Outline and Platform Design on Establishment of Digital Risk Information Platform (DRIP) Interface

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CEGIS
Center for Environmental and Geographic Information Services

Outline and Platform Design

on

Establishment of Digital Risk Information Platform (DRIP) Interface

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Acronyms and Abbreviation

ADB	Asian Development Bank
BBS	Bangladesh Bureau of Statistics
CEGIS	Center for Environmental and Geographic Information Services
CERP	Coastal Embankment Rehabilitation Project
CSS	Cascading Style Sheet
DFD	Data Flow Diagram
DFR	Draft Final Report
DIA	Disaster Impact Assessment
DRIP	Digital Risk Information Platform
DRIP	Digital Risk Information Platform
HERV	Hazard, Exposure, Vulnerability and Risk
HTML	Hypertext Markup Language
NWRD	National Water Resources Database
OTA	Operational Acceptance Testing
PLIS	Planning Information System
RDBMS	Relational Database Management System
RFP	Request For Proposal
SQL	Structured Query Language
ToR	Terms of Reference
UAT	User Acceptance Testing
UNDP	United Nations Development Programme
WARPO	Water Resources Planning Organization

1. Introduction

1.1 Background

Bangladesh has made significant progress in disaster risk management, the country is still at risk of growing loss and damage due to disaster and climate stresses. The evidence shows that the current and likely future impact of disaster and climatic stresses on the economy, livelihoods and assets of the country has been pointedly increased in the past decades. Limitations are found in incorporating disaster and climate change risks in all stages of development planning. This extensive linkage between disaster and development generates an urgency to establish a risk information platform/interface to access disaster and climate risk information and tools for risk-informed planning and investment. At present the available databases for managing development project life cycles, and climate risk screening tools are quite fragmented and lacks contextual data and information on disaster and climate change risks. Databases related to development planning and management located within the Government of Bangladesh do not supply necessary data and information for DPP preparation addressing disaster and climate change risks, rather mainly focusing on DPP submission to implementation, budget management and monitoring. In Contrast, most of the risk screening tools are about physical hazards and risks, and do not follow any integrated approach for risk and vulnerability assessment. For Bangladesh, to assist in the budgeting process of development projects, a climate risk screening tool has been developed under the project titled "Establishing a Climate Risk Screening System for Mainstreaming Climate Change Adaptation into National Development Budgeting Activities", funded by Asian Development Bank (ADB) which can help Planning Commission officials to ascertain the impact of climate change in a development project, its economic losses and adaptation need.

This platform/interface will be designed to provide necessary disaster and climate risk data and information to carry out Disaster Impact Assessment (DIA), a tool proposed by the National Disaster Management Council of Bangladesh headed by the Prime Minister, to ensure disaster resilient development. However, as such, there is no comprehensive database comprising tools and knowledge product to assist the planners to integrate disaster and climate risk data and information into development projects, plans and programmes for decision making and planning for risk-informed public investment. This platform will provide data and information for disaster and climate risk and vulnerability assessment, and potential climate change adaptation options as well as disaster risk mitigation measures to address identified risks and vulnerabilities caused by the project and also in project implementing areas.

1.2 Objectives

The Digital Risk Information Platform (DRIP), a specialized software application, aims to strengthen the institutional capacity of the Government of Bangladesh for assessing, understanding and communicating disaster and climate related risks, with the goal of integrating disaster risk information into development planning & budgeting, policies and programs. The specific objectives of the project are listed below.

- Integrate disaster and climate risk information into development projects, plans, programs and policies to ensure risk-informed public investment;

- Facilitate access to risk information from a common platform;

Assist the Planning Officials in different ministries with available risk information in different sectors

1.3 Scope of Work

This DRIP is intended to provide planners with guidance on how to consider climate and natural hazards in the project development and appraisal, particularly for agriculture and industry sector, as well as access to the necessary climate and disaster information for them to utilize. The platform will be developed following a data ecosystem approach, linking up with other digitalization initiatives, such as the Planning Information System (PLIS) of Bangladesh Planning Commission, Aspire to Innovate project (a2i), the Digital ECNEC project, the Disaster Management and Information Centre of Department of Disaster Management, and the Ministry of Environment and Forests' online climate database, Bangladesh Delta Plan 2100 Project's knowledge portal, as well as Programming Division's Climate Risk Screening Tool & database.

The works as understood from the ToR are as follows:

- Consult with Programming Division of Bangladesh Planning Commission and United Nations Development Programme (UNDP) to determine platform/interface needs and functionality;
- Review challenges and opportunities to link up with risk information platform/interface, existing disaster and climate databases and digitized information;
- Develop digital platform/interface for planners to access disaster and climate risk information and tools for risk-informed planning;
- Present and facilitate beta testing of the platform/interface with end users and super users; Deliver training to relevant government officials for operation and maintenance of platform/interface;
- Produce manual on operation and maintenance of platform/interface;
- Finalize platform/interface following beta testing.

2. Review of Literature and Other Platforms and Databases

2.1 Review of Documentation

Collection and review of relevant reports, documents and information is a continuous process throughout the project period. Extensive literature review has been made at this stage to accumulate the necessary information to finalize the approach and methodology and also for a clear understanding. Existing risk related national datasets, study reports, national and global best practices of risk information platform, risk screening tools has been reviewed to understand the existing and potential challenges to establish DRIP..

2.2 Review of Existing Risk Information Platforms

A rigorous review of existing Disaster Risk Information Platforms at home and abroad have been performed to understand the possible contents of a disaster risk information platform, tools, features and functionality, data sets, technologies, software and hardware issues. Following sections describe the outcome of the review:

National Portals

2.2.1 GeoDASH

About the Portal

The Bangladesh Geospatial Data Sharing Platform (GeoDASH) is a web-based spatial data infrastructure and GIS that empowers government, academia, private enterprise and the public to securely host, manage, share, visualize and analyze geospatial data in a collaborative manner.

