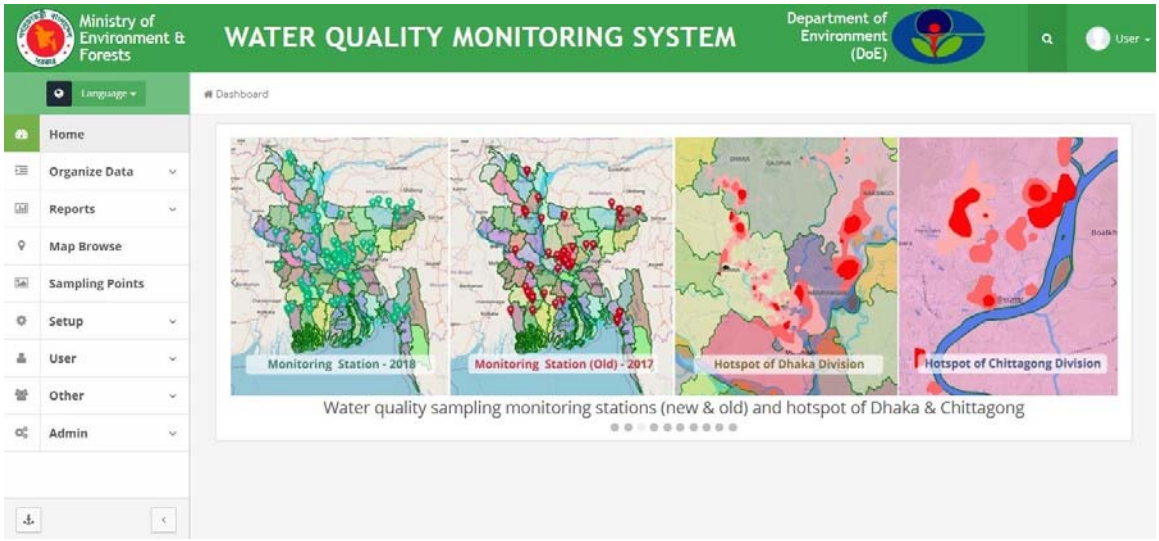
USER MANUAL
ON
WATER QUALITY MONITORING SYSTEM (WQMS)



Developed by

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1. Introduction

Water is an essential natural resource that demands wise and efficient management for conserving its optimum quality. This issue is crucial for major cities in Bangladesh due to rapid growth of industries across the country producing big volumes of industrial wastes with the provision of no ETP or inactive ETP. As the economy of Bangladesh is based on Agriculture, non-point agricultural pollution is a common scenario in the rivers in this country. The wastes generated by other sources like dwelling units, slum dwellings, Hat-Bazar, vegetable markets and other sources are usually dumped into rivers or water bodies and in some cases in barren land. As a result, the water quality of the major twenty nine rivers (Balu, Bhairab, Brahmaputra, Buriganga, Dakatia, Dhaleswari, Ganges, Gorai, Halda, Jamuna, Kaliganga, Kankshiali, Karnaphuli, Kirtankhola, Korotoa, Kushiyara, Madhumoti, Mathavanga, Meghna, Moyuri, Padma, Pashur, Rupsa, Shitalakhya, Sugandha, Surma, Tetulia, Titas and Turag) in Bangladesh are deteriorating rapidly due to pollution from industrial and municipal waste sources. WQMS is a set of computer-based tools that allows the user to admit new data, modify, visualize, query and analyze tabular and geographical data. WQMS is web-enabled and GIS based water quality database and monitoring system which is highly dynamic and real-time digital process. This web-based database system will strengthen the capacity of the staff and officials of Department of Environment to monitor water quality for the sake of country and to preserve the water quality data.

Supported Browsers

The following browsers have been tested for use the Web-based Water Quality Monitoring System. It is recommended to use the most current revision of the browser you choose. The minimum browser revisions supported by the Web-based WQMS are shown below:

- Firefox v50.0
- Google Chrome v55.0.
- Opera v41.0
- Internet Explorer v11.0

1.1 Software framework

The software framework development task included conceptualization of the software framework and identification of the software elements and users. The software framework of the WQMS has presented in Figure 1.1. Brief descriptions of the different part of the developed software are given different subsequent sections of this chapter.

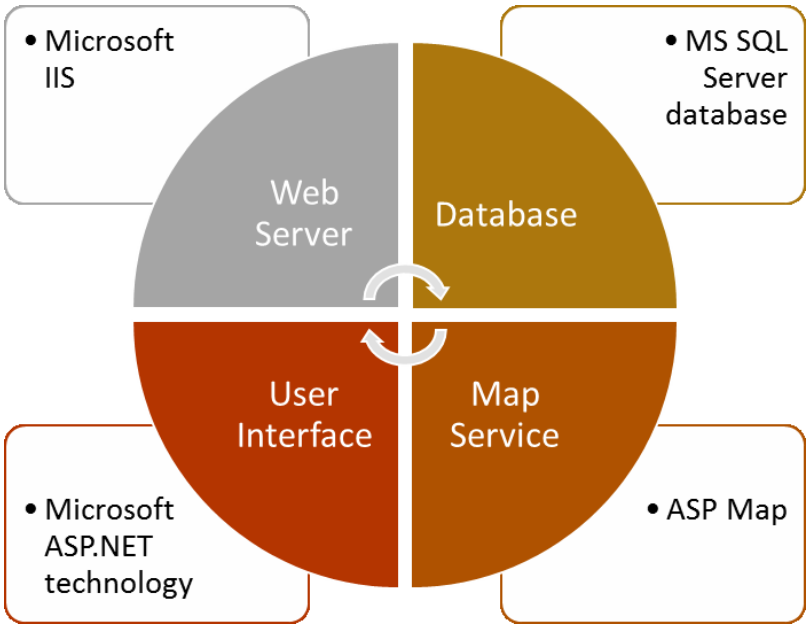


Figure 1.1: Framework of the WQMS

The system is designed and developed using four-tier architecture that will consist following layers:

- Web Server
- Database
- Map service
- User Interface

1.1.1 Web Server

The main component for a web-enabled application is the web server. Web server is a server program that handles the requests from web browsers for data and pages and delivers the requested web pages along with data, maps and other information based on request parameters through internet or intranet. We have developed WQMS using Microsoft's .NET platform which is running on the web server named IIS (Internet Information Services).

1.1.2 Database

The database contains data, views, triggers and stored-procedure. It executes SQL statements, views, triggers and stored-procedure for data manipulation. The database has been designed using another Microsoft tech product MS SQL Server. A relational database has been maintained to store all the existing data.

1.1.3 Map Service

ASP Map is a map service and it is an easy-to-use mapping library for use in. It provides access to many types of GIS data, enables spatial querying of that data, and renders beautiful maps. The engine is written in C# and based on the .NET 4.0 framework. The important features of ASP Map are described below:

- Completely written in C#, .NET Framework 4.0
- Embed the engine using any C#, Java Script
- Shape files in Geojson data format
- Http Handler for ASP.NET applications
- Support for Points, Line stings, Polygons, Multipoint, Multiline Strings and Multi-Polygons
- Renders attributes as labels
- Advanced thematic maps using delegates
- Easy extensible with additional data providers, layer types and geometry types

1.1.4 User Interface

The user interface has been developed using ASP.NET MVC, C-Sharp (C#), CSS, HTML, JAVA Script, Dot-Net framework version 4.0. The user interface of the WQMS is very user-friendly and it has been designed for easy access of data from the database server. The users can get online access to the system and database and able to get required information by different queries through different browser (i.e. Mozilla Firefox, Google Chrome, Opera, internet explorer, etc.). Authorized users can insert, edit and delete data to the system and can also able to download data in different format.

1.2 Technology used

The technology used for the development of WQMS is Microsoft's .NET framework 4.0. The following technologies have been used to develop WQMS in different components:

- Programming Language: C#
- Framework: Microsoft .NET framework 4.0
- Web components: ASP.NET MVC
- Data access components: .NET data provider for MS SQL Server
- Database: Microsoft SQL Server
- Map service: Map shape file in Geojson file format
- Chart: jQuery Flot JS

1.3 Software components

The main interface of the WQMS has been presented in Figure 1.2.

Double click on or Firefox or Internet or Google Chrome and **Type <u>web_address:port</u>** (e.g. 127.0.0.1:90) in the address bar. WQMS main home page will be appeared.

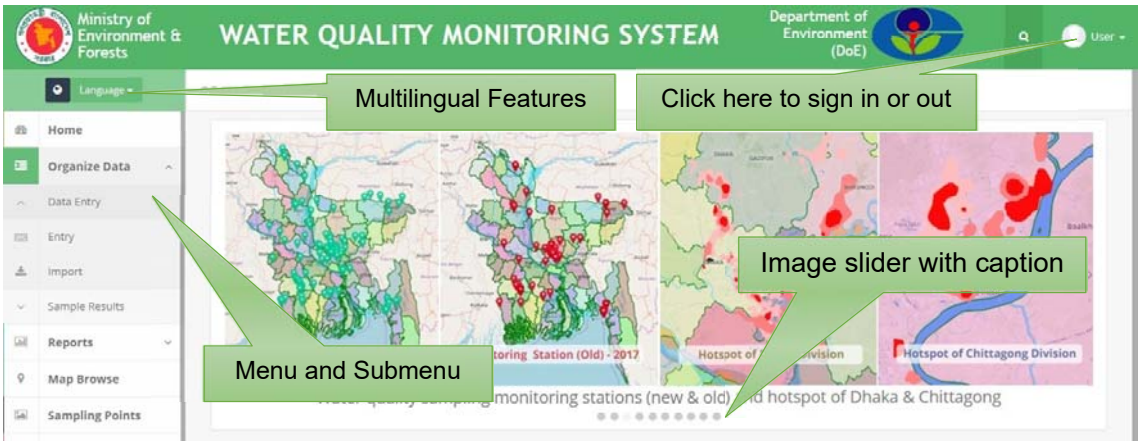


Figure 1.2: Home screen of the WQMS

The main intention was to develop a user-friendly web application to view the data from the WQMS database. Major components of the WQMS are as follows:

1. Home
2. Organize Data
   - Data Entry
     i. Entry
     ii. Import
   - Sample Results
     i. Tabular
3. Report
   - Routine Monitoring
   - Non-Routine Monitoring
   - Drinking Water
   - Ground Water
   - Sample Location
   - Graph Report
     i. Graph with Tabular
     ii. Time Series
   - Individual
4. Map Browse
5. Sampling Points

6. Options
    - Parameter Category
    - Parameters
    - River
    - Monitoring Stations
7. User
    - Log in
    - Change Password
8. Other
    - Contact us
    - User Manual
9. Admin
    - Users
    - Group
    - Role

1.4 Introduction to Water Quality Monitoring System (WQMS)

Water Quality Monitoring System software has the facilities to enter and explore water quality data, generate different types of reports in tabular format as well as graphical format, finding monitoring stations on dynamic map with monitoring station information in popup view. We have also attached software user manual, etc. User can also download these reports at any time. Adding new users and updating existing user information, user access rules and other administrative activities are also present in the Admin module.

1.5 User Sign In

User login is required when any user will enter new data, edit or delete existing data. To login put the mouse pointer on the **User** then ***click*** on **Log In.**

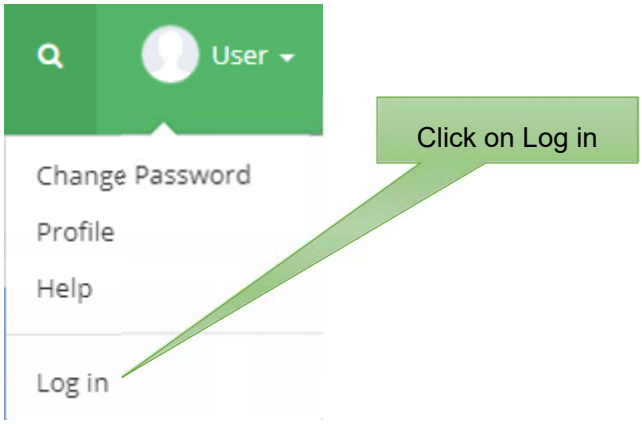


Figure 1.3: Log in Procedure

After clicking on Sign in, a new Sign in page will appear like this:

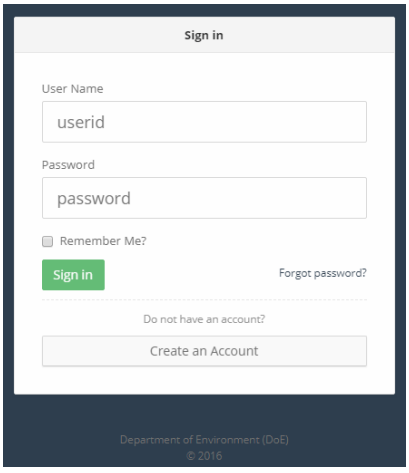


Figure 1.4: Sign in Window

After that, *enter* User Name and Password then *click* on Sign in button.

At the same way, for logout ***point*** the mouse pointer on the **User (User Name)** then ***click*** on **Sign Out.**

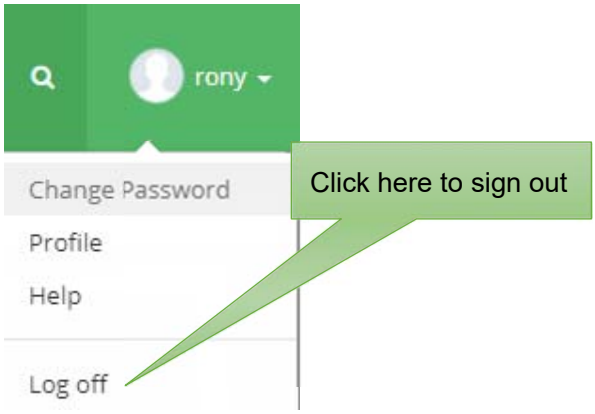


Figure 1.5: Sign Out Procedure

1.6 Main-Menu and Sub-Menu

The main-menu located at the left side of the MIS under the banner.

