigned to RRI by the local and foreign clients. In order to modernize the research facilities, RRI formulated and submitted a Development Project Proposal to the Ministry of Water Resources, Government of the People's Republic of Bangladesh in 2005. That project was approved for three years duration started from FY 2005- FY2008 and it was revised in 2008. But all equipment was not procured in time for many technical causes.

On the other hand, present equipment status is very much inadequate to meet up the present demand of the nation and to perform the activities in accordance with the mandate of RRI. In order to keep in pace with modern research trend, more sophisticated instruments are needed. So, for the institutional development and capacity building it is necessary to procure new equipment along with replacement of old machineries, maintenance and construct new research laboratory and repair of existing old buildings. For the continuation of the development of RRI the ongoing development project proposal was submitted in 2017 and was approved in 2018. The overall objective of this

project is to enhance and update of Geotechnical research laboratories facilities as well as physical and mathematical modeling facilities to conduct test and research in the field of water resources sector in accordance of RRI's mandate. To facilitates cutting edge research some of the state of the art equipment such as 2D Wave Generator, Tide Generator with 3D wave system, Acoustic Doppler Velocity Profiler (ADCP), ECHO sounder, 3D Bed Profiler, Hydraulic Rotary Drilling Rig, Particle Size Analyzer, CHNS Analyzer, TOC Analyzer and other environmental and water quality testing equipment have been procured. The specific goal of the project is to procure necessary equipment for the overall institutional development and strengthen RRI research capability as well as to develop human resources. It is also essential to train up RRI scientists to utilize full potential of the sophisticated high-quality instruments. Considering the above circumstances, the Government of Bangladesh has approved this development project with a Revised (1st Revision) project value of 5366.81 lakh BDT. The duration of the project was from January 2018 to June 2021.

Upon completion of this project, RRI in future will be the leading national Institute to contribute meaningfully to the sustainable Water Resources Development Projects in Bangladesh and RRI will develop as a self-earning institute under the Ministry of water Resources. RRI would be in a position to take up all sorts of test and researches pertaining to the overall water resources development of the country.

2D Wave Generator, Tide Generator with 3D Wave Phenomena, MIKE Mathemetical Modelling Series, Desktop ArcGIS, Acoustic Doppler Velocity Meter (ADV), High Capacity Coarse Aggregate sieve shaker, BOD meter, COD meter, Environmental Impact Assessment (EIA) Instruments such as Air Quality Monitoring Device, Sound Meter, Trionocular Microscope have been procured and installed during the FY 2020-21 under this project. Moreover, a total of seven in-house trainings have been conducted through online training platform in the same fiscal year under this project. Officers from all directorates of RRI have participated in the trainings.

The project has been successfully completed in the last financial year.

Recently built water treatment plant (supported by IDCB Project, Phase-II) which will be enabled to supply fresh water in the residential area

Recently commissioned 2D Wave Generator (HR Wallingford, UK) in the RRI Hydraulic Lab to facilitate coastal physical model study (supported by IDCB Project, Phase-II)

HUMAN RESOURCE DEVELOPMENT

RRI has been putting special emphasis to human resources development since its establishment in order to achieve its goals as mandated by the Government of the People's Republic of Bangladesh. Scientists and engineers are working at RRI whose efforts are being put with a view to reach the research standard through innovation of new technologies and ideas in the related fields of activities. RRI is a relatively new organisation of this kind of research in the country. As the technologies of the disciplines concerned are fast developing, the necessity of higher studies and advanced on the job training of the research personnel in the academic and research institutions of similar activities at home and abroad (especially in developed countries) has strongly been highlighted in order that it can keep them abreast of the latest development in the related fields of research. Some of the RRI personnel attended higher studies and training program both at home and abroad.

RRI conducted nine in-house training programs for skill development of its scientists and engineers during the 2020-2021 fiscal year of which seven training programs (serial no. 1, 2, 3, 5, 6, 8 and 9) organized under Institutional Development and Capacity Building (IDCB) Project (Phase-II) for River Research Institute (RRI), Faridpur and the remaining under establishment budget. RRI also conducted three seminars to share knowledge, views and findings among the scientists and officers during the 2020-2021 fiscal year. The venue for these training programs and seminars was RRI conference room. Almost all scientists and officers took part in these training programs and seminars. The title and duration of these training programs and seminars were as the following:

Sl No	Title of the training / Seminar	Duration
1.	Flood Risk Management and River Flood Analysis and Modelling	12.10.20-14.10.20
2.	Installation, Operation & Application Training on Mathematical Modelling Software (MIKE) Series	01.12.20-23.12.20
3.	User Training Course on ArcGIS Desktop, ArcGIS Desktop Advance and Pro Extension	23.03.20-25.03.20
4.	Training Course on APA	26.06.21
5.	Statistical Downscaling for Developing Climate Change Scenarios	21.06.21-22.06.21
6.	Training Course on Desktop arc GIS including arc mappro, arc hydro and DEM	23.06.21-25.06.21
7.	Training Course on National Integrity Strategy (NIS)	26.06.21
8.	Training Course on Research Methodology	26.06.21-27.06.21
9.	Training Course on Basic Statistical Analysis and Scientific Article Writing and Publications	28.06.21-29.06.21
10.	Seminar on Solid waste management	26.06.2021
11.	Seminar on The Pilot Project in different areas of Bangladesh using Bamboo bundling Structures to reduce river bank erosion, land reclamation and increase navigation	30.06.2021
12.	Seminar on Development of Suitable Technologies for Removal of Manganese from Ground Water in Household, Community and Municipal Levels.	30.06.2021

RRI specialists also took part in training program or workshop organized by different organizations as an expert or trainer in the field of river hydraulics and morphology, navigation, hydraulic modelling, bridge hydraulics etc. Besides, some training has been conveyed to RRI officials and staffs of different categories on group basis. The name of the persons took part in seminar, conference; workshop and training (outside of RRI) during the year 2020-2021 are mentioned below.

Persons attended in higher studies, seminar, conference, workshop and training in the fiscal year 2020-2021

SL. No.	Name & Designation	Name of Course/Seminar/ Workshop/Training	Course period (Date)
1	Md. Azizul Haque Podder Principal Scientific Officer	Workshop on "Execution of My Gov service", MoWR, Dhaka	29.09.20-30.09.20
2	Dr. Engr. Md. Alauddin Hossain Principal Scientific Officer	Seminar on "Agricultural Mechanization in Bangladesh: Present Status and Future Strategy" organized by Institution of Engineers, Bangladesh (IEB), Dhaka.	07.01.21
3	Dr. Moniruzzaman Khan Eusufzai Senior Scientific Officer	Workshop on "Execution of My Gov service", MoWR, Dhaka	29.09.20-30.09.20
4	Nayan Chandra Ghosh Scientific Officer		

A view of participants in the in-house training course supported by the IDCB Project (Phase ii)

MONETARY MANAGEMENT

River Research Institute is a national organization having mandate of a statutory Public Authority under the Ministry of Water Resources, Government of the People's Republic of Bangladesh. The annual expenses are being borne by its own income and some grant from the Government revenue budget. The main sources of RRI's own income are revenue received from model studies (physical and mathematical model), and geo-technical testing fee (testing of soil, concrete, water and sediment sample). Detailed budgetary information (income and expenditure) for the fiscal year 2019-2020 and 2020-2021 are given hereafter:

Earnings and Expenses for the fiscal year 2020-2021

Earnings		Expenses	
Items	Taka (Lakh)	Items	Taka (Lakh)
Govt. grant	1477.80	Establishment: • Officers salary 236.25 • Staff salary 364.83 • Allowances 554.16 • Supply and services 210.99 • Capital expenditure 101.13 • Refund of non-expended money 10.44	1477.80
Model study	45.07	Model study	18.15
Geotechnical testing fee	38.71	Geotechnical testing	15.99
Others	43.47	Surplus (+)	93.11
Total	1605.05	Total	1605.05

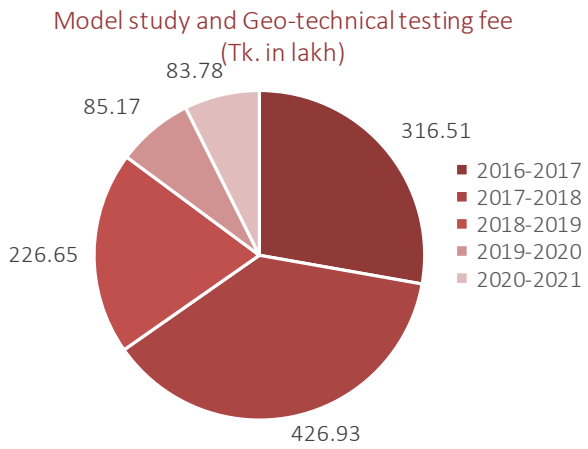
Earnings and Expenses for the fiscal year 2019-2020