Government of Bangladesh established GeoDASH dataset in 2015 and made it accessible to all keeping provision of accessing and downloading layer taking permission from data uploader end. The data with open access permission given can be downloaded in more than 20 formats including the shapefile format itself. The GeoDash can be accessed through this web link: https://geodash.gov.bd/

Data Availability and Format

Presently it is active and the datatype of the dataset is GIS. Various Government and private sector upload different type of layer to enrich the portal like RAJUK, Dhaka WASA, the World Bank, UNICEF, Bangladesh Bureau of Statistics (BBS), BIWTA,BMD, PWD, CEGIS, Streamtech etc. The type of the layers available in the portal are-

- Administrative
- Disaster
- Development and Facilities
- Infrastructure
- Education
- Demography

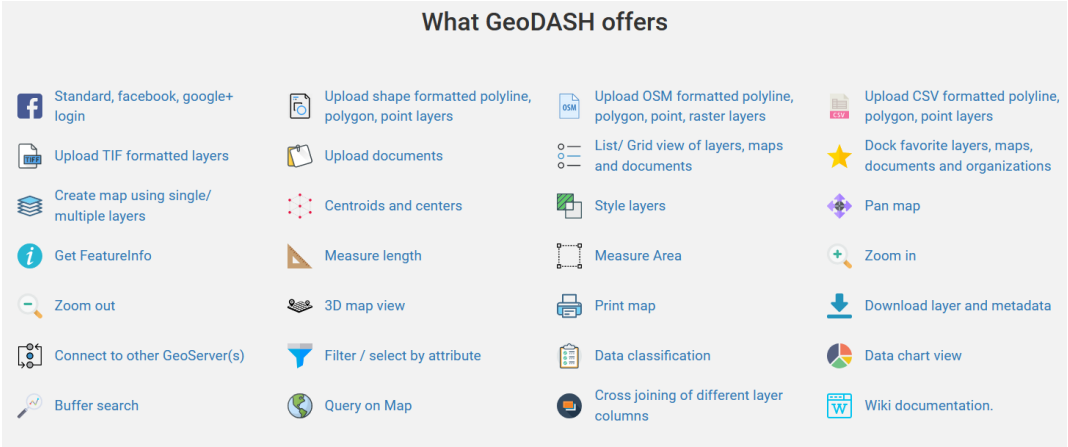
The infrastructure, demography and education are helpful in considering the element exposed to a disaster while performing risk analysis. Information gathered from administrative, development and facilities is helpful is determining the sensitivity of the infrastructure,

educational institution and population of a community to a disaster. The portal has 27 maps, 740 layers and a total 54 organization upload various layers to this portal.

Functionality Available

The features and functionality that GeoDASH provides are listed below:

- **Interoperability** between programs across the enterprise for managing, sharing, and analyzing geospatial and non-geospatial content.
- **Share maps** via e-mail, LinkedIn, Twitter, Facebook etc. to maximize data sharing and promote your work. Map can also be published and embedded.



- **Import layers** of the various data format for Vector (Example: .shp, .shx, .dbf, .prj) or Raster (.tiff, .img) either in WGS 84 or BTM projection system. In order to upload layers or map in GeoDash user need to open an account in GeoDash web portal with the credentials of his/her organization, and need to specify who can view the uploaded layers, download it, edit or manage the layers like delete, update, change permission, publish or unpublished it etc.
- **Make pretty maps** with GeodDash with the contributed or existing layers

Technologies Used for the Portal

Development Technologies of GeoDash are-

- System Dependencies
- Python Packages
- Frontend

The technologies used in frontend are-

- CSS3
- Bootstrap
- JavaScript
- Jquery
- Ajax

Architectural diagram of GeoDash based on technologies is following-

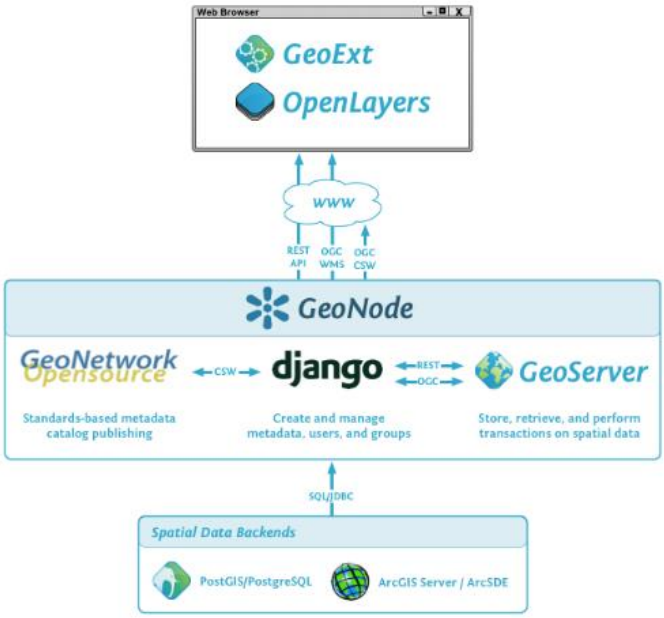


Figure 2.1: Architectural Diagram of GeoDash

2.2.2 Bangladesh GIS Portal (BGISP)

About the Portal

Bangladesh GIS Portal was established in 2019 to establish coordination among the institution of the country preparing GIS data and to make this portal a common platform where all the GIS data will be stored. It is the central GIS repository which accumulates all the GIS data from all GIS agencies of Bangladesh in a single platform as per the provision of Section No. 6 of Statistical Act, 2013. Bangladesh Bureau of Statistics (BBS) provides supports to upgrade the portal. The mission of establishing this portal are-

- Coordination among all the GIS management department and institution
- To exchange GIS related work to BGISP for national interest
- To help different organization in preparing metadata
- To establish communication among Asia Pacific Spatial Data Structure, International Steering Committee for Global Mapping like national and international organization
- Provide technical assistance among member organization
- Preparing guideline and infrastructure for data archiving and sharing

The Bangladesh GIS Portal can be accessed through this web link: https://gis.gov.bd/