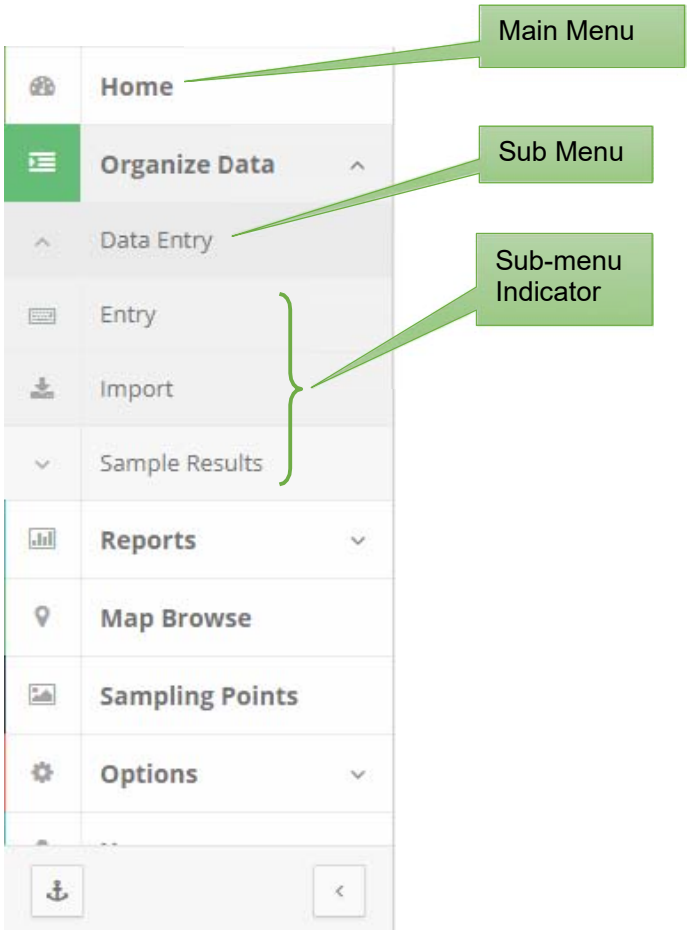


Figure 1.6: Main Menu and Sub-Menu

2. Organize Data

This is one of the major components of the WQMS. It has Data Entry and Sample Results sub modules. Data Entry sub module has another two sub modules Entry and Import 2.1 is used to add new water quality information and import data from pre-designed excel format, Sample Results sub modules 2.2 also used to view and searching water quality data with export facility.

In Organize Data Main Menu, there are two Sub-Menus:

2.1. Data Entry

(1) Entry

(2) Import

2.2. Sample Results

2.1 Data Entry

Data Entry sub module > Entry is used to add new water quality data and Import is used to import data from defined excel sheet. Description of Monitoring Station, Water Source, Purpose of Sample, Type of Sample in Main tab, different types of parameter result in Sample Result tab, Depth of Water, River Flow Condition in Hydrological Information tab and Monitoring Station sample point photo upload in Upload Photo tab. It's also mentioned that Custom ID will be generated automatically. So here is the procedure:

Step 1: Move mouse pointer on **Organize Data** from the main menu.

Step 2: ***Click*** on **Data Entry**. Entry and Import option will open.

Step 3: When the **Entry** is selected, the page appears in window. There, user needs to select appropriate options to add new water quality data for the data entry and upload photos. After that it shows an empty form with several parts of it.

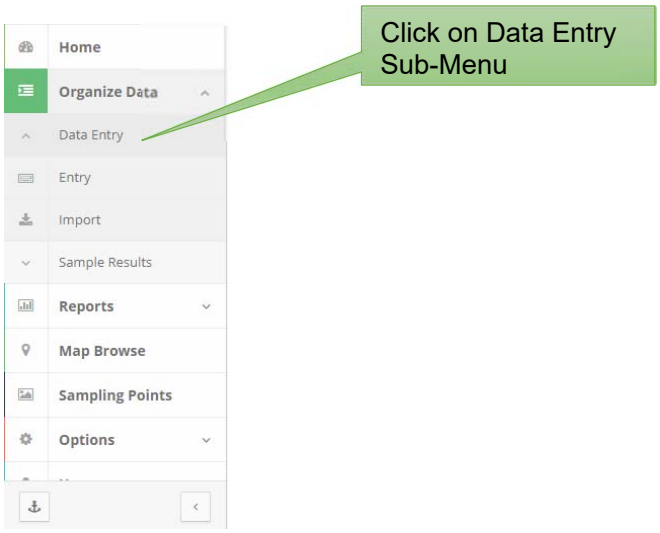


Figure 2.1: Organize Data Sub-menu Data Entry

When Data Entry part opens, first it appears like this:

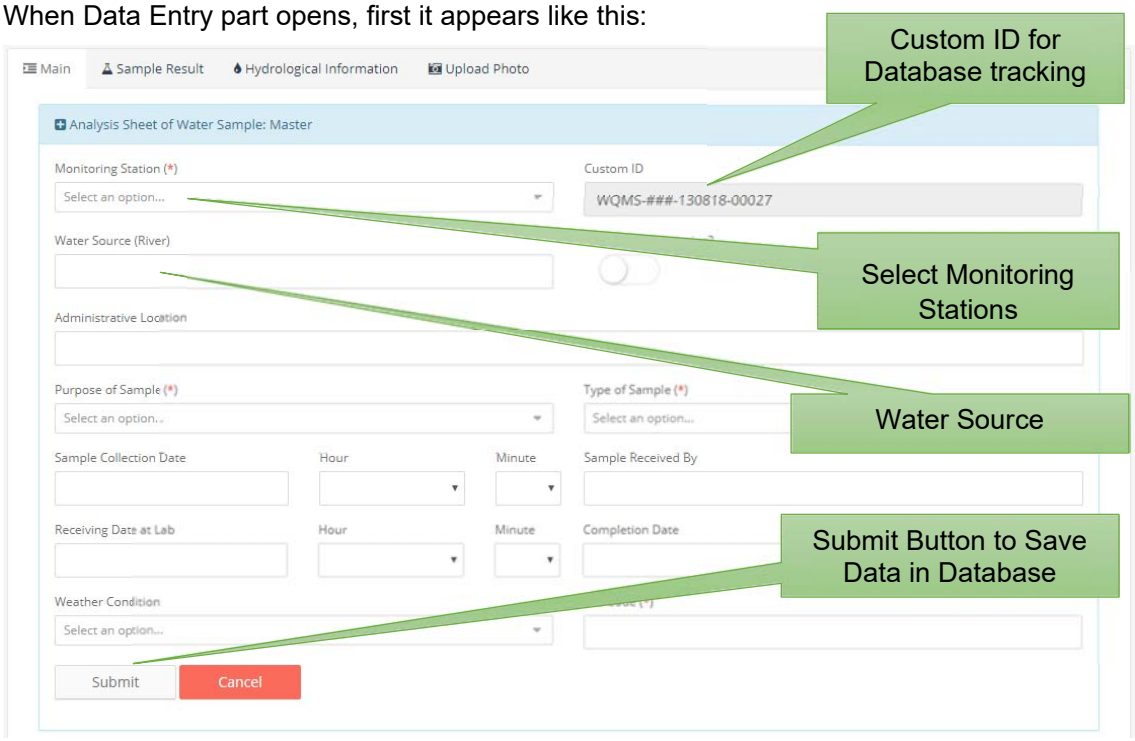


Figure 2.2: Entry Module

2.1.1 How to enter parameter result in sample result tab:

First, in the **Main** tab, select the proper information step by step and ***click on*** **Submit** to save initial information.

Then click on Sample Result tab (in figure 2.3) which is used to add different parameter results.

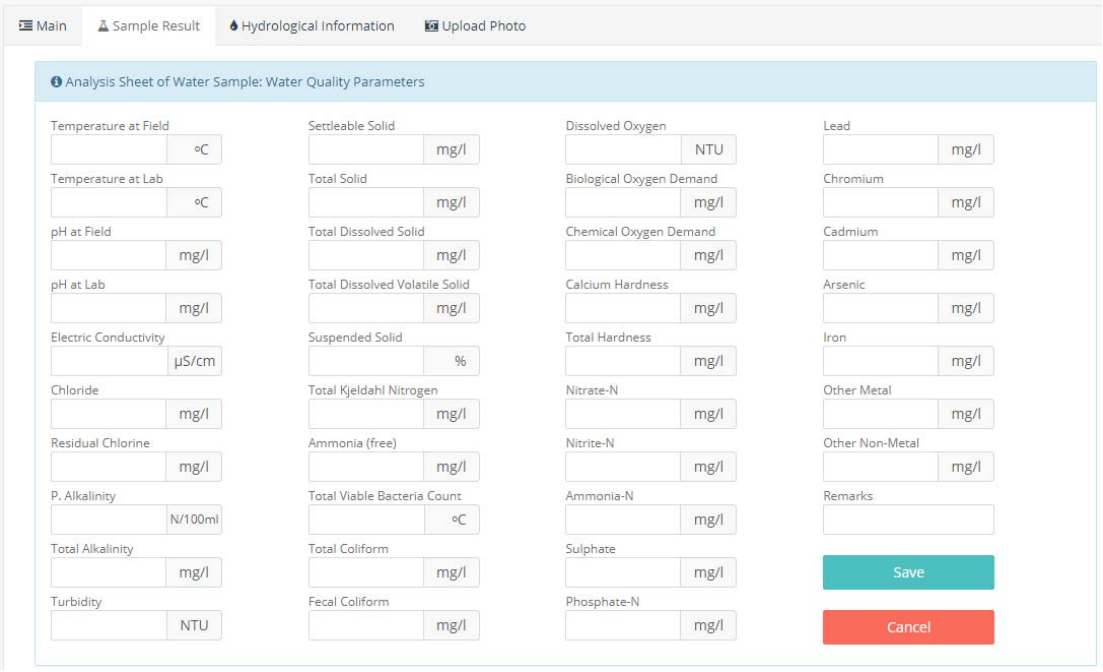


Figure 2.3: Different Water Quality Parameter Result

2.1.2 Hydrological Information:

After submitting main information and sample result information then click on Hydrological Information. It contains river flow condition and depth of sample collected water information. If river flow condition does not appear in dropdown option then select other option and a textbox will appear to add other information about river. Figure 2.4 represents about the hydrogeological information.

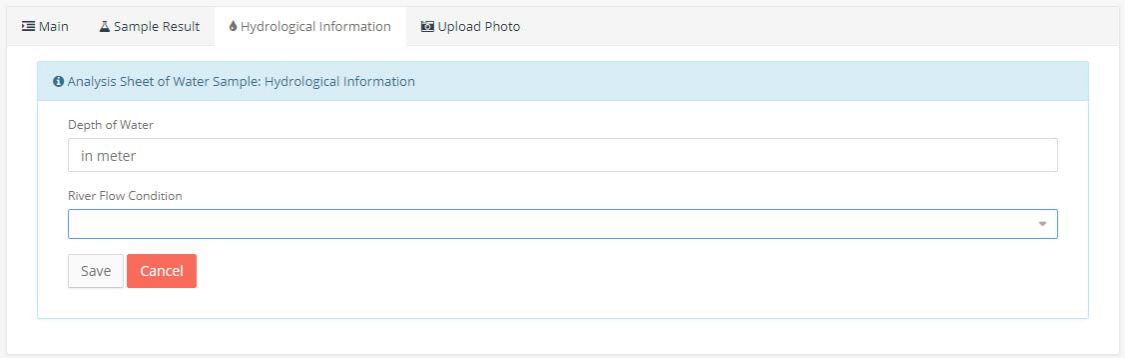


Figure 2.4: Hydrological Information

2.1.3 Upload Photo:

Different photos of Monitoring stations will be uploaded by this option in figure 2.5.

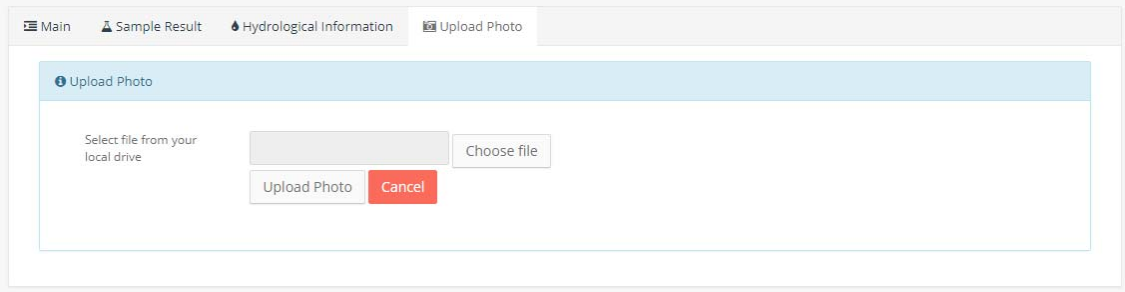


Figure 2.5: Upload Photo

2.1.4 Import:

This is one of the most important menu of this MIS. Import menu will help to save bulk data at a time from excel file. A sample excel format will found in the link of "**Download Sample File**". User have to download this file and input data as formation. Noticeable that, users should not try to do any change of formation otherwise bulk data will not be imported properly. Figure 2.6 represent the interface of choosing file and date and figure 2.7 shows sample imported data.

Figure 2.6: Import Bulk Data

	Sl	Monitoring Stations	River	Parameters	Purpose of Sample	Type of Sample	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	1	Horindhora (CETP)	Dhaleswari	Ammonia	Routine Monitoring	Surface Water	2.2	0	0	0	0	0	0	0	0	0	0	0
	2	Horindhora (CETP)	Dhaleswari	Arsenic	Routine Monitoring	Surface Water	0.007	0	0	0	0	0	0	0	0	0	0	0
	3	Horindhora (CETP)	Dhaleswari	BOD	Routine Monitoring	Surface Water	36	0	0	0	0	0	0	0	0	0	0	0
	4	Horindhora (CETP)	Dhaleswari	CalciumHardness	Routine Monitoring	Surface Water	70	0	0	0	0	0	0	0	0	0	0	0
	5	Horindhora (CETP)	Dhaleswari	COD	Routine Monitoring	Surface Water	128	0	0	0	0	0	0	0	0	0	0	0
	6	Horindhora (CETP)	Dhaleswari	Chloride	Routine Monitoring	Surface Water	48	0	0	0	0	0	0	0	0	0	0	0
	7	Horindhora (CETP)	Dhaleswari	FecalColiform	Routine Monitoring	Surface Water	780	0	0	0	0	0	0	0	0	0	0	0
	8	Horindhora (CETP)	Dhaleswari	DO	Routine Monitoring	Surface Water	6.5	0	0	0	0	0	0	0	0	0	0	0
	9	Horindhora (CETP)	Dhaleswari	ECmicro	Routine Monitoring	Surface Water	642	0	0	0	0	0	0	0	0	0	0	0

Figure 2.7: Import Bulk Data

2.2 Sample Results

On this page you will find data saved by registered users to the WQMS database. This data includes short information, sampling location, river, upazila and results in pop up view and date of survey. This page also includes different types of searching parameters to find individual or specific location water quality information. Also you can export expected data to excel data sheet format. Move mouse pointer on **Organize Data** from the main menu, and then ***click*** on **Sample Result > Tabular** link in figure 2.8. Add data will open only if the user is **logged in**. Or it will ask for **User login**.