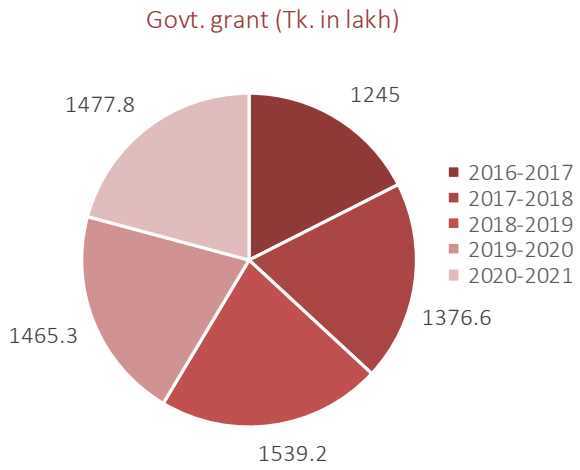
Earnings		Expenses	
Items	Taka (Lakh)	Items (Lakh)	Taka (Lakh)
Govt. grant	1465.30	Establishment: • Officers salary 238.14 • Staff salary 344.15 • Allowances 540.27 • Supply and services 281.87 • Capital expenditure 24.22 • Refund of non-expended money 36.65	1465.30
Model study	66.17	Model study	47.93
Geotechnical testing fee	19.00	Geotechnical testing	10.91
Others	38.21	Surplus (+)	64.54
Total	1588.68	Total	1588.68

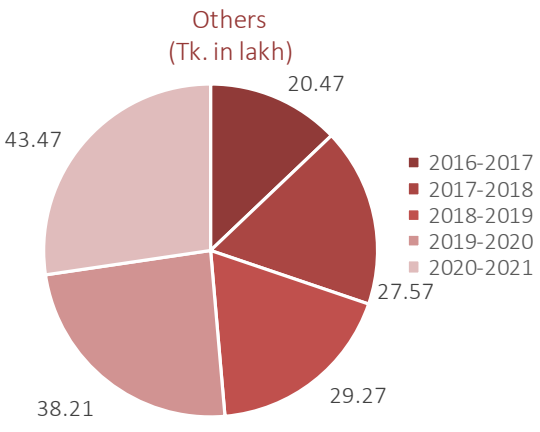
Significant features of RRI's earnings, expenses and closing balance in recent years (last 5 years) are given here.

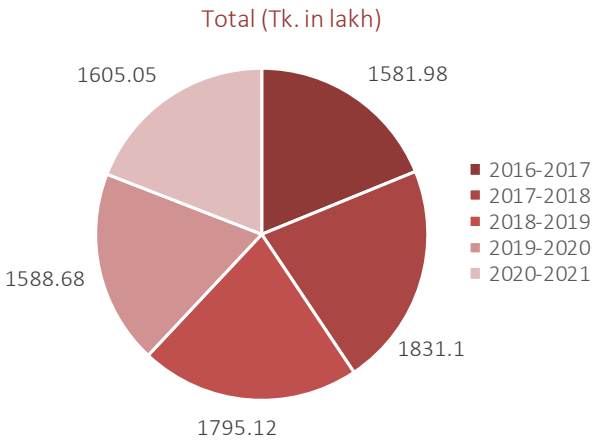
Earnings

Sl. No.	Sources of income	Total (Tk. in lakh)				
		2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
1	Model study & geo-technical testing fee	316.51	426.93	226.65	85.17	83.78
2	Govt. grant	1245.00	1376.60	1539.20	1465.3	1477.80
3	Others	20.47	27.57	29.27	38.21	43.47
Total		1581.98	1831.10	1795.12	1588.68	1605.05