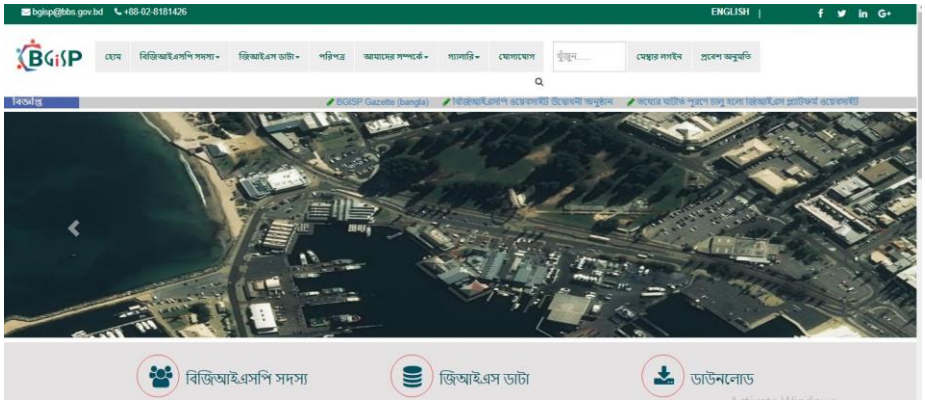


Figure 2.2: BGISP Web Portal

Data Availability and Format

The GIS data and metadata available in the portal are by organization wise and data type wise. All the government and non-government organization deal with GIS data share their data in this portal. Type wise GIS meta data is categorized as-

- Administrative Boundary
- Forest Map
- Mouza Map
- Road Networks
- Settlement Map

Type wise GIS data is categorized as

- Document
- Layer
- Map

The GIS Portal is still in development stage in a sense that only a few datasets are now uploaded and available, and the uploaded datasets are mostly either document or pdf.

Functionality Available

The BGISP allows use to view and download the data maintaining all security and confidentiality issues. The presently uploaded GIS data can be viewed but it cannot be easily downloaded. In some cases, the link is given from where the data or layer can be downloaded, but those links are of data sources only like website link of ADB or BWDB etc. To download the data layer even to some data, user need to open an account in BGISP and also the user must be from the allowed selected organization of BGISP.

2.2.3 Bangladesh Open Data

About the Portal

Bangladesh Open Data Initiative is a supportive initiative to achieve Sustainable Development Goal, particularly Goal 16. In order to achieve SDG's and their targets, access to more and better data is one of the pre-conditions. Thus, considering the importance of data openness, Government of Bangladesh has taken initiative with the technical support of a2i programme to establish a portal for opening the government data to the citizen. This Portal is an initiative by the Prime Minister's Office, Cabinet Division, Bangladesh Computer Council, Bangladesh

Bureau of Statistics, and Statistics and Informatics Division. The portal was launched in 2016. This portal provides datasets from more than 35 Ministries and related agencies.

By making the government data open to all, the government aims to: encourage the development of innovative solutions for better public service delivery; enhance scope of research to identify and develop innovative solutions; create opportunities for new jobs and more investment; and make government more transparent and accountable.

The aim of this portal is to

- Provide one-stop access to the government's publicly available data
- Communicate government data and analysis through visualizations
- Create value by catalyzing application development
- Facilitate analysis and research

The Bangladesh GIS Portal can be accessed through this web link: https://data.gov.bd/

Data Availability and Format

The data are accessible to all and are in tabular or CSV form. Topic wise data are available as

- Economy
- Finance
- Business
- Society
- Agriculture
- Environment
- Health
- Infrastructure
- Education
- Technology
- Transport
- Local-Govt

These data can be downloaded easily by user in excel or CSV format.

2.2.4 BFIS Geoportal

About the Portal

BFIS Geoportal is the national platform to integrate and access geospatial information for forestry in Bangladesh developed under the Bangladesh Forest Department. This portal has

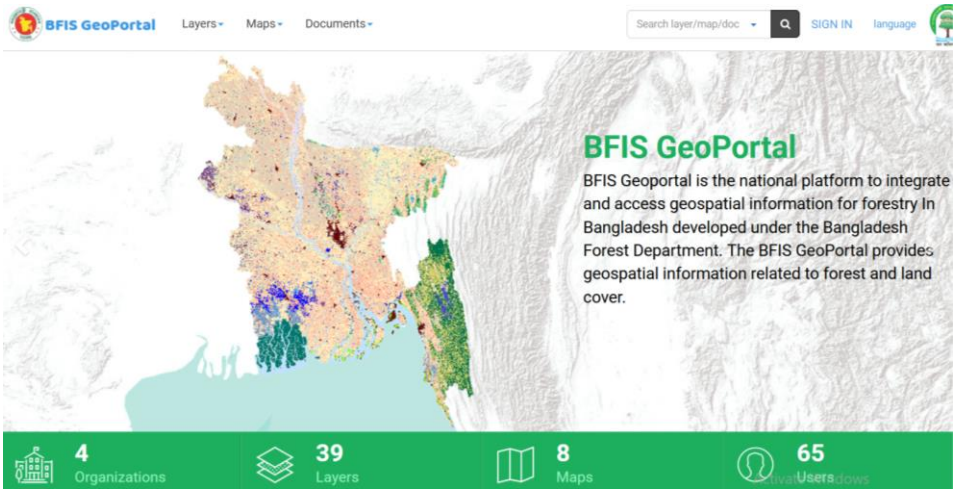
been developed with the technical support by Food and Agriculture Organization of the United Nations (FAO) and financial support of United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation (UN- REDD) and United States Agency for International Development (USAID).

Bangladesh Forest Information System (BFIS) is managed by Resources Information Management System (RIMS) unit of Bangladesh Forest Department (BFD).

This web portal can be accessed through this web link: http://geoportal.bforest.gov.bd/

Data Availability and Format

This portal has 39 layers, 8 maps, 65 users. This portal provides geospatial information related to forest and land cover, which can be printed only, download option is not available for public user.



Functionality Available

The available features of BFIS Geoportal are following-

- **Documentation-** all geospatial layers are documented and metadata is provided.
- **Online mapping tools-** Users can query on available geospatial information, prepare maps and access other maps.
- **Interoperability-** users can access information from others open source GeoNode platforms.
- **Sematic Query-** Similarity between Land Cover Classification System (LCCS) based map legend classes and user-defined classes can be accessed