Figure 2.8: Sample result tabular view menu link

In this part, when the **Sample Result** is selected, the page appears with a new window. There, users will view all listed monitoring stations data. Here appears a sample view of searching criteria (**Figure 2.6**).

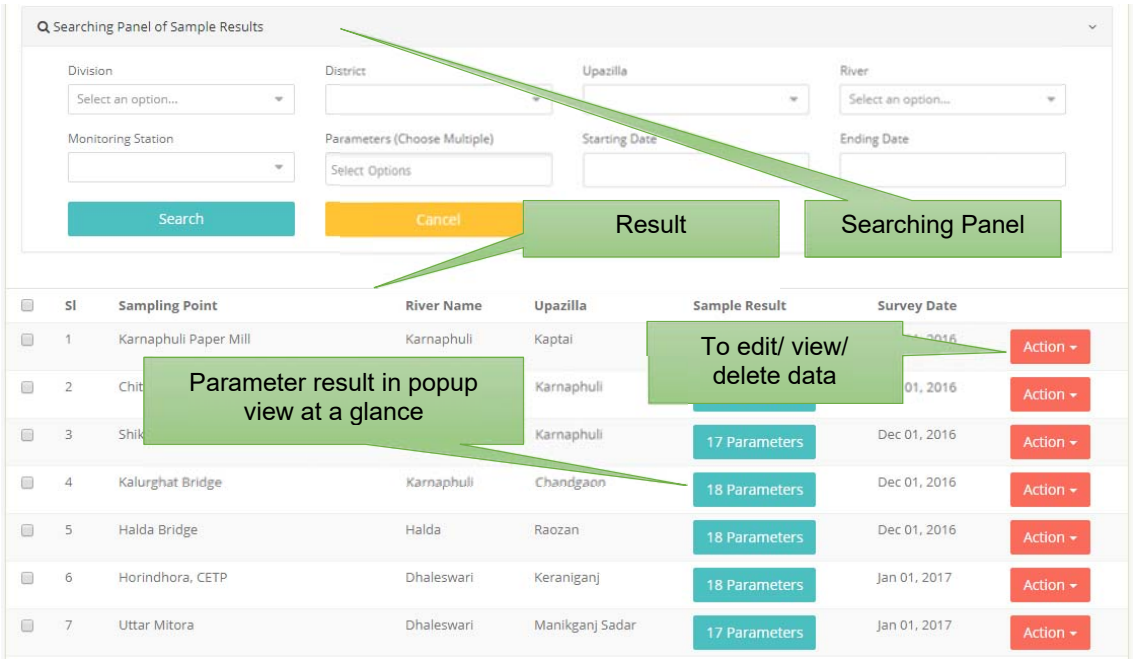


Figure 2.9: Sample Result view with different searching parameters.

If user click on sample result column of any row then a popup window will come like figure 2.10.

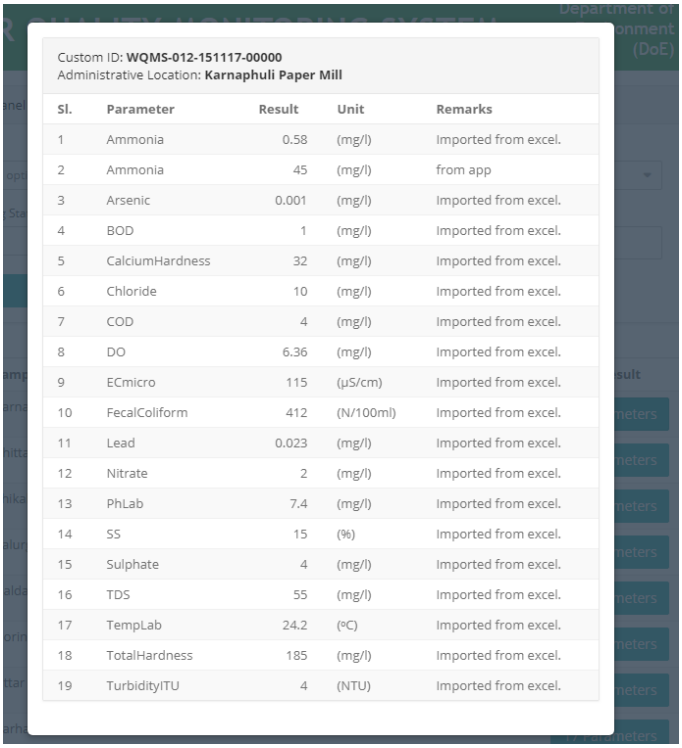


Figure 2.10: Sample Result popup view with parameters.

3. Reports

Reports: Analysis of data is a process of inspecting, reporting in tabular and graphical data with the goal of discovering useful information. Reports have multiple facets and approaches e.g. encompassing diverse techniques to generate different water quality related reports.

Okay, now point the mouse pointer on “Report” it will show sub-menu (Figure 3.1)

In Data Analysis Main Menu, there are two Sub-Menus:

3.1. Routine Monitoring, 3.2. Non-Routine Monitoring, 3.3. Drinking Water, 3.4. Ground Water, 3.5. Sample Location, 3.6. Graph Report, it has two menu i) Graphical with Tabular and ii) Time Series, 3.7. Individual

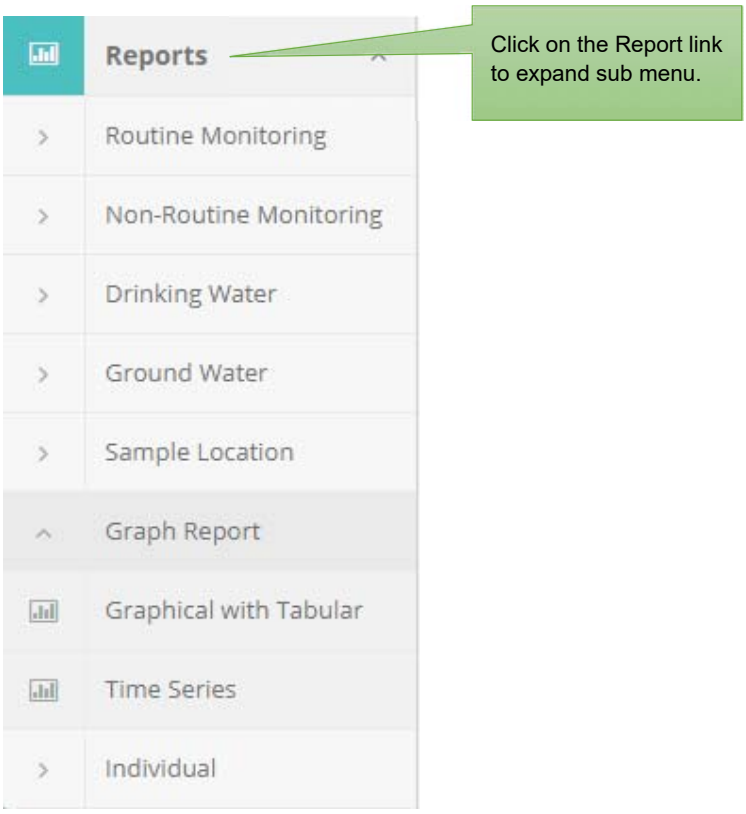


Figure 3.1: Report Sub-menu

3.1 Routine Monitoring Report

Move mouse pointer on **Report** from the main menu, and then ***click*** on **Routine Monitoring**. This link will open only if the user is **logged in**. Or it will ask for **User login**.

In this part, when the **Routine Monitoring** is selected, the page appears with some related filtering parameters. Figure 3.2 illustrates the view of routine monitoring report.

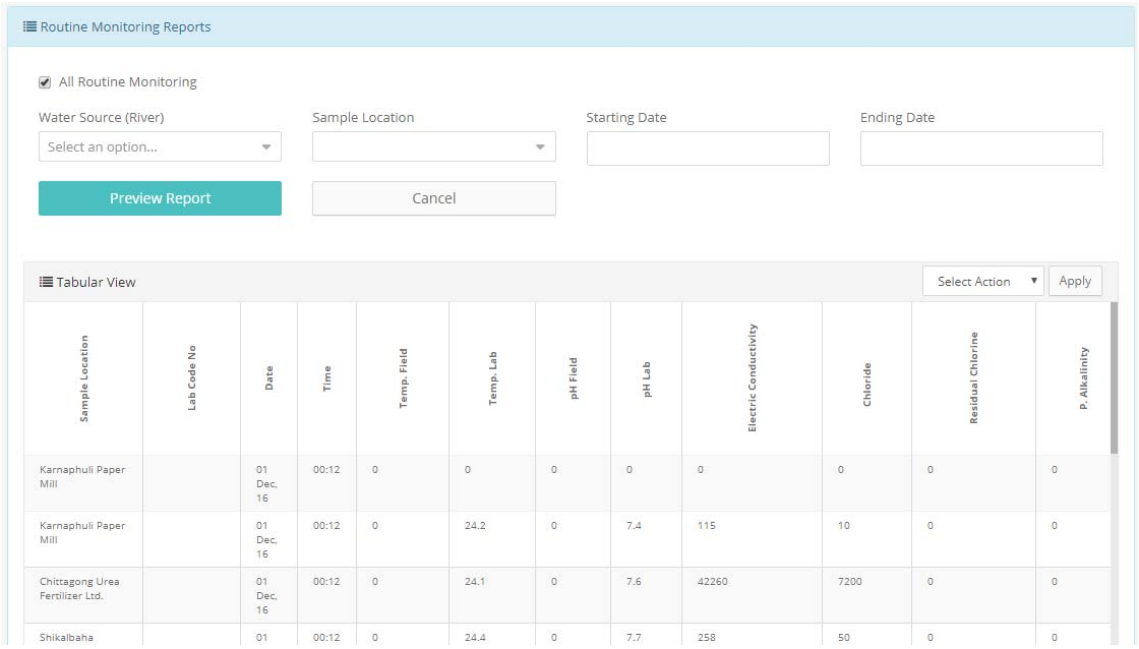


Figure 3.2: Report of Routine Monitoring

3.2 Non-Routine Monitoring Report

In this part, when the **Non-Routine Monitoring** is selected, the page appears with some related filtering parameters. Figure 3.3 illustrates the view of non-routine monitoring report.

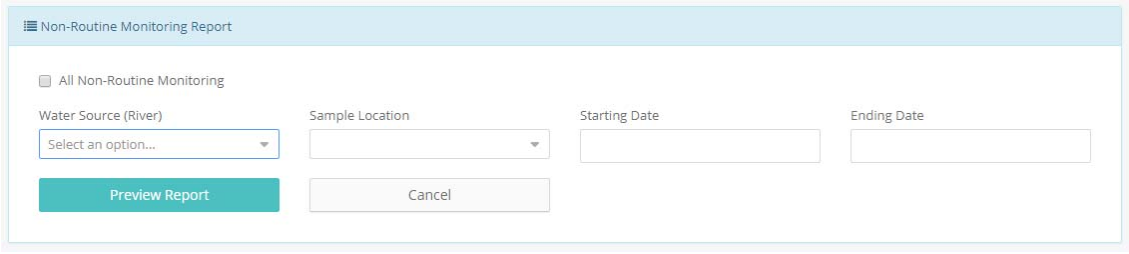


Figure 3.3: Report of Non-Routine Monitoring

3.3 Drinking Water Report

In this part, when the **Drinking Water** is selected, the page appears with some related filtering parameters. Figure 3.4 illustrates the view of drinking water report.

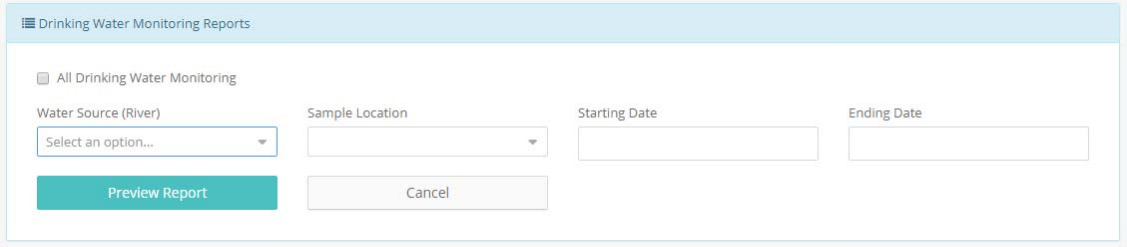


Figure 3.4: Report of Drinking Water

3.4 Ground Water Report

In this part, when the **Ground Water** is selected, the page appears with some related filtering parameters. Figure 3.5 illustrates the view of ground water report.

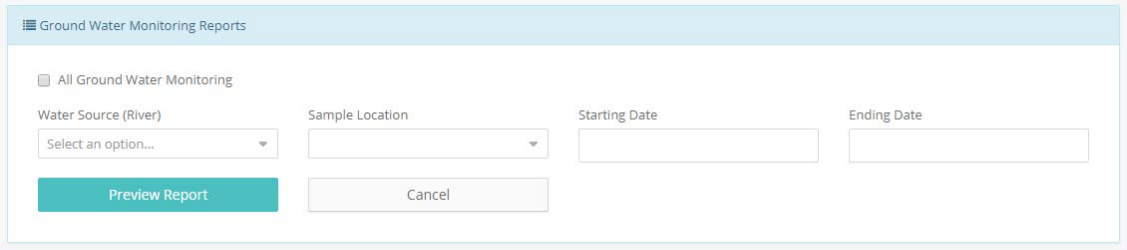


Figure 3.5: Report of Ground Water

3.5 Sample Location Report

In this part, when the **Sample Location** is selected, the page appears with some related filtering parameters. Figure 3.6 illustrates the view of sample location report.