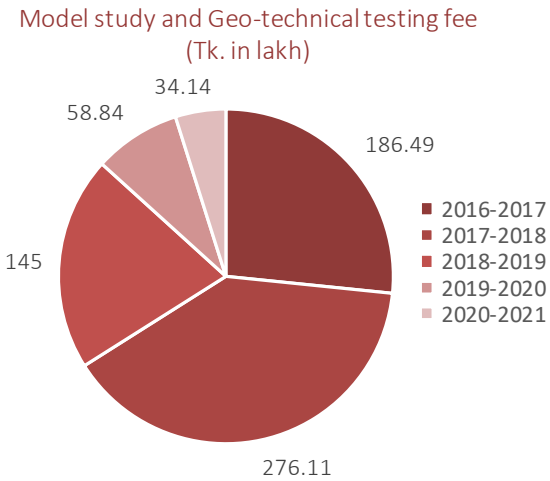


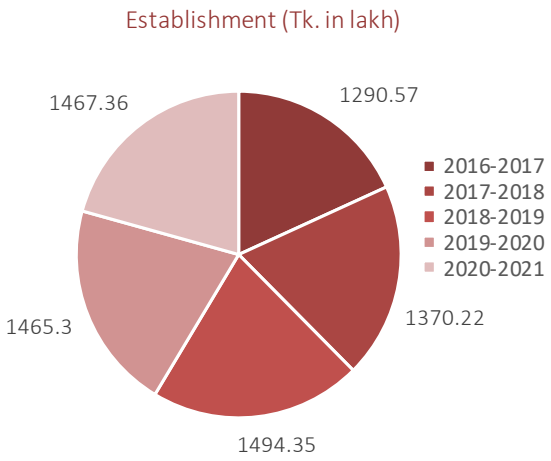


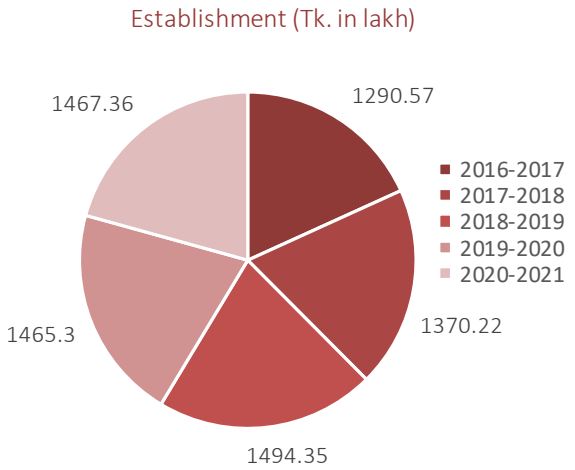


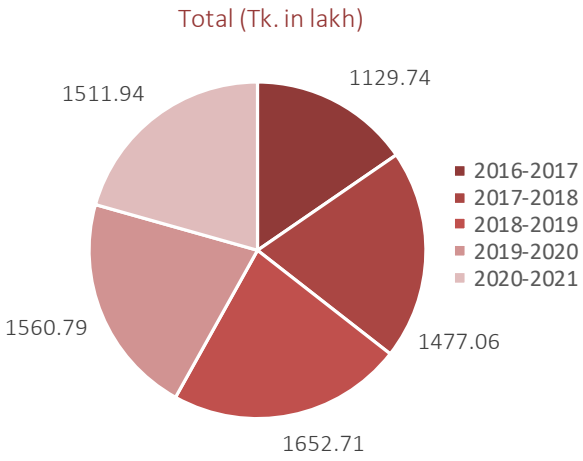
Expenses

Sl. No.	Description	Total (Tk. in lakh)				
		2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
1	Model study and Geo-technical testing.	186.49	276.11	145.00	58.84	34.14
2	Establishment	1290.57	1370.22	1494.35	1465.3	1467.36
3	Refund of non-expended money	-	6.38	44.85	36.65	10.44
	Total	1129.74	1477.06	1652.71	1560.79	1511.94





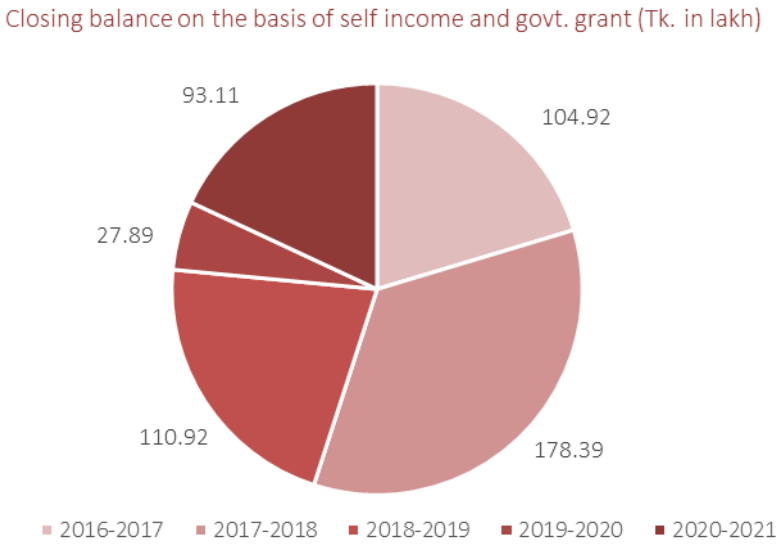




Closing balance

Sl. No.	Description	Total (Tk. in lakh)				
		2016-2017	2017-2018	2018-2019	2019-2020	2020-2021
1	Closing balance on the basis of self-earnings and govt. grant	(+) 104.92	(+) 178.39	(+) 110.92	(+) 27.89	(+)93.11

NB: (**+**) indicates surplus.