The uploading and data sharing process of a layer is following-

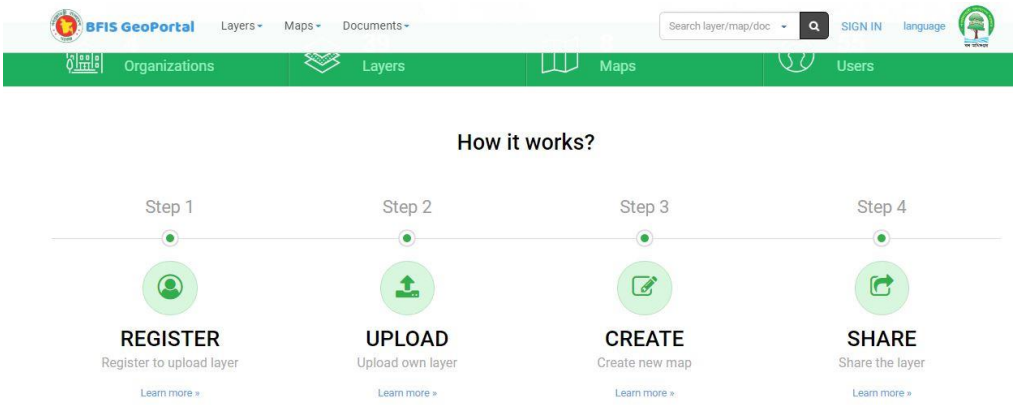


Figure 2.3: BFIS Geoportal Functionality

2.2.5 National Spatial Data Infrastructure (NSDI)

About the Portal

National Spatial Data Infrastructure (NSDI) was established in 01 June 2016 which was inaugurated by Honorable Prime Minister Sheikh Hasina to generate geo-data and digital mapping. Survey of Bangladesh (SoB) is the main organization behind establishment of BARC. NSDI enables to connect the research organization well as teachers and students of various public and private educational with geo-spatial information flow without any interruption. About 22 organization are connected and provide data in this portal.

The NSDI portal is on beta stage now and still under development. The beta version of this web portal can be accessed through this web link: https://nsdi.gov.bd/

Data Availability and Format

This portal consists of 6 Maps and 159 layers. The data type of this portal is mainly GIS type and open access to all but need to send request to download the data layers. The layers and maps are available in several categories which are helpful in defining vulnerable communities of the country like –

Category	Category	Category
• Administrative	• Development and Facilities	• Geology
• Agriculture	• Disaster	• Geoscientific Information
• Biota	• Economy	• Health
• Boundaries	• Education	• Imagery Base Maps Earth Cover
• Climate and Atmosphere	• Elevation	• Infrastructure

• Climatology, Meteorology and Atmosphere	• Environment	• Inland Water
• Commercial	• Farming	• Intelligence Military
• Conservation Area	• Financial	• Location
• Demography	• Forest	• Marine and Coastal
• Non commercial	• Planning Cadatre	• Structure
• Oceans	• Recreational	• Transport and communication
• Physiographic	• Society	• Urban
• Utilities Communication	• Water Bodies	

If any user wants to upload any layer he/she has to open an account and the procedure for opening an account is given below-

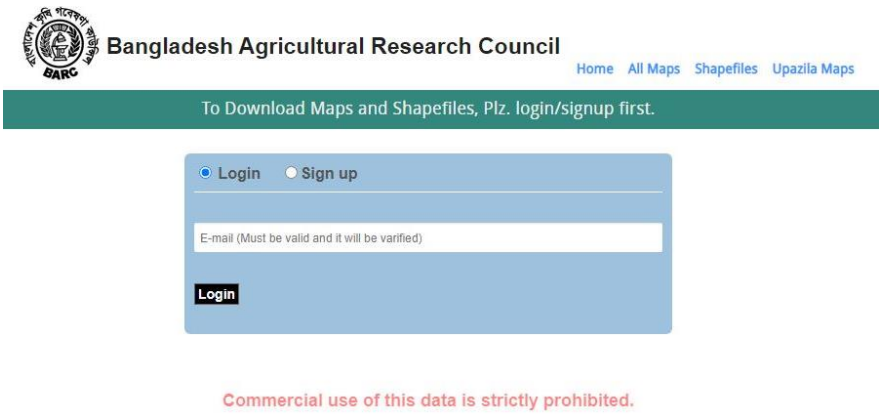
Figure 2.4: Procedure to publish data layers in NSDI Platform

Although, presently user account registration system is not functioning.

2.2.6 Web Portal of Bangladesh Agricultural Research Council (BARC)

About the Portal

Bangladesh Agricultural Research Council established developed and maintained a GIS web portal by it's Computer and GIS unit. This portal enables registered users to view and download maps and shapefiles upon required permission, whose commercial use is strictly prohibited.



This web portal can be accessed through this web link: http://maps.barcapps.gov.bd/index.php

Data Availability and Format

The available data of BARC are in GIS format and permission is required to access these data. BARC provides Maps, Shapefiles and Upazila Maps data which are further categorized like-

All Maps

- Crop Suitability
- Crop Zoning
- Administrative
- Agriculture
- Ecological
- Edaphic
- Adverse Eco-system
- Climate
- Agricultural Region
- Base and Soil

Shapefiles

- Administrative Map
- Hydrographic Map
- Natural Resource Map
- Soil Characteristics Map
- Ecological Map
- Edaphic Map

2.2.7 Bangladesh Bureau of Statistics

About the Portal

Bangladesh Bureau of Statistics (BBS) is the centralized official bureau in Bangladesh for collecting statistics on demographics, the economy, and the other facts about the country and disseminating the information. BBS initially launched a static website (http://www.bangla.net/ndb) in 1998 with a view to illustrate the socio-economic outlook of Bangladesh to the global people through the National Data Bank project. Later the web

addressed and domain name changed to http://www.bbs.gov.bd/ in 2006 as per Government Order. In, 2010 it turned into a dynamic website through the Optical Data Archive and Networking project. The portal development become complete in 2016 and currently it is being hosted by the a2i programme and Bangladesh Computer Council (BCC).

This national web portal is one of the biggest hubs of large number of datasets in the world which is enriched by different Government organizations. Around 25000 Govt. organizations are connected with this portal.