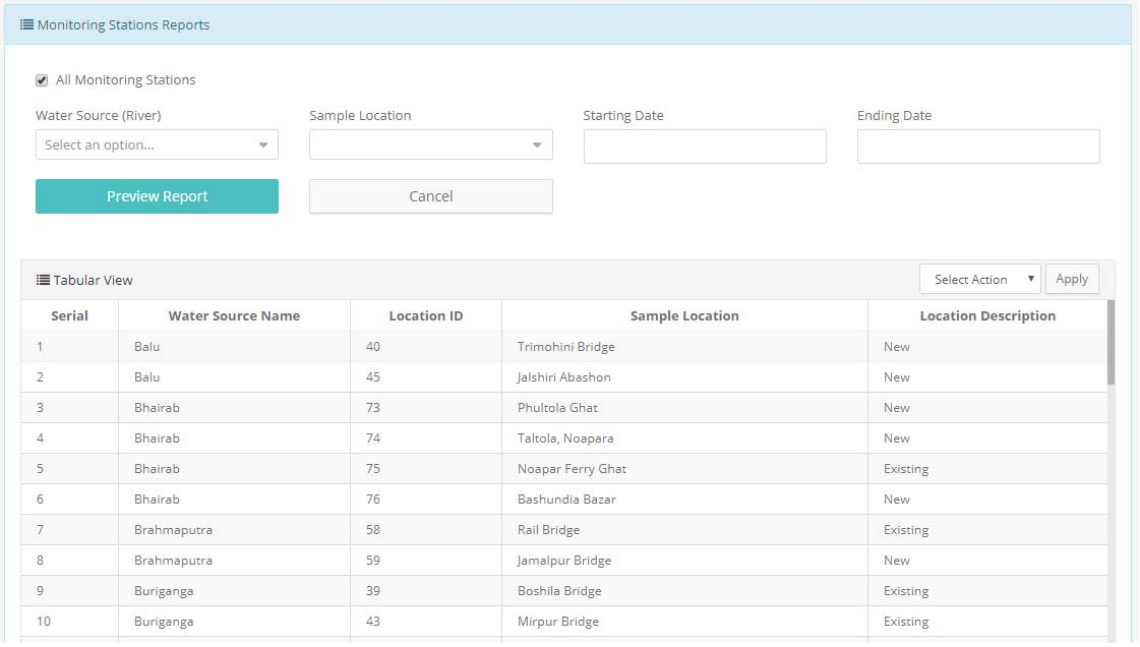


Figure 3.6: Report of Added Sample Location

3.6 Graph Report

In this part, when the **Graph Report** is selected, a sub menu also appear: one is the **Graphical View with Tabular** format and another is the **Time Series**. Graphical with Tabular consists with line chart graph report with different filtering parameters and a tabular format with export data in different format. Figure 3.7, 3.8 and 3.9 represents a graphical report respectively.

3.6.1 Graphical with Tabular

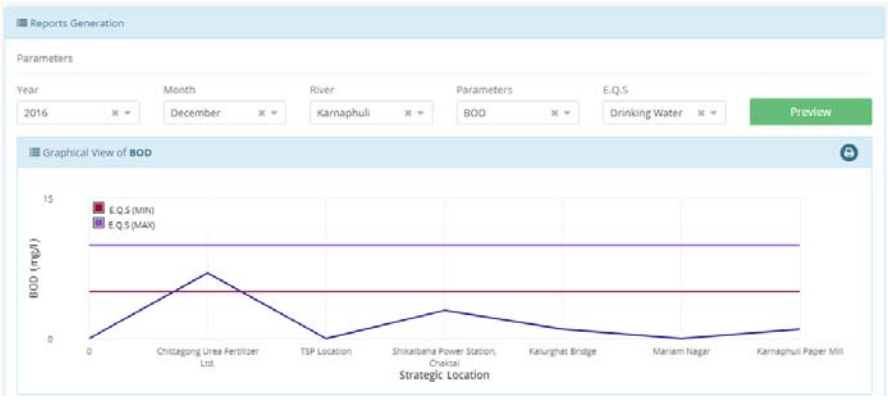


Figure 3.7: Line Chart Graph Report

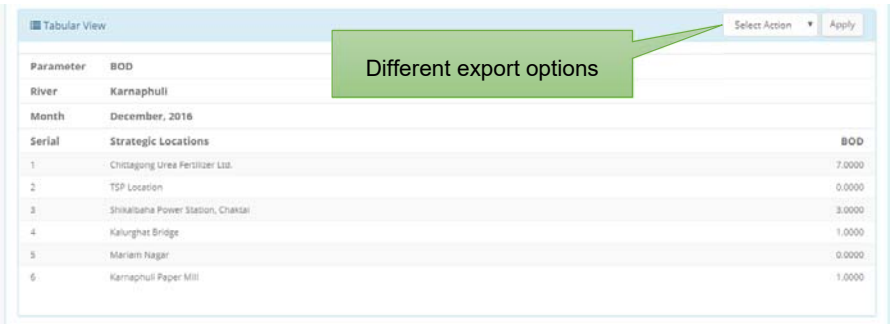


Figure 3.8: Tabular view of Graph Report

3.6.2 Time Series

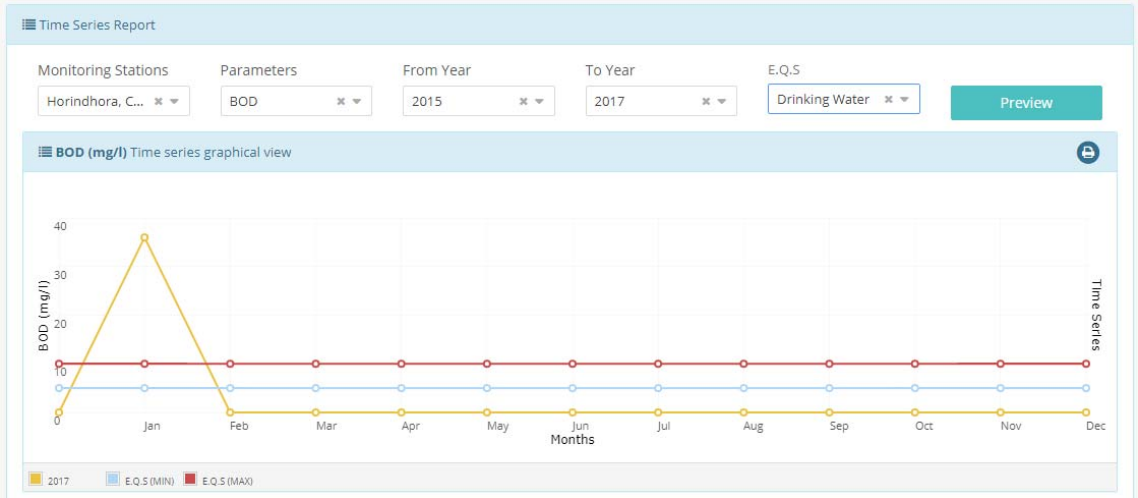
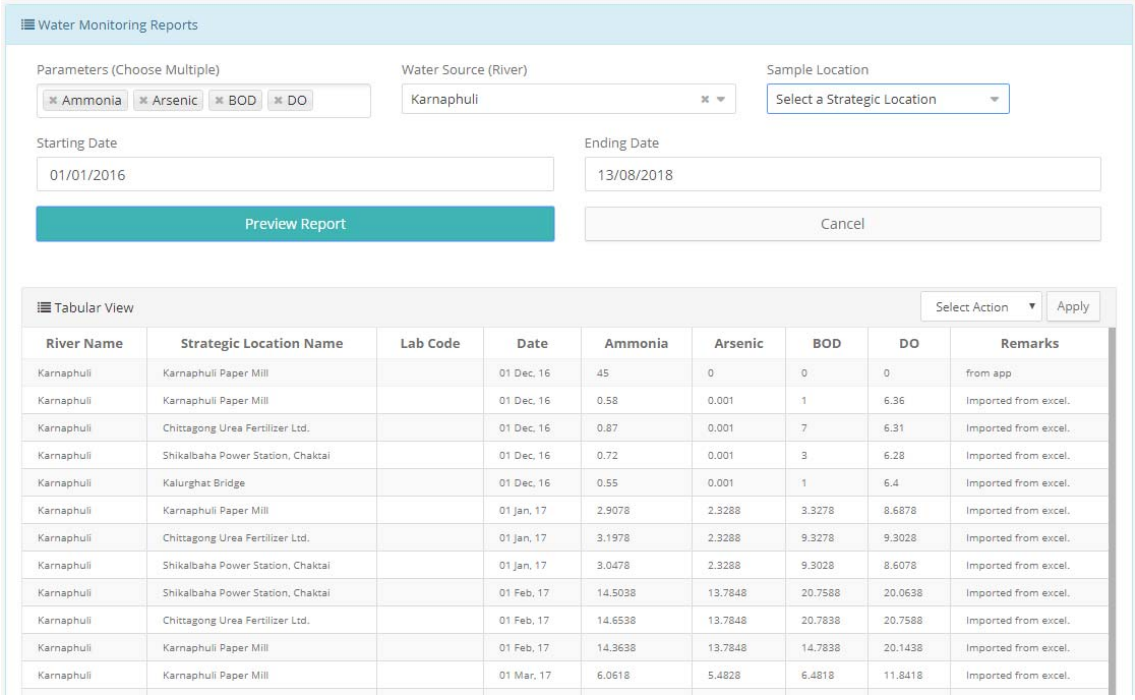


Figure 3.9: Time Series Report

3.7 Individual Report

Dynamic column output is in an individual report. It depends on user, multiple parameters can be chosen by users. A starting date and an Ending date is required for this report. User can also export output as excel or pdf format. Figure 3.10 illustrates the individual report based on appropriate filtering.



River Name	Strategic Location Name	Lab Code	Date	Ammonia	Arsenic	BOD	DO	Remarks
Karnaphuli	Karnaphuli Paper Mill		01 Dec, 16	45	0	0	0	from app
Karnaphuli	Karnaphuli Paper Mill		01 Dec, 16	0.58	0.001	1	6.36	Imported from excel.
Karnaphuli	Chittagong Urea Fertilizer Ltd.		01 Dec, 16	0.87	0.001	7	6.31	Imported from excel.
Karnaphuli	Shikalbaha Power Station, Chaktai		01 Dec, 16	0.72	0.001	3	6.28	Imported from excel.
Karnaphuli	Kalurghat Bridge		01 Dec, 16	0.55	0.001	1	6.4	Imported from excel.
Karnaphuli	Karnaphuli Paper Mill		01 Jan, 17	2.9078	2.3288	3.3278	8.6878	Imported from excel.
Karnaphuli	Chittagong Urea Fertilizer Ltd.		01 Jan, 17	3.1978	2.3288	9.3278	9.3028	Imported from excel.
Karnaphuli	Shikalbaha Power Station, Chaktai		01 Jan, 17	3.0478	2.3288	9.3028	8.6078	Imported from excel.
Karnaphuli	Shikalbaha Power Station, Chaktai		01 Feb, 17	14.5038	13.7848	20.7588	20.0638	Imported from excel.
Karnaphuli	Chittagong Urea Fertilizer Ltd.		01 Feb, 17	14.6538	13.7848	20.7838	20.7588	Imported from excel.
Karnaphuli	Karnaphuli Paper Mill		01 Feb, 17	14.3638	13.7848	14.7838	20.1438	Imported from excel.
Karnaphuli	Karnaphuli Paper Mill		01 Mar, 17	6.0618	5.4828	6.4818	11.8418	Imported from excel.

Figure 3.10: Individual Report by Parameter Choosing

4. Map View

Map Browser is an efficient way to assess and view monitoring stations with popup descriptions, hot spot and administrative boundaries and can also export the dynamic map in image format. ***Click*** on the **Map Browse** menu to open Map view page (Figure: 4.1).

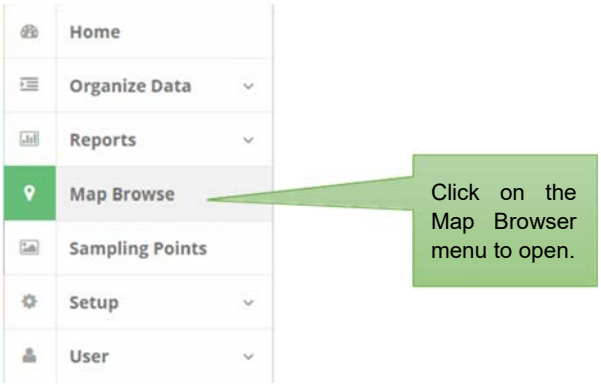


Figure 4.1: Map Browse selection from menu

The Map Browse page contains a dynamic digital map with list of different layers, Google open street view, grayscale view, streets view and satellite view. Figure: 4.2 contains the basic view of map.

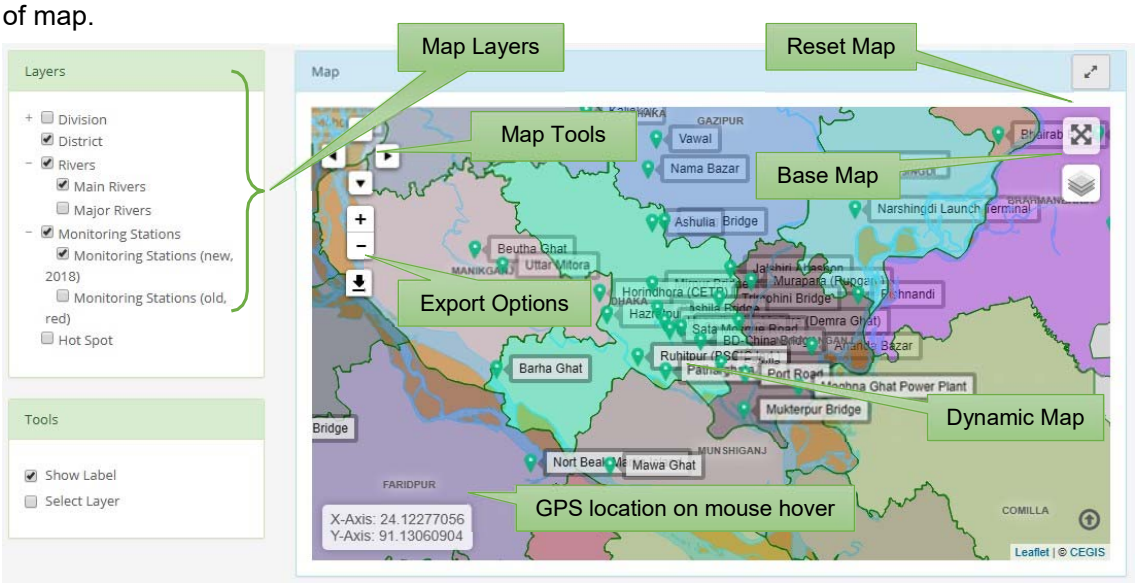


Figure 4.2: Dynamic map on map browser page

The water pollution hotspots have been identified based on the two major pollution sources, such as point source pollutants (industrial pollution) and non-point agricultural pollution, sediment pollution from river bank erosion, urban ruff off and others. The geospatial technique of Optimized Hotspot Analysis followed to identify the hotspots for point source pollutions. Landsat Enhanced Thematic Mapper 8 Satellite images of July, August, September, and October were used to identify non-point water pollution sources (inundated areas during rainy season). SRTM DEM 30 meter is used to delineate watershed as catchment area of each river. Figure 4.3 illustrates the hotspot view of Dhaka.