INVENTORY OF PROJECTS WITH REVENUE RECEIVED

The revenue earned In the last fiscal year (2020-21) from the model studies conducted by Hydraulic Research Directorate (HRD) and from the sample test accomplished by Geotechnical Research Directorate (GRD) are given here.

Name of the models in HRD with estimated cost and money received during the fiscal year 2020-21

Sl. No.	Name of the model	Total estimated cost (Tk in lakh)	Money received during 2020-21 (Tk in lakh)	Remarks
1	Physical Model Investigation for Sustainability of the Buriganga River Restoration Project	95.00	21.00	Completed
	Total	95.00	21.00	

Volume of works done by GRD and revenue earned during the fiscal year 2020-21

Sl. No.	Name of the discipline	Total no. of samples tested	Total billed (Tk. in lakh)	Money received (Tk. in lakh)
1	Soil Mechanics & Ground Water Eastern & Western Zone.	Disturbed-380 Undisturbed-00	4.23	4.05
2	Material Testing and Quality Control.	366	10.05	10.05
3	Sediment, Chemical and Water Pollution.	1222	19.64	15.54
	Total	1968	33.92	29.64

DEVELOPMENT AND FUTURE PROSPECTS

Since its establishment as a national organization with distinct mandates for rendering services to deal with river related problems and to devise economic and sustainable solutions to the problem RRI has been discharging its responsibilities using established facilities and available man power. At the beginning, the main focus was physical modelling and soil and material testing mainly to support planning and design of different water infrastructures and Bangladesh Water Development Board (BWDB) was the main client. With the passage of time physical modelling technology has been applied to address wide range of river related issues namely sediment management at the off-take, river restoration, bridge and barrage hydraulics, river dredging etc. However, the application of physical modelling technology was very limited for tidal and coastal systems due to lack of required modelling facilities. In order to meet the growing need for comprehensive and multidisciplinary studies RRI adopted mathematical modelling technology in 2007 as a tool for conducting model studies side by side physical modelling technology. At the same time a number of RRI engineers and scientists pursued higher education in different disciplines and many of them are trained at home and abroad to enable RRI to carry out multidisciplinary studies. Under an institutional development and capacity building project a number of sophisticated equipment were procured to upgrade testing facilities. However, some facilities are yet to be established to carry out all mandated activities as well as to deal with new challenges and emerging issues in water sector. With this end in view the second phase of institutional development and capacity building project has begun in the financial year 2017-18.

For RRI to function as a pioneering organization in water sector and to cope with the increasing demand of the time in the competitive market; institutional development, instrumentation, sustainable technology and highly trained manpower are very essential to enhance the standard of service to international level. From this point of view the following future development prospects are important to be mentioned:

- Now-a-days, Information Technology (IT) has become a very useful tool for research and studies, sound management and transparent administration in the world. RRI has to encounter this new challenge to meet the demand for quality services.

- RRI has already established a network system by connecting all the activities of this institute. For this RRI has completed all the installations and collected software, hardware and networking components required. By this time, LAN is working at RRI. A complete wing (manpower & logistics) wing will be required to govern the IT sector in RRI.

- Two Material Testing and Quality Control field laboratories at Bogra and Barisal have already been established. A liaison office is situated at 72, Green Road, Dhaka. In the liaison office soil, building materials, sediment & water samples are being received from BWDB and other Govt, Semi-Govt, NGOs and consulting firms. There is system for bringing the collected samples to RRI headquarter in Faridpur within a short period of time to complete the tests in due time. The test results are furnished to the clients in report form to execute the work of the projects in scheduled time. RRI is contemplating to establish field laboratory in all district headquarters of the country to make its services easily available.

- RRI has already established well-equipped Math Model LAB with internet facilities and uninterrupted power supply required to support mathematical modelling. However, existing facilities need to be expanded and upgraded by purchasing more computers and accessories, installing updated modelling softwares, introducing modelling in new areas and imparting training to the modellers. Some of the needs are expected to be fulfilled under the on-going IDCB project. It is understood that in order to further expand the RRI mathematical modelling services a full-fledged Math Model LAB has to be established in Dhaka.

- RRI successfully completed the physical model studies of some of the biggest projects of Bangladesh namely Bangabandhu Railway Bridge Project, Paira Bridge Project, Bangabandhu Bridge Project, Padma Multipurpose Bridge Project, Ganges Barrage Project, Gorai River Restoration Project, Arial Khan Roadway Bridge Project, 3rd KarnafullyRoadway Bridge Project, Kushtia Town Protection Project etc. However, due to lack of needed facilities RRI could not do much

in physical modelling of coastal systems. Initiatives have already been taken to establish the tidal and coastal modelling facilities and to train scientists in this field.