BBS upload and publish different statistics and disseminate in large scale in regular basis through this web portal. The portal can be easily accessed through this web link: http://www.bbs.gov.bd/

Data Availability and Format

The data accessibility is open which means the data can be downloaded easily and data are stored as document type (PDF). The data that BBS regularly published as document type are-

- Zilla Statistics
- Small Area Atlas Bangladesh
- Disaster Prone Area Atlas Bangladesh
- Statistics Bulletin
- Statistics Pocket Book
- Statistics Year Book
- Bangladesh Statistics
- Agriculture Statistics Year Book
- Annual Report

Above all this BBS also documented data as subject wise like-

- Agriculture
- Demography and Health
- E-Book
- Economic Census
- Environment, Climate Change and Disaster
- Foreign Trade Statistics
- GDP
- Slum Census 2014
- ICT Statistics
- Education and Literacy
- Geo-code
- Income, Expense and Poverty
- Industrial Statistics
- Labor and Employment
- Population and Housing Census
- Price and Wages (CPI and QIIP)
- Vital Statistics
- Open and Child
- Other Publications

2.2.8 National Water Resources Database (NWRD)

About the Portal

Natural Water Resources Database has been developed by Water Resources Planning Organization (WARPO) to meet the demand of consistent and corrected data and information from the planners, researchers, and managers working in water sector. The data contained in NWRD have been collected from a wide range of sources and agencies; data are also captured from satellite images, aerial photographs and hardcopy maps. WARPO collated data from different primary data collecting agencies, do needful conversion, processing and quality checks of the data layers. Data is being scrutinized through proper temporal and spatial quality guidelines.

NWRD data is being disseminated to large no. of users in universities, government & non-government agencies, national and international institutions and others. It can be considered as the only authentic water related database in Bangladesh from where users can get relatively good quality data in a nicely organized and compact form and in their favored formats.

Overall objectives of this national database are to:

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

WARPO updates and upgrades the database of all the existing NWRD data layers and gather new information in regular basis.

Data Availability and Format

NWRD holds more than 400 data layers, out of which 125 layers are spatial data in GIS format. Data in the NWRD are organized in several main groups which are:

- Base data
- Surface water
- Groundwater
- Soil and Agriculture
- Fisheries
- Forest
- Socio-economic
- Meteorological
- Environment and
- Images

A web enabled meta-database has been created to browse through Internet/Intranet. NWRD is a geo-spatial database stored in Oracle database system in the backend and front end is designed in ASP and ArcView GIS.

Functionality Available

Besides above groups the NWRD has following tools and functionality–

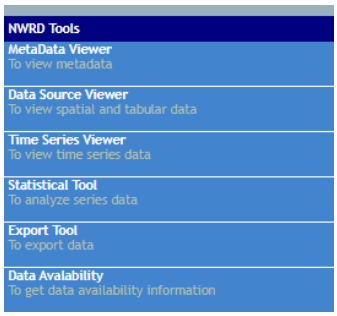


Figure 2.5: Tools of NWRD

Data Dissemination and Update Protocol

WARPO has developed a data dissemination protocol through a guideline. As per the guideline, any individual or student or any organization or agencies or institutes from public or private sector can request to the Director General, WARPO in the prescribed format and get the data upon approval of DG, WARPO and doing necessary payment through pay order or bank draft. There are certain clauses and disclaimers inside the guideline to use the purchased data.

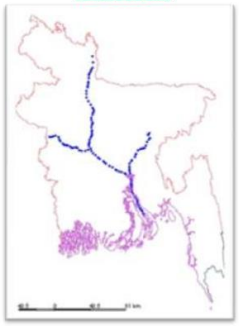
Further, WARPO has prepared a data catalogue as well to facilitate the review and understanding of the datasets for the stakeholders and beneficiaries in advance of purchasing the data.

Name of Data layer:	**Grid points for Simulation of Dry Season Waterlevel of GM**

Metadata

Data type	Spatial
Abstract	Grid points to simulate dry season waterlevel of General Model area for the period of 1965 to 1989 using a mathematical model.
Quality	Quality of the model information depends on the input data, calibration and verification of the model.
Completeness	The data set is created for the General Model Area (covers major river networks of the country except the Chittagong area).
History of the dataset	The model has been developed by SWMC under National Water Management Plan (NWMP) based on MIKE-11 software system. The model is established on 1990's data and then calibrated for 1 year, which was verified for 3 years.
Purpose of production	This analysed information are created by using MIKE-II a one dimentional mathematical model to compute the water level values where the observed values are not avilable and to present the location of the interpreted values.
Process description	The data layer is the model result, which has been evolved to fulfil some specific requirements of NWMP. NWRD has collected the dataset and stored in a well-ordered way.

Sample of Data



Attribute Table

grid_id	region_id	river_id	river_name	chainage
246000000	7	246	ICHAMATI	0
246002000	7	246	ICHAMATI	2
246004000	7	246	ICHAMATI	4
246006000	7	246	ICHAMATI	6
246007667	7	246	ICHAMATI	7.667
246009333	7	246	ICHAMATI	9.333

Figure 2.6: Illustration of data catalogue of NWRD

Moreover, WARPO has developed inter-agency data networking mechanism where recommendations are made to have a special arrangement with data provider organizations so that each organization can update their inventory and send it back to WARPO for future publication of reports with updated information. The web-based application can help agencies to update the inventory easily and on a regular basis.

2.2.9 Integrated Coastal Resources Database (ICRD)

About the Portal

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

WARPO has completed the development of the Integrated Coastal Resources Database in December 2005. Data from primary and secondary sources have been collected, collated and complied.

Data Availability and Format

Presently 421 data layers have been collected and generated for ICRD. Both GIS shapefile and documents or table-based data are available. The summary of data can be presented based on 6 indicators as follows:

- **Administration and Institutions (ADM):** Administrative Area, Participation, FMOs/CBOs, GoB Organizations, Informal Organizations, NGOs, Laws, Regulations, Policies etc.
- **Economics and Finance (ECO):** Credit, Employment, Foreign Currency Earning, GDP, Savings, Wages, Agriculture, Fishery, Industry, Services, etc.
- **Funds and Interventions (FUN):** Water, Health, Food Assisted Program etc.
- **Human beings and Social Conditions (HUM):** Demography, Financial Assets, Gender Related Data, Education and Skills, Health, Income, Natural Assets, Physical Assets, Social etc.
- **Assets, Infrastructure and Services (INF):** Agriculture Sector, Communication Sector, Education Sector, Health Sector, Power Sector, Protection, Transport Sector etc.
- **Natural Resources and Environment (NRE):** Chars and Inter-tidal Areas, Estuarine Dynamics, Fish and other Aquatic Resources, Plain Land Forest, Shallow Aquifer, Homestead Gardens, Mangroves, Agricultural Land, Ponds and Ghers, Settlement Area/Industrial, Area/Infrastructure: Air, Humidity, Rainfall, Sunshine, Wind, Gas and Oil, Sand and Minerals, Deep Sea, Estuary Branches and Coastal Waters, Floodplains (Wetland), Perennial Water Body, River etc.