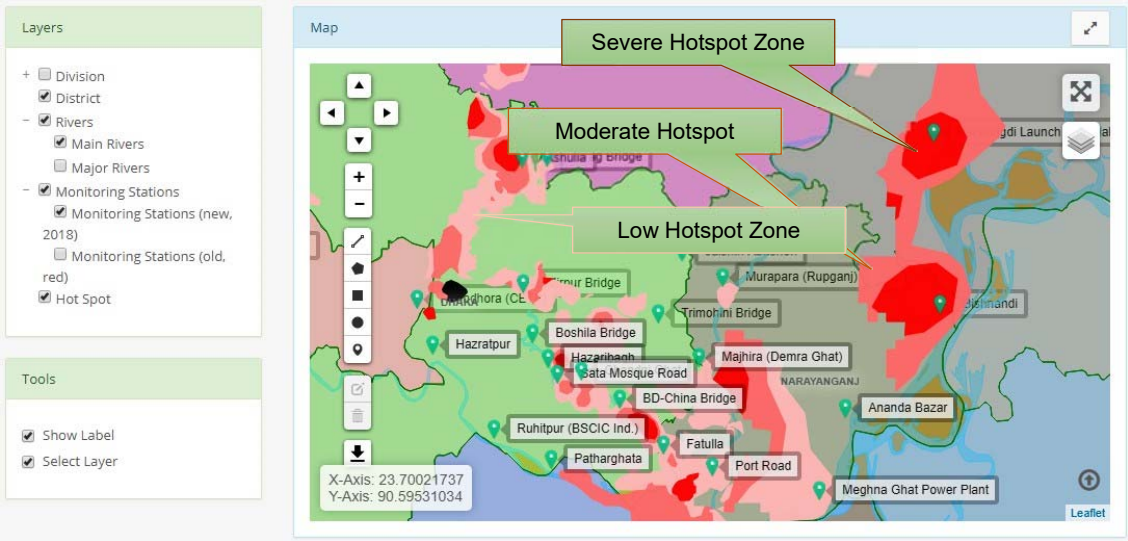


Figure 4.3: Hotspot view on map

User can also view new monitoring stations and old monitoring stations by selecting layer. Green marker point represents the new monitoring stations and red marker point represents the old monitoring stations. You can click on any marker point to know about the details with point photos. Figure 4.4 illustrates the new and old monitoring stations.

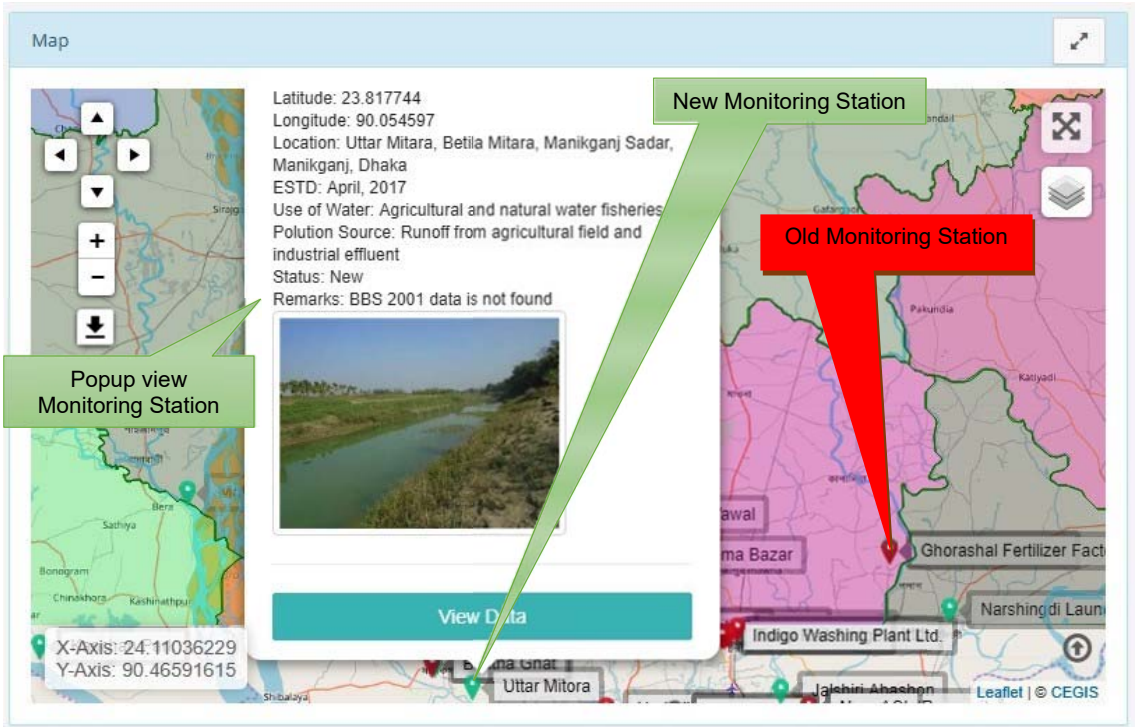
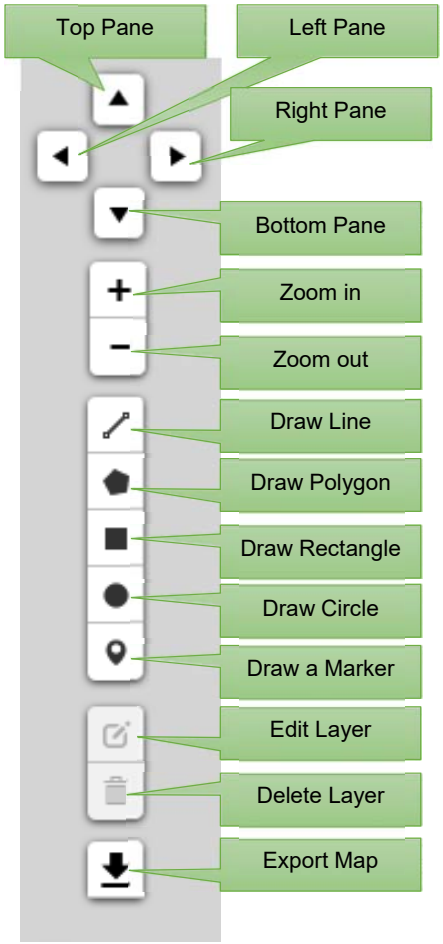


Figure 4.4: New & Old Monitoring Stations with Popup View

a) Map Tools:

There are 14 map tools to view map in different styles and map export is in the right side of the figure. These are:



i. **Top Pane:** Used to panning in top side.

ii. **Left Pane**: Used to panning in left side.

iii. **Right Pane**: Used to panning in right side.

iv. **Bottom Pane**: Used to panning in bottom side.

v. **Zoon In:** To zoom the map, click this tool then again click on the map. Or click this tool then drag on the map and release to zoom in.

vi. **Zoom Out:** To zoom out from the map, click the tool then again click on the map.

vii. **Line:** To draw a line on the map.

viii. **Polygon:** By using this tool user can draw polygon on the map.

ix. **Rectangle:** By using this tool user can draw rectangle on the map.

x. **Circle:** By using this tool user can draw circle on the map.

xi. **Marker:** By using this tool user can point a new location on the map.

xii. **Edit Layer:** User can edit layer by using this tool.

xiii. **Delete Layers:** Click on this tool to delete layer.

xiv. **Export:** This tool is used to export the map in JPEG format.

b) GPS Position on mouse hover:

GPS position contains GPS reading of Latitude and Longitude values. So, wherever the mouse pointer goes on the dynamic map, GPS position will show automatically. These latitude and longitude values will show just under the dynamic map (Figure 4.5).

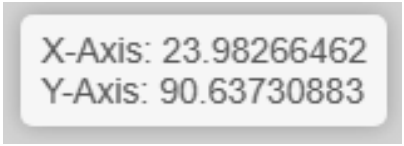


Figure 4.5: GPS Position

5. Sampling Points

In Sampling Points there are nothing but some monitoring stations and field visit photos that contain appropriate captions. To open the page, ***click*** on **Sampling Points** from the ***main menu***.

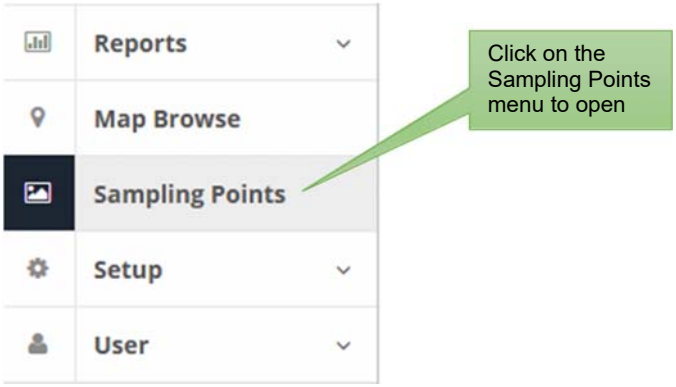


Figure 5.1: Sampling Points in main menu

Then the Sampling Points page appears (Figure 5.2).

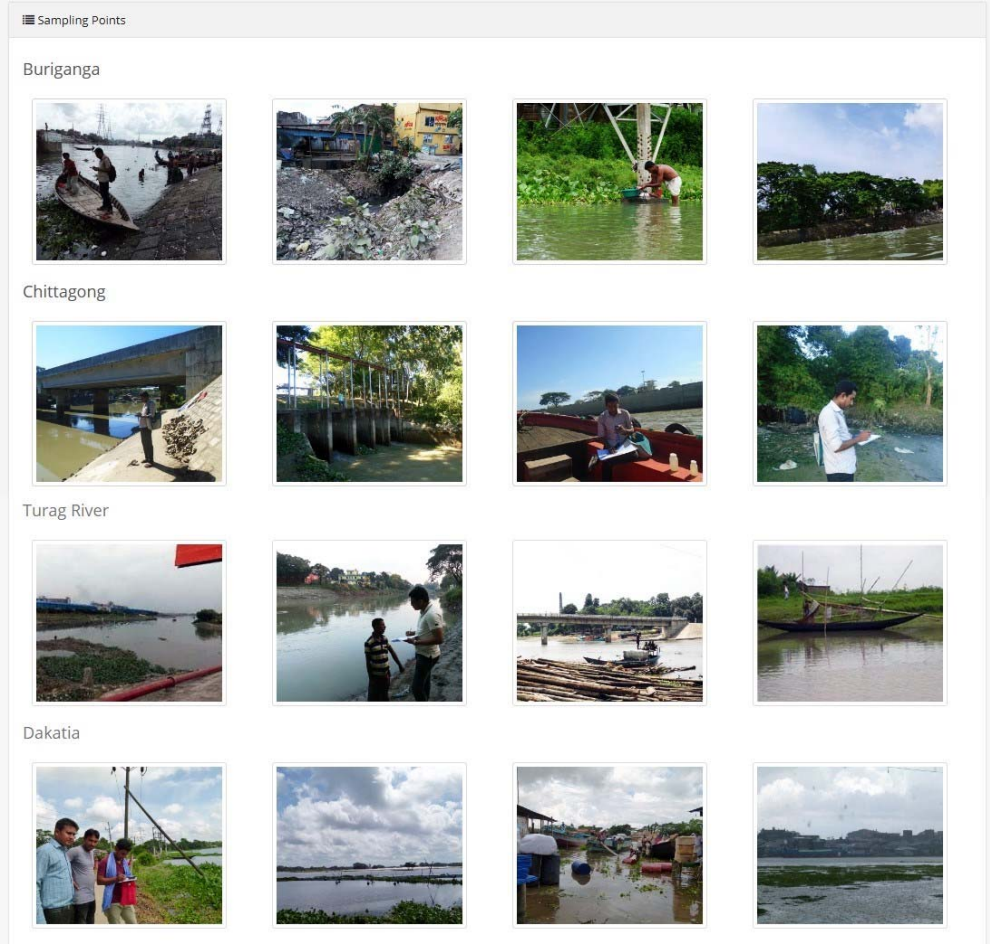


Figure 5.2: Images of the Different Sampling Points.

6. Setup

This section describes how to use the Setup menu. To open Setup, click on the link “Setup” and it will expand with four sub menus e.g. Parameter Category, Parameters, River and Monitoring Stations in (Figure 6.1).

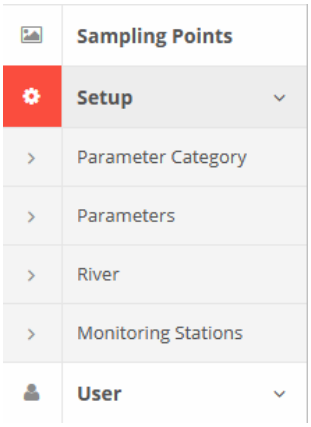


Figure 6.1: Setup menu

6.1 Parameter Category:

Move mouse pointer on **Parameter Category** from the main menu of **Setup**, and then ***click***. The settings of parameter category will open only if the user is **logged in**. Or it will ask for **User login**.

In this part, assigned admin user can have privileges to this operation. New water quality parameter category is needed to add first. We have already added few categories in database e.g. Drinking Water, Water use for Industries, Water use of Fisheries, Ground Water and Surface Water. Figure 6.1 contains the added parameter categories of water quality sample.

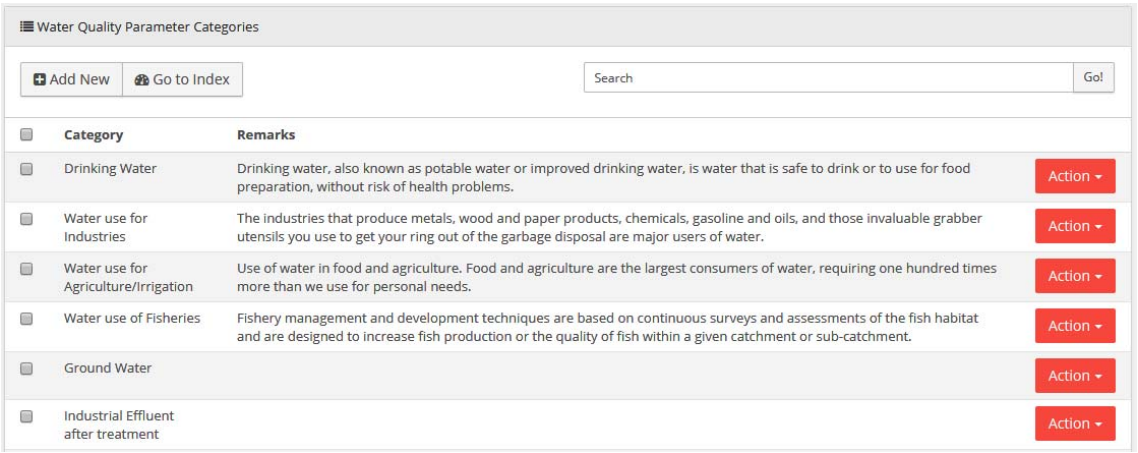


Figure 6.1: Parameter Categories List

To add new parameter category click on Add New button, then a new page will appear soon like this in figure 6.2.