- RRI may act as a focal institution of its peripheral region to investigate regional water resources problems. A monitoring cell may be established at RRI to monitor the natural hazards like flood, draught, bank erosion, earthquake etc. As a focal institution, RRI may provide consultancy services to the Government, Local Authority of any organizations or may directly advise the beneficiaries to take precautionary measures against those hazards.

- RRI is working in collaboration with BUET and is willing to work with similar foreign institutions like CWPRS (India), DHI (Denmark), Delft Hydraulics (The Netherlands), HR Wallingford (UK), NHC (Canada), SMEC (Australia), LHI (Sri Lanka) etc. Efforts are being made by RRI to start joint venture/bi-lateral study/research projects with these similar international institutions.

- More opportunities should be extended for RRI research personnel for imparting higher studies leading to MS/Ph D degree and other advanced on-job training. There should also have enough scope for RRI officials to participate in the national/international seminar, symposium, congress, workshop etc.

- It can be mentioned here that though RRI is primarily catering the needs for national agencies, with the gradual development of manpower and technology, the institute will fulfil the demands for international bodies and organizations in future.

ANNEXURES

Padma Multipurpose Bridge

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Note: Sequence of the officials in the list has been maintained in accordance with the official gazette of the Government of the People's Republic of Bangladesh published on February 9, 2020.

LOOKING BACK AT 2020-21: KEY MOMENTS

A view of joy rally on the campus celebrating 101st birth anniversary of Father of the Nation Bangabandhu Sheikh Mujibur Rahman and "National Children's Day-2021

DG, RRI watching art competition for children on the occasion of the Centenary Celebration of Birth of the Father of the Nation Bangabandhu Sheikh Mujibur Rahman and "National Children's Day-2021" organized by RRI at its premises on March 17, 2021

A colorful rally was held at RRI campus to mark 50 years (Golden Jubilee) of independence and birth anniversary (Mujib Borsho) of Bangabandhu Sheikh Mujibur Rahman, Father of the Nation.

DG, RRI along with other officials and staffs paying tribute by placing a wreath at the portrait of Father of the Nation Bangabandhu Sheikh Mujibur Rahman on the occasion of "National Mourning Day-2020"

On the occasion of "Independence Day-2021", DG, RRI is taking salute after hoisting the national flag ceremonially

A view of "Bangabandhu Sheikh Mujib Dhaka Marathon -2021" organized by RRI to celebrate historic 7th March