Functionality

The tools and functionality are similar to the NWRD as ICRD is linked with the NWRD.

Data Dissemination and Update Protocol

WARPO uses the same protocol of NWRD to disseminate and update the datasets for ICRD.

Name of Data layer:	**Coastal District Boundry**

Metadata

Data Type	Shapefile
Abstract	A spatial data layer of District boundaries of coastal area along with the attribute information derived from Geomaster Database, 2001 published by Bangladesh Bureau of Statistics (BBS).
Quality	Scale of the source data was 1:63360. Therefore, it is recommended that in any kind of analysis the data layer should not be used exceeding above mentioned scale.
Completeness	This data layer covers all district coastal area according to Geomaster database 2001.
History of the dataset	This datalayer is extracted from datalayer of NWRD. Original source of this dataset is Police Station Maps published by Directorate of Land Record and Survey (DLRS), which were compiled between 1905-1945. Some maps are still being updated as new upazillas are created. Scale of these maps were 1"=1mile excluding Chittagong Hill Tracts. Reserve Forest maps published by Survey of Bangladesh were used for Sundarbans region. Attribute information were attached according to the Geomaster database 2001 collected from Bangladesh Bureau of Statistics (BBS).
Purpose of production	This data layer is essential for any data analysis and thematic map preparation. It can linked with BBS statistical information or any other statistical database through geocode. It is also national, regional and local level planning, analysis and management purposes.
Process description	The coastal distict boundaries have been captured by Police Station Maps published by Directorate of Land Record and Survey (DLRS) with input RMS error 0.002 - 0.005 inch and output 3 - 20 meter. For Sundarban area, union boundaries have been delineated with the help of river course and small atlas of BBS over Reserve Forest maps published by Survey of Bangladesh. Geocoding in the maps has been done according to the Geomaster database 2001 collected from BBS. Other attribute information have been attached according to the Geomaster database 2001.The source map was in Cassinii projection system projection system. It's transformed into Bangladesh Transverse Mercator (BTM) projection system.International boundary is used from SOB Topo map of 1: 50,000 scale and coast line generated from IRSLiss 2005 image.

Sample of Data

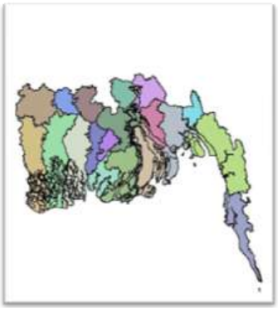


Figure 2.7: Data catalogue of ICRD

2.2.10 Flood Forecasting and Warning Center (FFWC)

About the Portal

Flood Forecasting and Warning Center (FFWC) aims to recognize as a center of emergency response through Flood Forecasting and Warning Services (FFWS) to minimize or mitigate loss of life and damage of properties in more effective manner through enhanced capacity of agency and community for disaster management and to meet national needs of disaster risk reduction.

FFWC generates and provides flood forecast and warning information to enhance the disaster management capacity of national agencies and communities using the best scientific principles, real time data, weather forecast information and mathematical models. This center works with partners for continuous updating and improvement of FFWS and capacity of professionals for better services.

The portal can be accessed through this link: http://www.ffwc.gov.bd/

Data Availability and Format

The data of FFWC is accessible to all, mostly is in viewer format through map, charts, reports or documents and table which can be downloaded or printed. FFWC provides two type of maps-

- Rainfall Distribution Map
- Inundation Map due to Floods

Rainfall distribution map provides daily rainfall distribution throughout the country and inundation map is provided hour wise forecast like 24hr forecast, 48hr forecast, 72hr forecast, 96hr forecast and 120hr forecast. Besides hydrographs are also available as following-

- Monsoon,
- 5-Days Deterministic Flood Forecast,
- Medium Range (1-10 Days) Flood Forecast
- Satellite Altimetry Based Forecast
- Real Time Data (RTD)

In addition, station wise two type of data are also available which are rainfall data and water level. Water level data throughout the country is provided according to danger level, observed water level, forecasted water level. Water level status is provided according to following level-

- Normal Level- more than 50 cm below Danger Level
- Warning Level- below Danger Level within 50cm
- Flood- At and above Danger Level up to 1m
- Severe Flood- More than 1m above Danger Level

Rainfall data and water table data are also provided in the portal. Daily Rainfall data is uploaded and updated at 9:00 am and 3:00pm. On the other hand, daily water level data is also uploaded at 6:00 am. However, long term historical data are not available in this website.

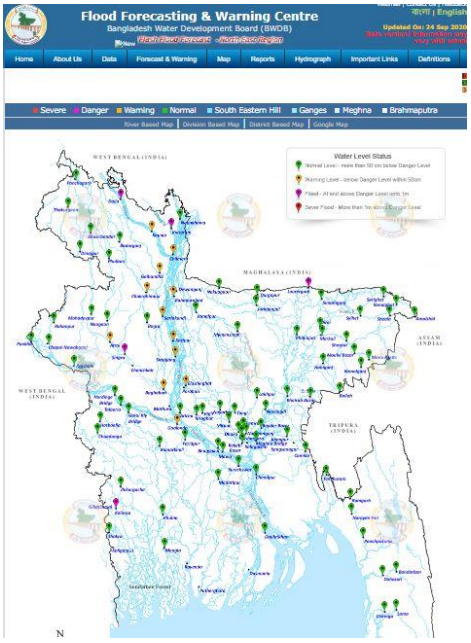


Figure 2.8: Flood Forecasting and Warning Center

Besides the maps and data FFWC also uploads flood summary, morning and afternoon flood bulletin, 5-Days Deterministic, maximum range (1-10 Days) Forecast which can be downloaded easily, maximum range, extended range (1-15 Days) experimental forecast which is also known as Flood Watch. This system runs daily around 4:00pm Bangladesh time (UTC +6:00) and generate output like water level, forecasted discharge at the stations, danger level expedience probability at stations for –

- Brahmaputra River at Bahadurabad
- Ganges River at Hardinge Bridge Station
- Meghna River at Bhairab bazar Station

FFWC has another wing of portal which is very recently developed on flash floods forecasting system for the north east region of Bangladesh based on WRF forecast of rainfall on Meghna basin.