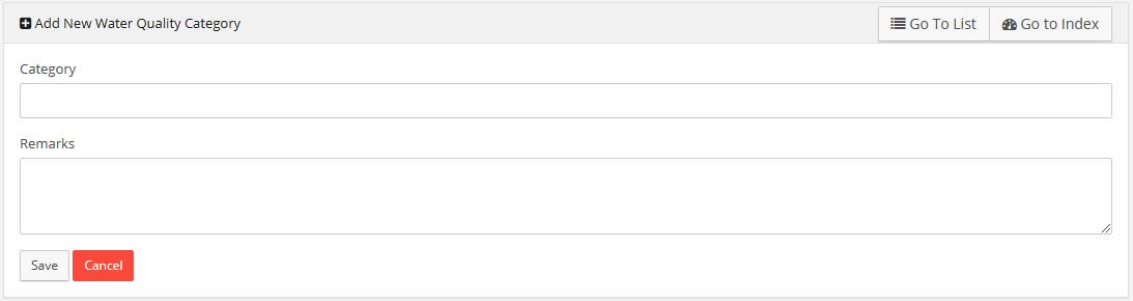


Figure 6.2: Form to add new parameter category

6.2 Parameter:

Move mouse pointer on Parameters from the main menu of Setup, and then click. The settings of parameter will open only if the user is logged in. Or it will ask for User login.

Water samples has different parameters e.g. pH in Lab, pH in Field, BOD, COD, DO, EC micro, Chloride with standard range and remarks in index page. If a new parameter is needed to incorporate in the software then the user have to click on Add New button. Figure 6.3 and 6.4 illustrate the index list of parameters and add a new parameter.

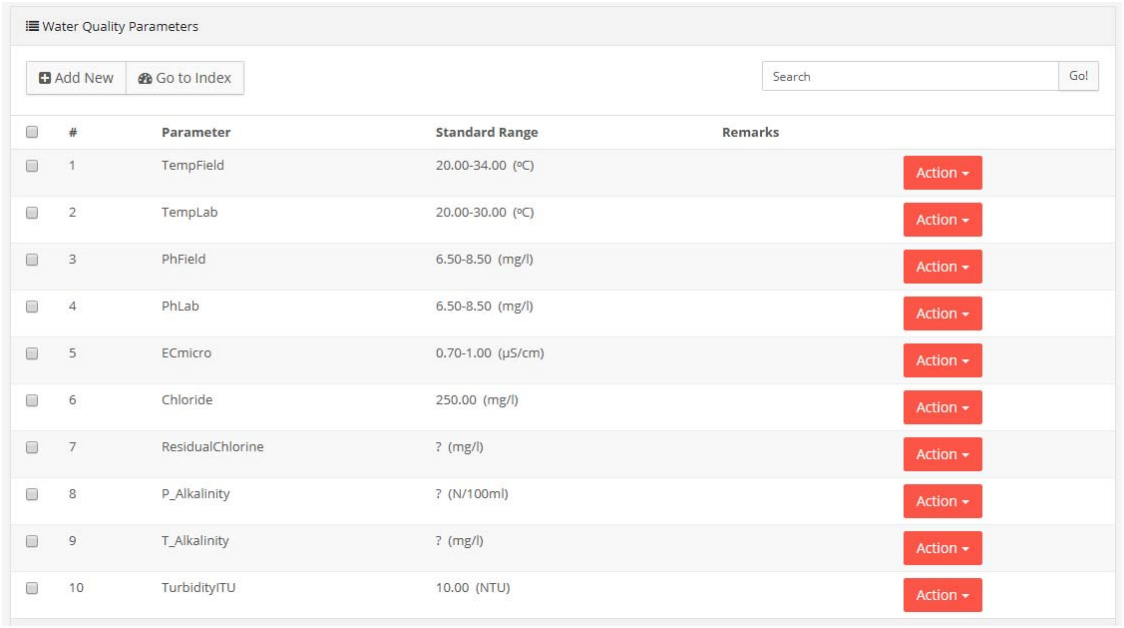


Figure 6.3: List of parameters

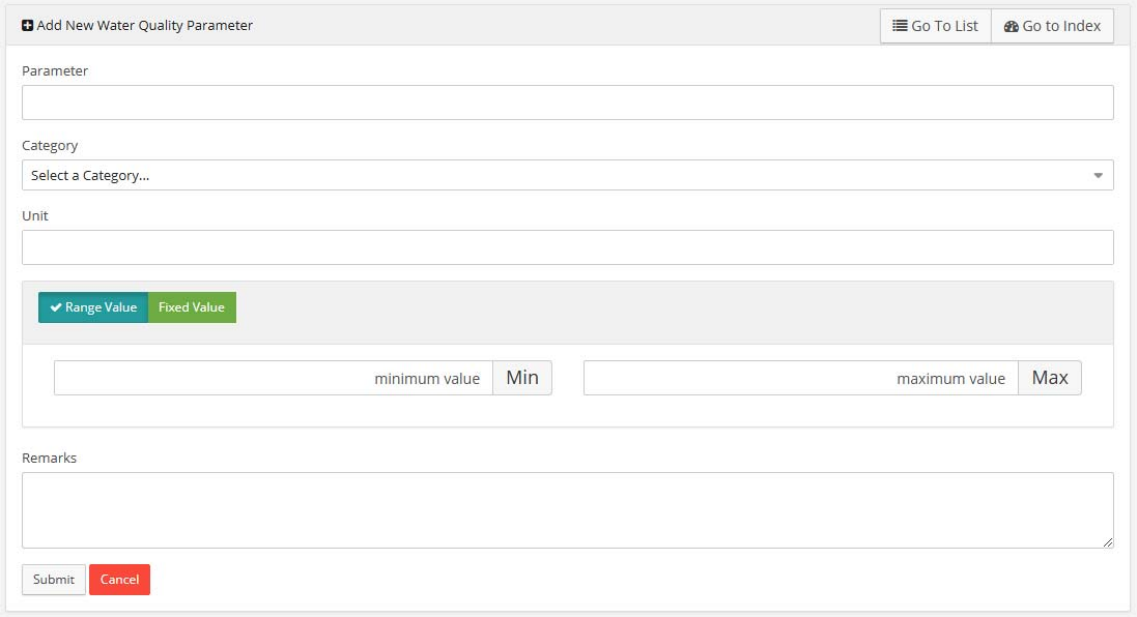
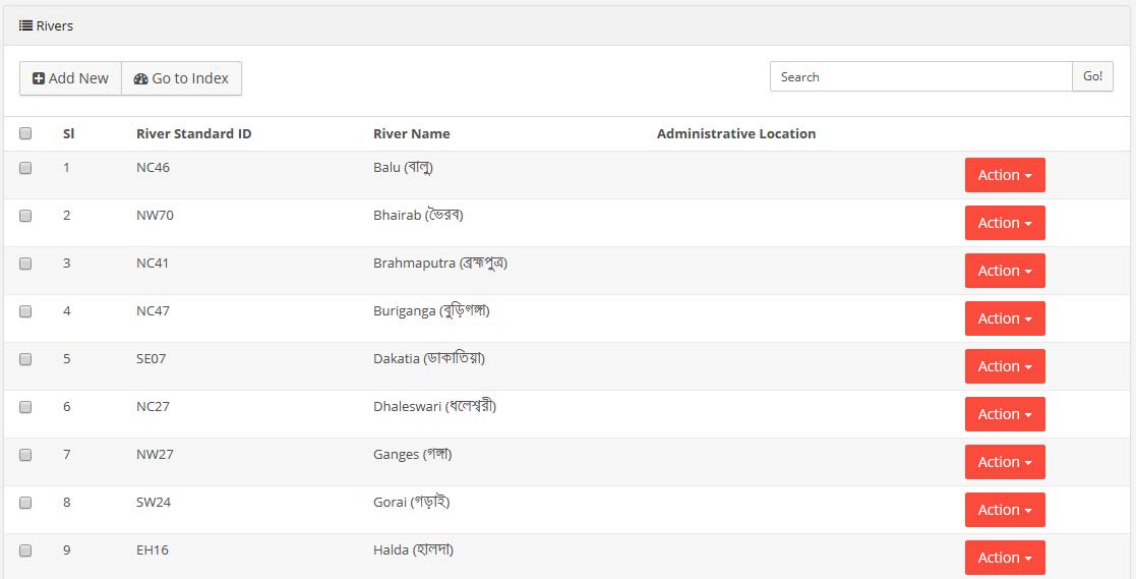


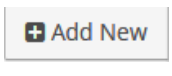
Figure 6.4: New parameter add form

6.3 River:

Move mouse pointer on River from the main menu of Setup, and then click. Total 30 rivers information already added to database. Figure 6.5 shows the existing river list in the database.

Figure 6.5: List of Existing Rivers



TO add new river click on  button, then an empty web form will appear to add new river information (Figure 6.6).

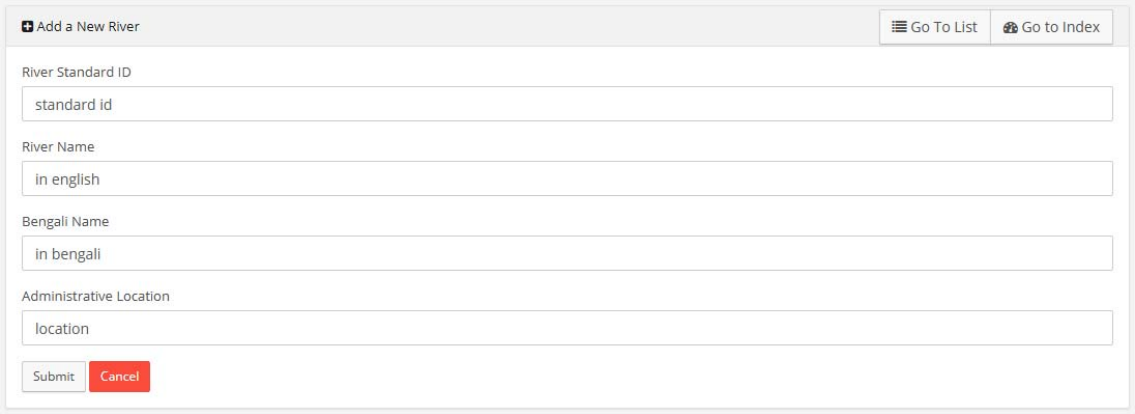


Figure 6.6: Add a New River Form

6.4 Monitoring Stations:

This is one of the important menu in this MIS. Total 99 monitoring stations already incorporate to software. It has 3 menus: list, import and new monitoring stations. Here is at a glance in figure 6.7.

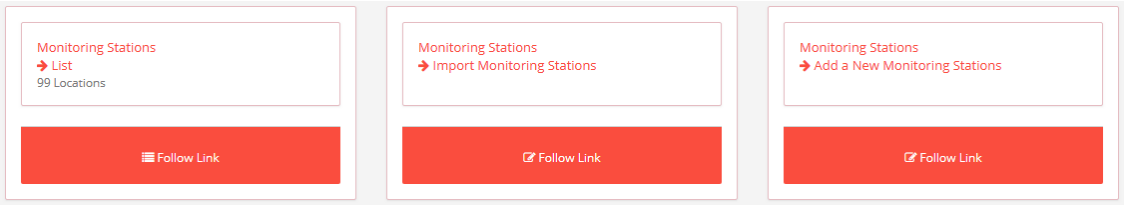


Figure 6.7: Monitoring Stations shortcut links

a) **List**: List contains added monitoring stations. User can also update, view or delete any monitoring stations by clicking on **Action** menu. Figure 6.8 shows the list of saved monitoring stations.

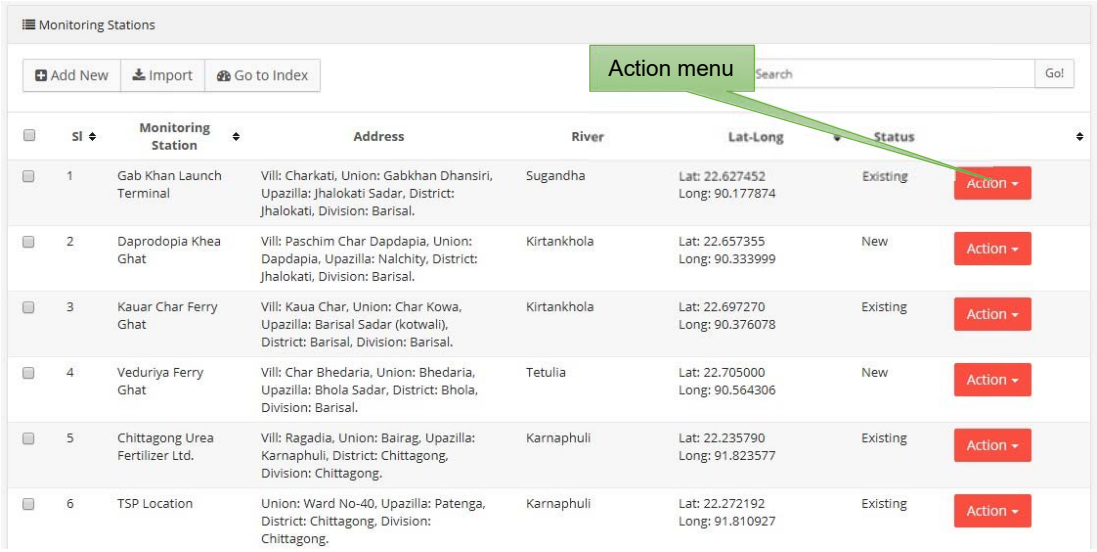


Figure 6.8: List of Monitoring Stations

b) **Import**: There has been developed an easy option to add new bulk monitoring station which is called “Import”. Users have to enter data to a pre-designed excel file and then import it by this form in figure 6.9.