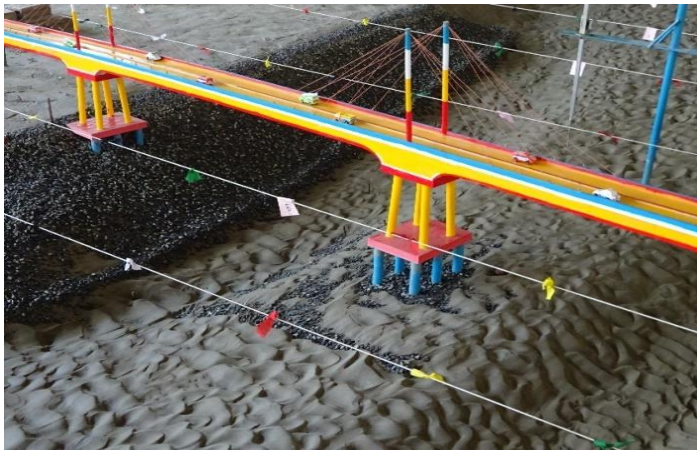
ABBREVIATIONS

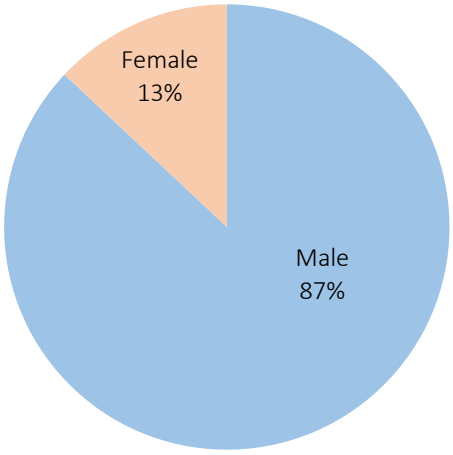
A	AD	Assistant Director
	ADB	Asian Development Bank
	AFPM	Active Flood Plan Management
	A & F	Administration and Finance
	A & FD	Administration and Finance Directorate
	AIT	Asian Institute of Technology
	ASTM	American Society for Testing Materials
	ASO	Assistant Scientific Officer
B	B.A	Bachelor of Arts
	BAU	Bangladesh Agricultural University
	BARD	Bangladesh Academy for Rural Development
	BCL	Bangladesh Consultant Limited
	BCSIR	Bangladesh Council of Scientific and Industrial Research
	BIAM	Bangladesh Institute for Administrative Management
	BIM	BIM Bangladesh Institute of Management
	BIT	Bangladesh Institute of Technology
	BIWTA	Bangladesh Inland Water Transport Authority
	BIWTC	Bangladesh Inland Water Transport Corporation
	BoG	Board of Governors
	BPATC	Bangladesh Public Administration Training Centre
	BPI	Bangladesh Photographic Institute
	BPS	Bangladesh Physical Society
	BRRP	Buriganga River Restoration Project
	BUET	Bangladesh University of Engineering & Technology
	BWDB	Bangladesh Water Development Board
C	CBM	Concrete Block Mats
	CBR	California Bearing Ratio
	CC	Certificate Course
	CERP	Coastal Embankment Rehabilitation Project
	CEGIS	Centre of Environmental and Geographic Information Services
	CPT	Cone Penetration Test
	CPU	Central Processing Unit
	CPTU	Central Procurement Training Unit
	CSO	Chief Scientific Officer
	CT	Concrete Technician
	CUET	Chittagong University of Engineering & Technology
	CWPRS	Central Water and Power Research Station
	CZEM	Coastal Zone Engineering and Management
D	DDC	Design Development Consultants Limited
	DC	Deputy Commissioner
	DD	Deputy Director
	DG	Director General
	DHI	Danish Hydraulic Institute
	DIFPP	Dhaka Integrated Flood Protection Project
	Dip.	Diploma
	DPP	Development Project Proforma
	D/S	Downstream
	DU	Dhaka University
E	EC	Electrical Conductivity
	EEE	Electrical & Electronics Engineering
	EGIS	Environmental and Geographic Information Service
	EGB	East Guide Bund
	EIA	Environmental Impact Assessment
	EMP	Environmental Management Plan

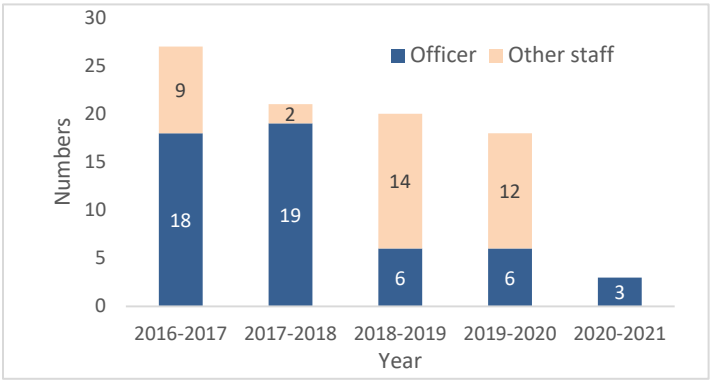
E	ESIA	Environmental impact statement
	ENGG.	Engineering
F	FAP	Flood Action Plan
	FCDI	Flood Control, Drainage & Irrigation
	F-IEB	Fellow of the Institution of Engineers, Bangladesh
	FM	Fineness Modulus
	FPM	Farm Power and Machinery
G	GBSP	Ganges Barrage Study Project
	GDP	Gross Development Profit
	GHH	Ground Water Hydrology
	GIS	Geographic Information System
	GO	Government Order
	GoB	Government of Bangladesh
	GR	Geotechnical Research
	GRD	Geotechnical Research Directorate
	GRRP	Gorai River Restoration Project
	GWC	Ground Water Circle
H	Hons	Honours
	HP	Horse Power
	HR	Hydraulic Research
	HRD	Hydraulic Research Directorate
	HRL	Hydraulic Research Laboratory
I	IAD	Integrated Agricultural Development
	IBAIS	International Business Administration and Information System
	ICDDRB	International Centre for Diarrheal Disease Research and Rehabilitation, Bangladesh
	IDCB	Institutional Development and Capacity Building
	IEB	Institution of Engineers, Bangladesh
	IHE	International Institute for Infrastructural, Hydraulic and Environmental Engineering
	IIT	Indian Institute of Technology
	IMED	Implementation, Monitoring and Evaluation Department
	IRD	Integrated Rural Development
	ITC	International Institute for Aerospace Survey and Earth Sciences
	IUSS	International Union of Soil Science
	IWFM	Institute of Water and Flood Modelling
	IWM	Institute of Water Modelling / Irrigation and Water Management
	IWRM	Integrated Water Resources Management
J	JOCL	Japan Overseas Consultants Limited.
	JU	Jahangirnagar University
K	KUET	Khulna University of Engineering & Technology
	KUL	Katholic University of Leuven
	KVA	Kilo Volt Ampere
L	LA	Laboratory Attendant
	LAB	Laboratory
	LGB	Left Guide Bund
	LHI	Lanka Hydraulic Institute
	LLB	Bachelor of Law
	LM	Life Member
	LOI	Letter of Intent
	LT	Laboratory Technician
	LTU	La Trobe University
M	M.A	Master of Arts
	M-ASCE	Member of American Society of Civil Engineer
	M-BAAS	Member of Bangladesh Association for Advancement of Science
	MBA	Master of Business Administration
	M-BCS	Member of Bangladesh Computer Society
	M-BES	Member of Bangladesh Environmental Society