2.2.11 RMMS RHD GIS Portal

About the Portal

RHD has several databases regarding different issues and among them particular RMMS is web based database. The Road Maintenance Management System (RMMS) is processed through Highway Development Management-4 (HDM-4) to produce maintenance plans and GIS (geographic information system) map. The datasets available in this system are useful to view ongoing work classified by development, revenue, and deposit work with historical reports. Presently, this gives a view-only version of the road database that is maintained by HDM circle in RHD headquarter. Information is generally collected once a year and the process is overseen by HDM circle.

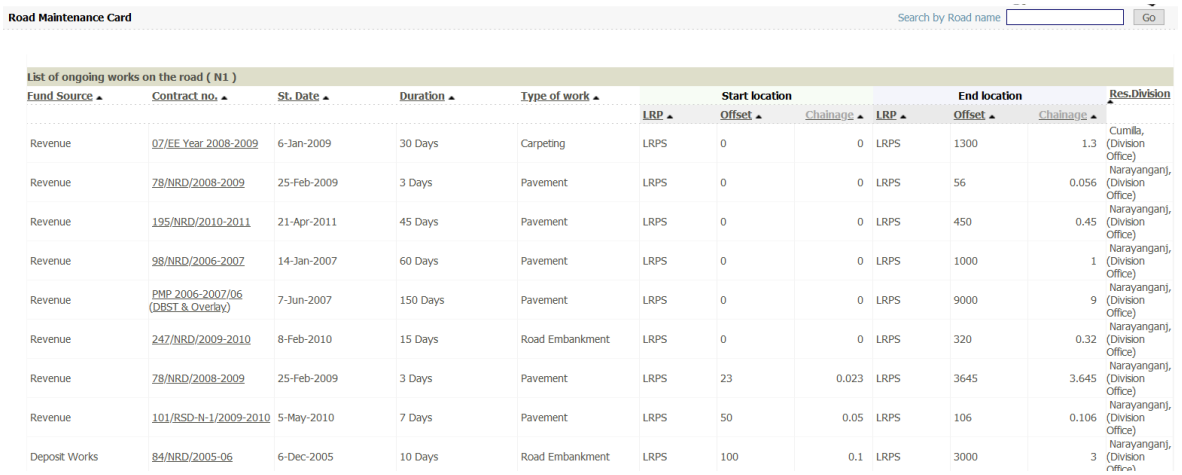
The RMMS can be accessed through this link: http://www.rhd.gov.bd/RoadDatabase/

Figure 2.9: RMMS of RHD

Data Availability and Format

RMMS holds following data of different classes of RHD roads:

- Basic info like road code number, road name, road length, road class, road starting and ending location
- Traffic info like AADT, average width, number and location of bridges or culverts, no and location of ferry ghats, location of other referencing points
- Road segment lengths and location
- Road maintenance work related info like funding source, maintenance road length, historical maintenance works, road maintenance card etc.



Road Maintenance Card

Search by Road name Go

List of ongoing works on the road (N1)

Fund Source	Contract no.	St. Date	Duration	Type of work	Start location			End location			Res.Division
					LRP	Offset	Chainage	LRP	Offset	Chainage	
Revenue	07/EE Year 2008-2009	6-Jan-2009	30 Days	Carpeting	LRPS	0	0	LRPS	1300	1.3	Cumilla, (Division Office)
Revenue	78/NRD/2008-2009	25-Feb-2009	3 Days	Pavement	LRPS	0	0	LRPS	56	0.056	Narayanganj, (Division Office)
Revenue	195/NRD/2010-2011	21-Apr-2011	45 Days	Pavement	LRPS	0	0	LRPS	450	0.45	Narayanganj, (Division Office)
Revenue	98/NRD/2006-2007	14-Jan-2007	60 Days	Pavement	LRPS	0	0	LRPS	1000	1	Narayanganj, (Division Office)
Revenue	PMP 2006-2007/06 (DBST & Overlay)	7-Jun-2007	150 Days	Pavement	LRPS	0	0	LRPS	9000	9	Narayanganj, (Division Office)
Revenue	247/NRD/2009-2010	8-Feb-2010	15 Days	Road Embankment	LRPS	0	0	LRPS	320	0.32	Narayanganj, (Division Office)
Revenue	78/NRD/2008-2009	25-Feb-2009	3 Days	Pavement	LRPS	23	0.023	LRPS	3645	3.645	Narayanganj, (Division Office)
Revenue	101/RSD-N-1/2009-2010	5-May-2010	7 Days	Pavement	LRPS	50	0.05	LRPS	106	0.106	Narayanganj, (Division Office)
Deposit Works	84/NRD/2005-06	6-Dec-2005	10 Days	Road Embankment	LRPS	100	0.1	LRPS	3000	3	Narayanganj, (Division Office)

Figure 2.10: Road maintenance card of RMMS of RHD

Most of the datasets available in this portal are tabular or maps and can be accessed in viewer mode only.

2.2.12 LGED GIS Portal

LGED GIS Portal was first developed under the project- Development of GIS Based Web Application for Project Planning of LGED, by Streams Tech Ltd. in June, 2016. The project was initiated by the ICT unit of LGED, after allocation of funds from the GOB, in order to bring advantage of GIS technology in mapping on web platform and decision support in different project planning and monitoring activities. GIS Portal has been, so far, a solid foundation for an integrated GIS asset management system for LGED.

This web application is intended primarily for LGED's engineers and GIS staffs who frequently use GIS maps in different project planning and monitoring activities, and in reporting. Besides, it is being used by the central GIS and MIS units of LGED in order to systematically maintain their asset information in a spatial and digital database. Other than LGED officials, the application is being frequently used by engineers, planners, research organizations, universities, NGOs, and other government and non-government development authorities who often need LGED's maps. However, anyone can access to the application without any prerequisites or log-in requirements through this web link: http://www.gis.lged.gov.bd/.