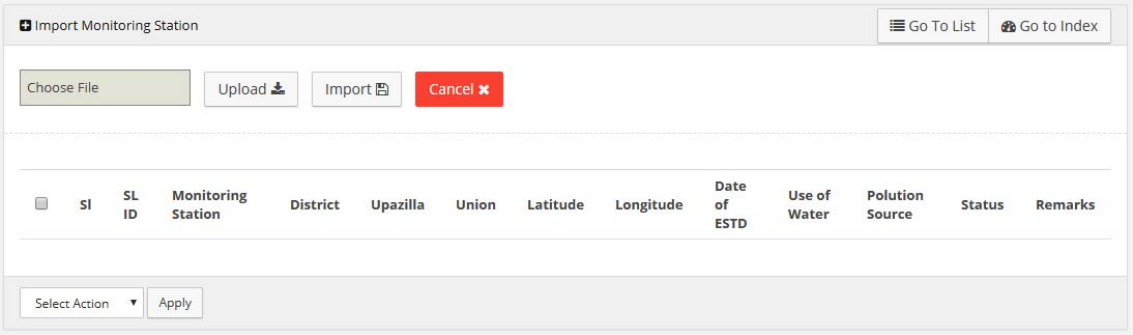


Figure 6.9: Bulk Import of Monitoring Stations

c) **New Monitoring Stations**: New monitoring stations will be needed to add in the software. Some known parameters in this form incorporated e.g. administrative address, monitoring station, is the monitoring station monitored, river name, geo-location, use of water and pollution sources in figure 6.10.

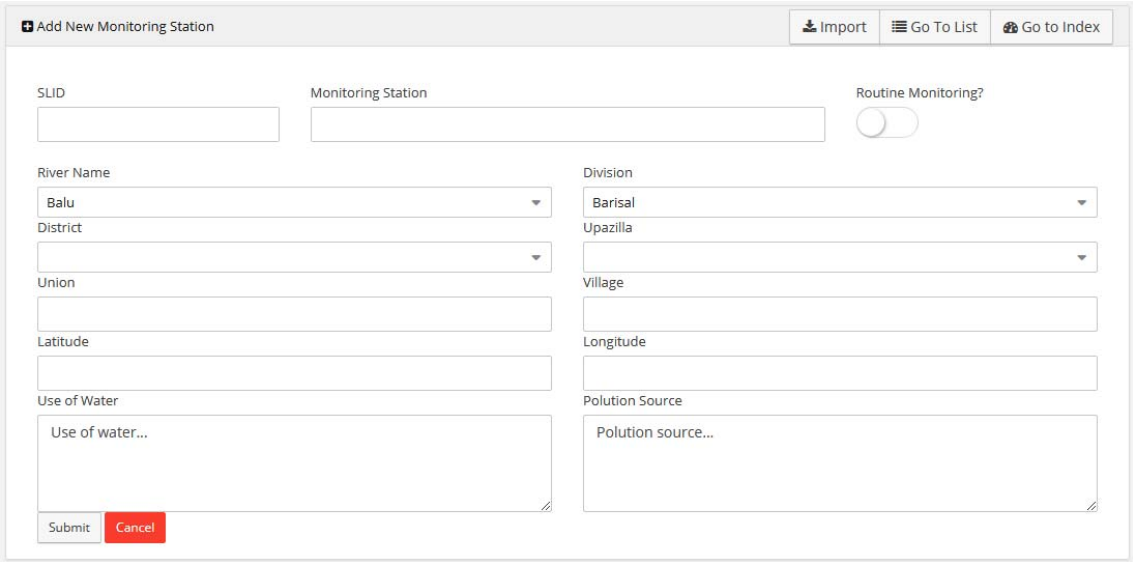


Figure 6.10: Form of new Monitoring Stations

7. User

Click on **User** from the main menu to expand its sub menu. These are:

A) Log in B) Change Password.

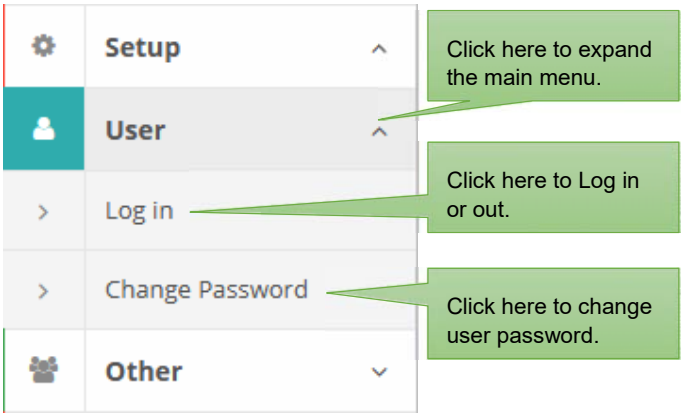


Figure 7.1: User menu

A) For an example, ***Click*** on **Log in** to get the Log in page (Figure 7.2). User can also log in or out from the upper-right side of the MIS application (Figure 7.3). ***Click*** on the **Arrow Sign** to expand. There are three sub menu. A) Change password B) Profile C) Help. Click on the **Log in** button to get the log in page which is shown in the Figure 7.2.

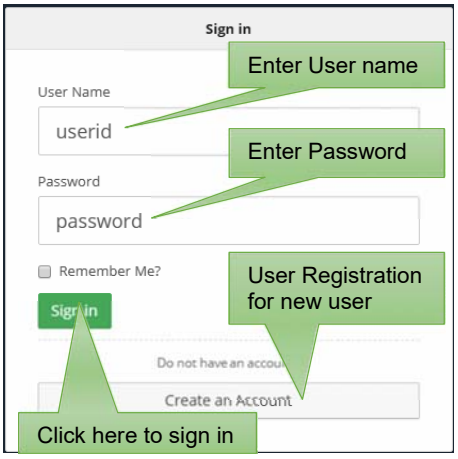


Figure: 7.2 User log in view

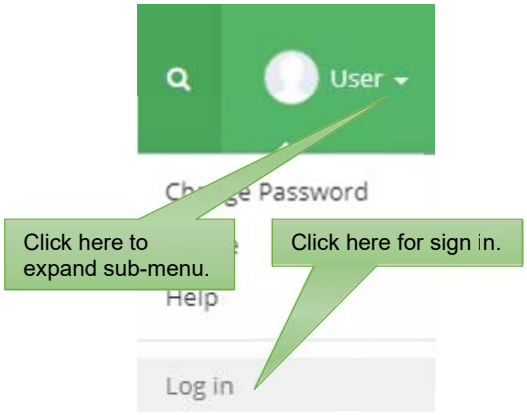
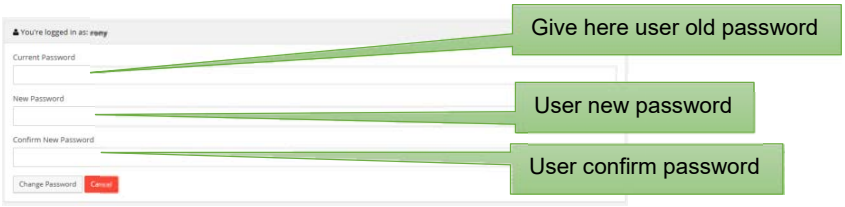


Figure: 7.3 Log in options

B) **Change Password**: A user can change his/ her password here. ***Click*** on ***User***, sub- menu will expand and then click on ***Change Password.*** User have to login to change his/ her own password.



8. Other

Click on the "**Other"** menu to expand and get its sub-menu. There are two sub-menu(s). These are:

A) Contact Us
B) User Manual

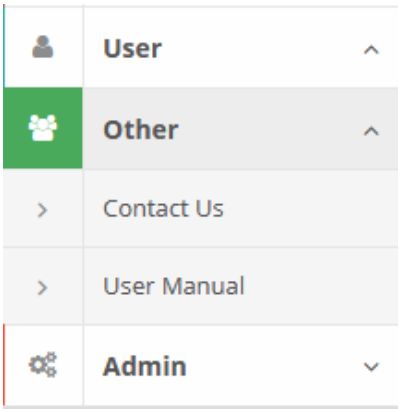


Figure 8.1: Other menu

8.1 Contact us

Click on **Contact us** sub-menu to open Contact us page. This page contains the address and map location of Forest Division (Figure 8.2).

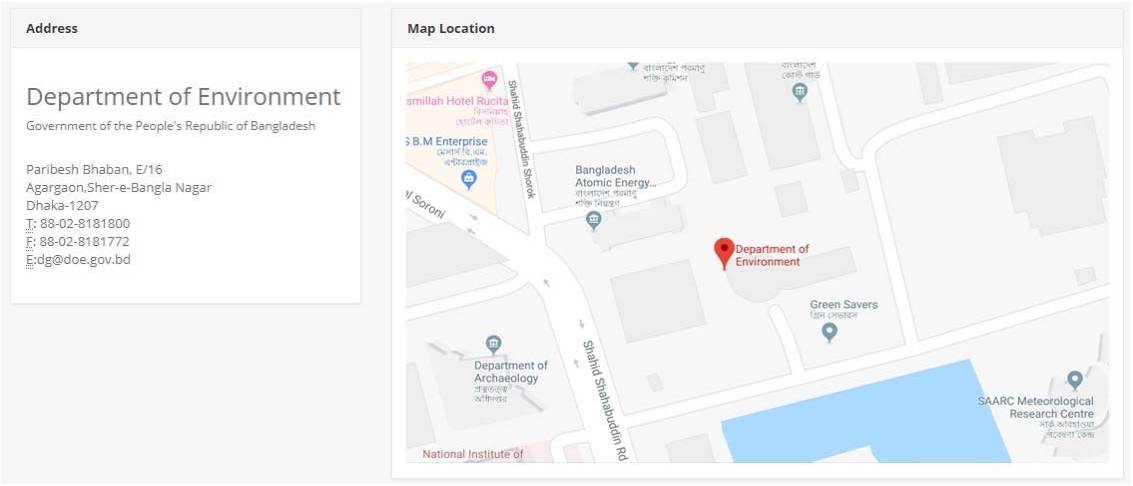


Figure 8.2: Department of Environment office address & location

8.2 User Manual

Click on **User Manual** sub-menu to open WQMS software user manual. The user manual will open as a PDF file (Figure: 8.3).

Figure 8.3: User manual
(Admin Panel)

9. Admin

The Admin module has restriction to General and Data Entry users. Only Admin can access this module. For this instance, this module has been kept invisible to the users accept Administrator. When the Admin is logged in, only then this module will be visible. This module has three sub-menu(s) (Figure 9.1):

A. Users
B. Groups
C. Roles

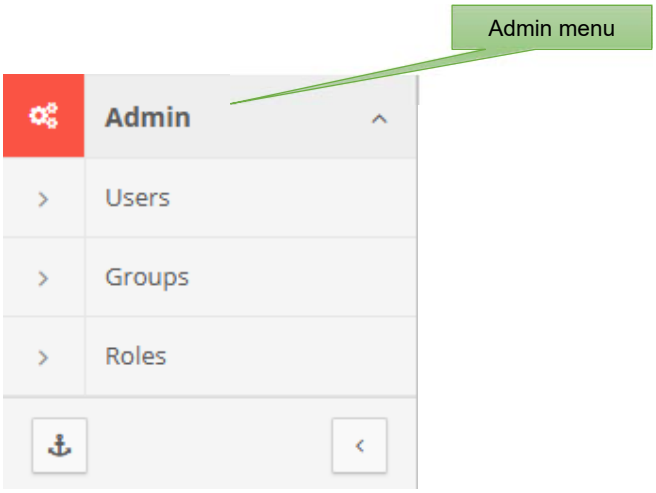


Figure 9.1: Menu of Admin

9.1 Users

To add a new user, ***click*** on **Admin** a sub-menu open and then click on ***Add New***. Existing user list will open like this

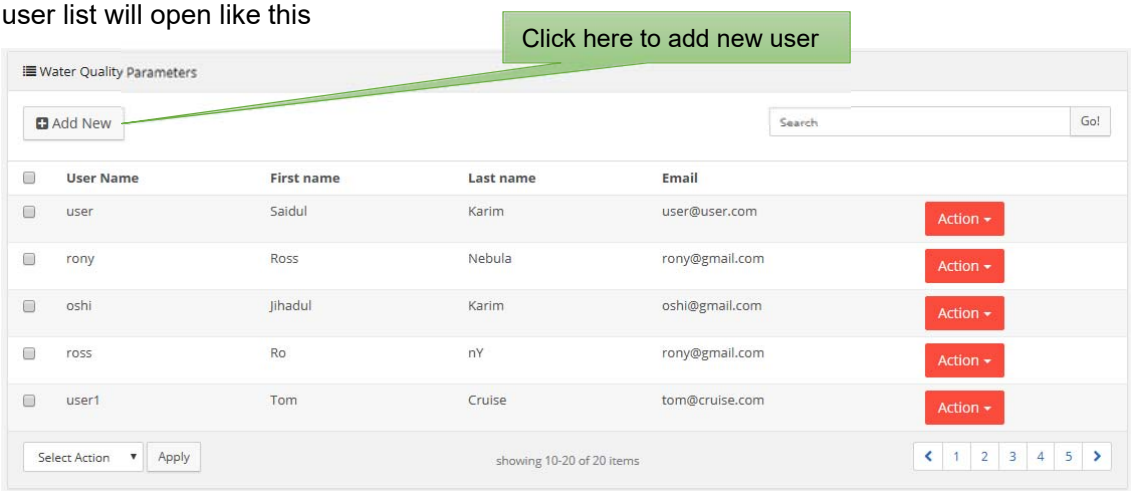


Figure 9.1: Existing Users List

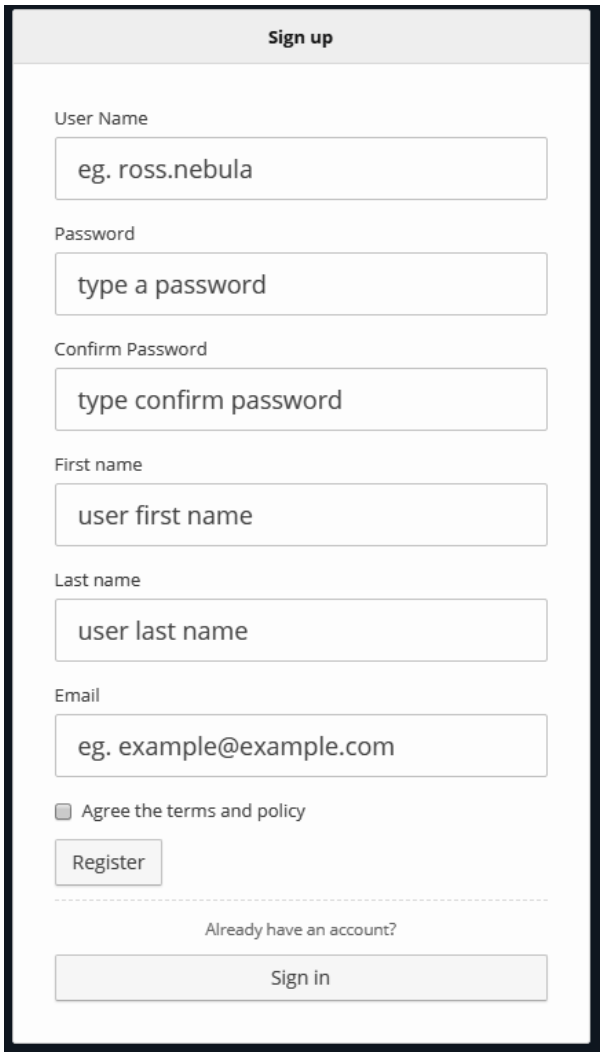


Figure 9.10: Add a New User

You have to give user name, password, confirm password, first name, last name, email address. Then click on **Register** button to add new user information. To update existing user information, ***click*** on **Admin,** a sub-menu will open and then click on ***User***. Edit user form will be opened which looks like this:

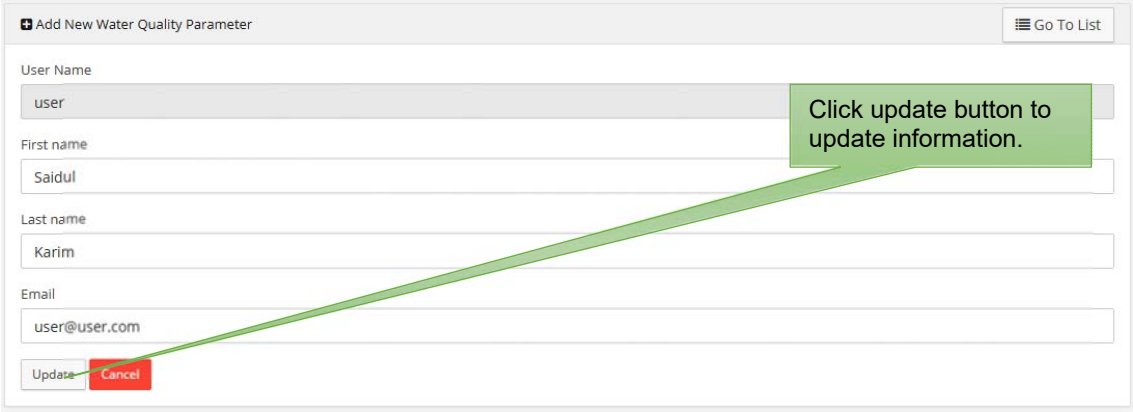


Figure 9.11: Update existing user information

9.2 Groups

A group is a category of users classified by common traits, such as job title. To add a new group of user click on Groups under Admin menu. Admin user can assign any user any permission by clicking on the permission option. Below the figure 9.12 shows the user group.

Figure 9.12: User Groups

9.3 Roles

A role defines which applications and what parts of each application users can access and what they can do. In other words, roles determine users' authorization levels.

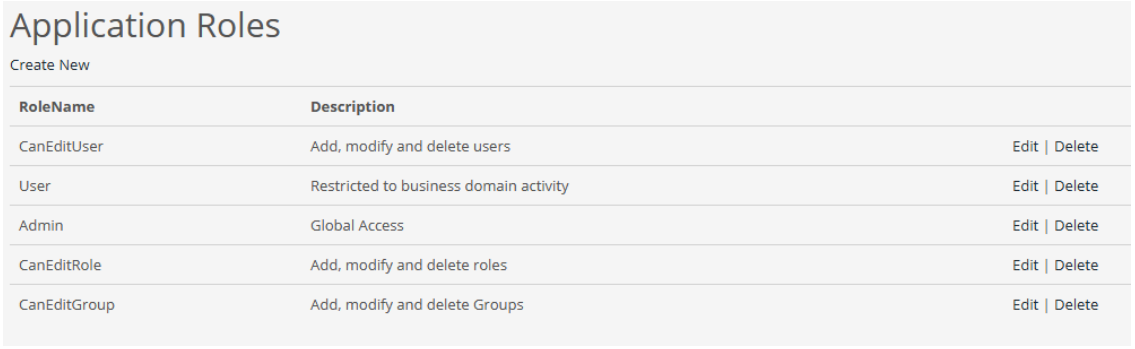


Figure 9.13: User Roles

10. Development of WQMS Application

10.1 Development of WQMS Application

The water quality monitoring system (WQMS) Android Application has been developed for sustainable monitoring of water quality in Bangladesh. The system will also help to facilitate within the entire South Asia. The DoE officials and staffs will be able to access the WQMS Mobile Application through the internet from any smart phone depending on their access authorization. The home screen of the WQMS Mobile Application is shown in Figure 10.1.

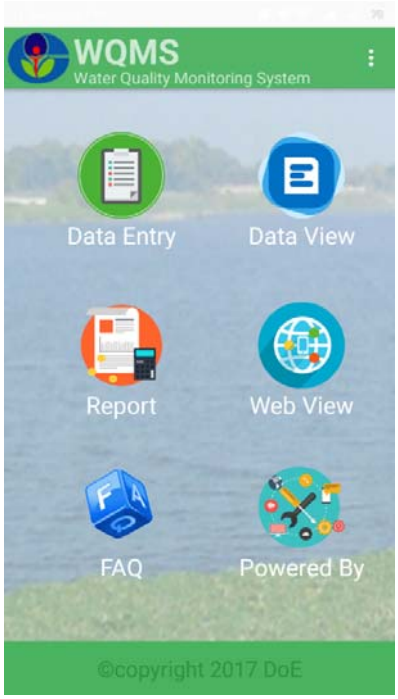


Figure 10.1: Home Screen

10.2 Opening the WQMS Mobile Application

Find the WQMS application from your smart phone. The application icon is shown in Figure 10.2.

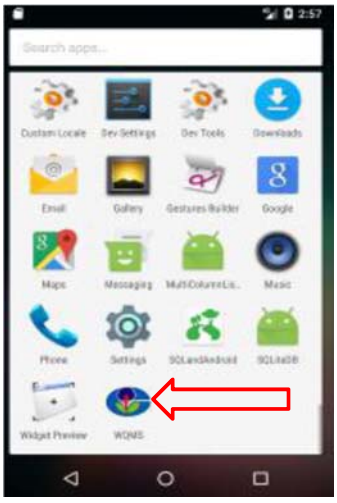


Figure 10.2: WQMS App Icon

10.3 User Sign In

Open and sign in to the application. User sign in is required when any user will enter new data and want to view any existing data. After signing in to the application, the Home (Figure 10.1: Home Screen) Page will be appeared.

Figure 10.3: Sign In Procedure

10.4 Data Entry

In the **Home Screen** of the application the **Data Entry Icon** is used to add new water quality data like strategic location, purpose of sample, type of sample, different types of parameters, depth of water, river flow condition and photo upload in the data entry part. It's also mentioned that Master ID will be generated automatically and that will be unique for every entered information. There are four parts in the data entry module which are given below:

- Master
- Parameter
- Hydrological
- Upload photo

10.4.1 Master

When the **Master** is selected, the page appears in window. There, user needs to select appropriate options to add new water quality data for the data entry. After that select the save button (in figure 10.4).

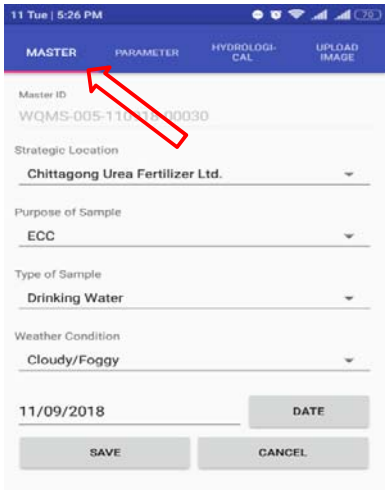


Figure 10.4: Master

10.4.2 Parameter

In the **Parameter** tab, select the proper information step by step and then save the data (in figure 10.5).

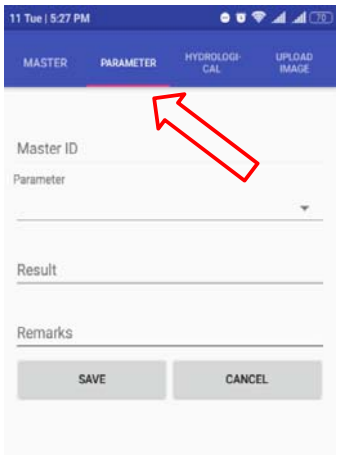


Figure 10.5: Sample Parameter

10.4.3 Hydrological

To enter Hydrological data, select **Hydrological** tab, then enter appropriate data and save it. It contains river flow conditions and depth of sample collected water information. Figure 10.6 represents about the hydrogeological information.

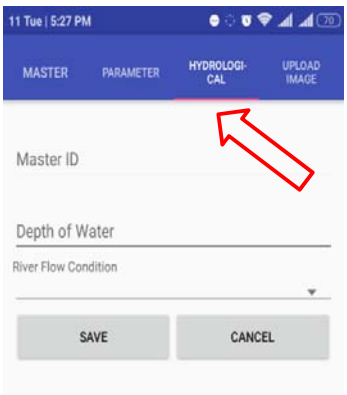


Figure 10.6: Hydrogeological Information

10.4.4 Upload Photo

Different photos of Monitoring stations will be uploaded by this option. Select **CHOOSE FILE** to upload single/multiple photos. Then select **UPLOAD IMAGE** button to save photos to the server. Select **VIEW IMAGE** button to view uploaded photos (figure 10.7).

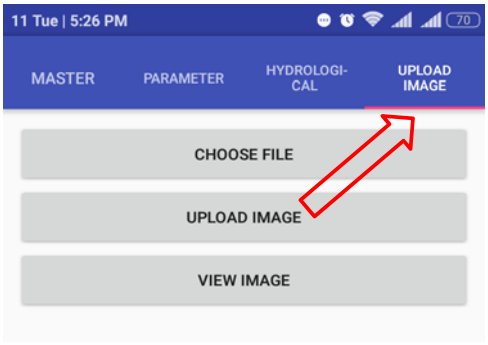


Figure 10.7: Upload Photo

10.5 Data View

In this part, when the **Data View Icon** is selected from the **Home Screen** of the application, the page appears with a new window. There, users will view all listed monitoring stations data. Here appears a sample view of searching criteria in Figure 10.8.

Figure 10.8: Data View

10.6 Report

In this part, when the **Report Icon** is selected from the **Home Screen** of the application, the page appears with some related filtering parameters. Figure 10.9 illustrates the view of sample location report.

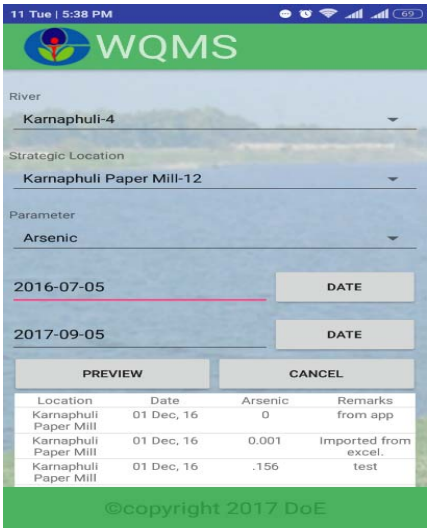


Figure 10.9: Sample Location Report

10.7 Web View

In this part of the application, when the **Web View Icon** is selected from the **Home Screen**, the whole website service will be appeared. The user can use the website service of this system by choosing the same options same as the web application parts which are discussed above (Section 1.3). If users select the top left side option in this page (Figure 10.10) mentioned as **Water Quality Monitoring System** then they will be able to see the overall options that are mentioned in the website part (Figure 1.2) and user login option is available on the top right side part.

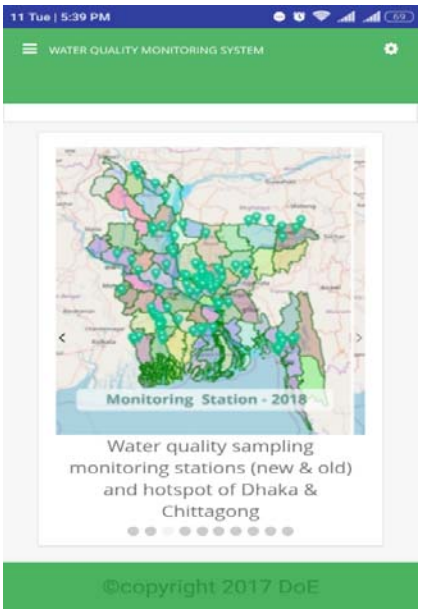


Figure 10.10: Web View

10.8 FAQ

In this part if users select the **FAQ Icon** from the **Home Screen**, then FAQ page will appear which contains some questions as well as answers that are helpful for visitors of the application (Figure 10.11).

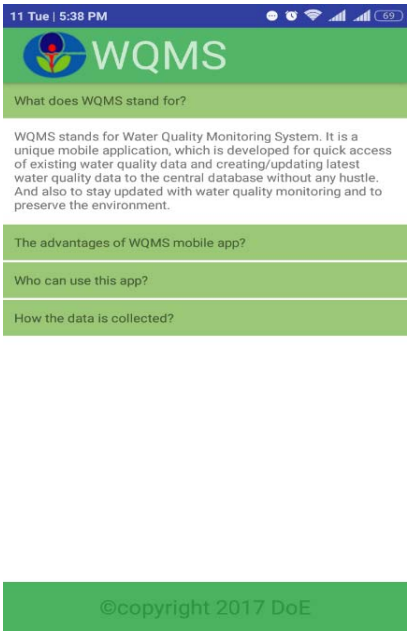


Figure 10.11: Frequently Asked Questions (FAQ)

10.9 Powered By

If users select the **Powered By Icon** from the **Home Screen**, then they will be able to know the information about the water quality monitoring system Android App which has been developed by Center for Environmental and Geographic Information Services (CEGIS) for the officials of Department of Environment (DOE) (Figure 10.12).

Figure 10.12: Powered By