M	MC	Main Consultant/Moisture Content
	M-IEB	Member of the Institution of Engineers, Bangladesh
	MIS	Management Information System
	M-JSCE	Member of Japan Society of Civil Engineers
	MLSS	Member of the Lower Class Subordinate
	M-NOAMI	Member of National Oceanographic and Maritime Institute
	MoU	Memorandum of Understanding
	MoWR	Ministry of Water Resources
	MP	Member of the Parliament
	MPA	Mongla Port Authority
	MS	Mild Steel
	M.S/M.Sc.	Master of Science
	M. Phil	Master of Philosophy
N	NHC	North Hydraulic Consultants Limited
	NMC	Natural Moisture Content
	NU	National University
	NAHRIM	National Hydraulic Research Institute Malaysia
	NHC	North Hydraulic Consultants Limited
O	O & M	Operation & Maintenance
	OTM	Open Tendering Method
P	PABX	Public Automatic Branch Exchange
	PATC	Public Administration Training Centre
	PC	Personal Computer
	PD	Project Director
	PGD	Post Graduate Diploma
	PGT	Post Graduate Training
	PhD	Doctor of Philosophy
	PLOI	Provisional Letter of Intent
	PPM	Parts per Million
	PS	Private Secretary
	PSO	Principal Scientific Officer
	PU	Prime University
	PWD	Public Works Department
R	RAC	Regional Accounts Centre
	RDPP	Revised Development Project Proforma
	REBRFM	Research on the Effect of Bandalling on River Flow and Morphology
	RFQ	Request for Quotation
	RGB	Right Guide Bund
	RHD	Roads & Highways Department
	RPATC	Regional Public Administration Training Centre
	RRI	River Research Institute
	RTW	River Training Work
	RU	Rajshahi University
	RUET	Rajshahi University of Engineering & Technology
S	SAE	Sub-Assistant Engineer
	SICT	Support to Information and Communication Technology
	SMEC	Snowy Mountain Engineering Corporation
	SO	Scientific Officer
	SRNDP	Southwest Road Network Development Project
	SSD	Submerged Soil Density
	SSO	Senior Scientific Officer
	SSFCDI	Small Scale Flood Control, Drainage & Irrigation
	ST	Soil Technician
	SWH	Surface Water Hydrology
	SWMC	Surface Water Modelling Centre

T	TDS	Total Dissolved Solids
U	ToR	Terms of Reference
	TU	Technical University
	UGC	University Grant Commission
	UK	United Kingdom
	UNESCO	United Nations Educational, Scientific and Cultural Organization
	UPM	University Putra Malaysia
	U/S	Upstream
	USA	United States of America
	UTM	Universal Testing Machine
W	WR	Water Resources
	WRDP	Water Resources Development Project
	WRE	Water Resources Engineering
	WRM	Water Resources Management
	WRS	Water Resources Survey







Human resource development by external training

Professional staff in 2021

Directorate	DR	CSO	PSO	SSO	SO	TOTAL
Hydraulic Research	1	2	3	1	7	14
Geotechnical Research	-	1	4	2	5	12
Administration and Finance	1	-	-	1	3	4
Total	2	3	7	4	15	30

DR: Director, CSO: Chief Scientific Officer, PSO: Principal Scientific Officer, SSO: Senior Scientific Officer, SO: Scientific Officer

Directorate-wise total employee in 2021

Directorates	1st Class	2nd Class	3rd Class	4th Class	TOTAL
Hydraulic Research	15	-	13	12	40
Geotechnical Research	12	-	33	14	59
Administration and Finance	10	01	33	31	75
Total	37	01	79	57	174

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