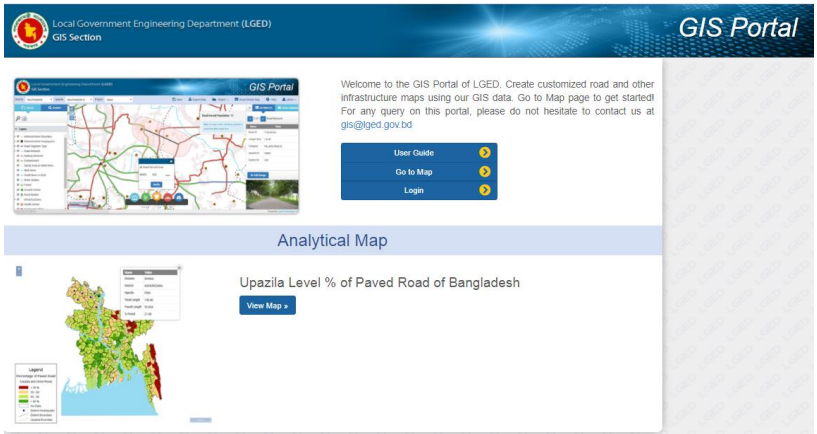


Figure 2.11: Interface of LGED GIS Portal

Data Availability and Format

The web portal contains following GIS data layers all over Bangladesh:

SL. No.	LGED Data Layers
1	Administrative Boundary
2	Administrative Headquarters
3	Road Network (LGED, National)
4	Rail Network
5	Embankments
6	Sandy Area(in Wide Rivers)
7	Water Bodies
8	Growth Centre
9	Health Centers
10	Community Clinic
11	Asrayan
12	Abasan
13	Rural Market
14	Cyclone Shelters
15	Small River or Khal
16	Forest
17	Wide River
18	Institutions
19	Settlements

All layers in the application are projected in Lambert Conformal Conic (LCC) which is currently used by LGED in their GIS mapping system.

Functionality Available

This GIS portal enable user to:

- Create LGED's road network maps with, and customize the number and type of object layers for viewing on the map
- Create special maps to support decision making in different project planning and monitoring activities
- Identify or check duplicate roads while planning for new project schemes
- View project-wise maps and generate project road inventories
- Generate road inventory and map summary reports.
- Measure the length along a path or area of a polygon on the map
- Prepare road density maps

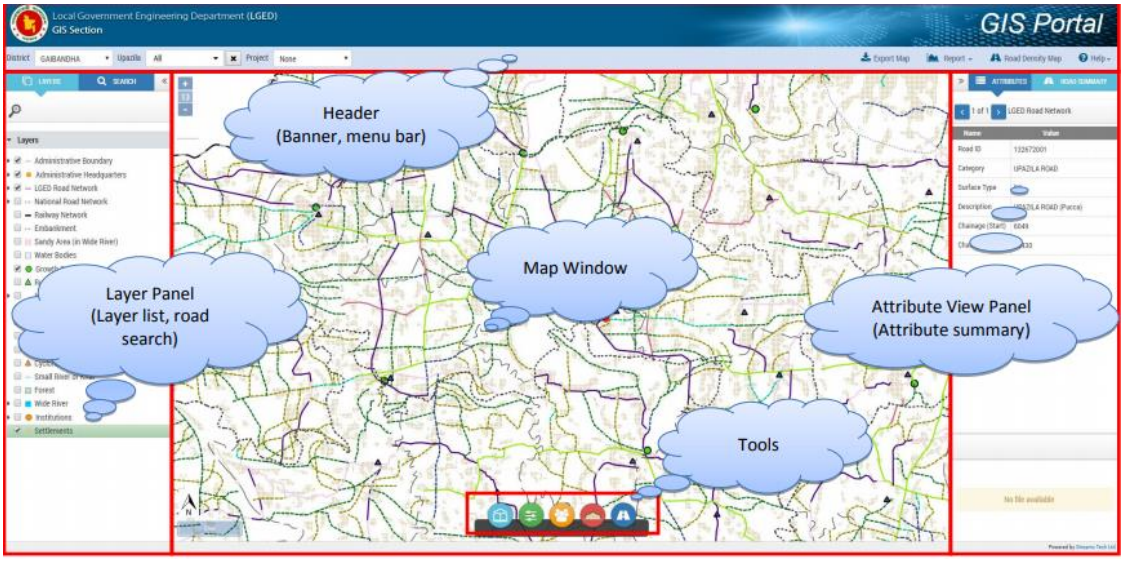


Figure 2.12: Features and Tools of LGED GIS Portal

Moreover, LGED has some advanced analysis feature to facilitate the project planning, monitoring and budgeting.

Tool Icon	Tool/Feature Name	Function
	School served area identification tool	Identifies a circular served (or influence zone) area around each school feature based on a user specified buffer distance, and displays the served area on the map.
	Duplicate road identifying tool (to be used in project planning)	Identifies duplicate roads based on user supplied road information, and displays them in a table.
	Road served area identification tool	Identifies a polygon served (or influence zone) area around a selected road object based on a user specified buffer distance, and displays the served area on the map. Besides it also shows an estimate of served population number based on habitat density in the settlement areas.
	Road cross section view tool	Displays cross section information of a selected road in a diagram.
	Road special property selection tool for viewing on the map	Allows users to specify a single property among AADT, IRI and CVD; and then to generate a second level road symbology based on that property and view on the map. By doing this, this tool allows to view a two-fold symbology view for the same road layer, e.g. one usually showing the road category, and another one (overlaid on the first one) showing that special property.

Figure 2.13: Some Advanced Features of GIS Web Portal of LGED

Users can generate following types of reports for the mapped network in the application.

- District Road Summary Report
- Upazilla Road Summary Report
- Project Road Summary Report
- Project Road Inventory
- Single Road Inventory
- Attribute List of a Selected Road or Any Other Object
- Road's Cross Section Diagram

Data Dissemination and Update Protocol

As a general user, one can only view them on the map but can switch on/off a particular layer to control its visibility on the map. However, users can download only the map layout as a pdf

file. To get the shapefiles of the maps, user need to make an application to the GIS Unit of LGED and pay required amount upon approval from the Chief Engineer, LGED.

With any update in the central GIS database, mapping attributes used in the application automatically become updated.

2.2.13 Delta Knowledge Portal:

The Bangladesh Delta Plan 2100 Formulation Project is led by the General Economics Division of the Bangladesh Planning Commission and was launched in August 2014 supported by the Government of the Netherlands. Delta Plan 2100 is a long-term, holistic and integrated plan for the Bangladesh delta. The formulation of the Bangladesh Delta Plan 2100 draws on experience from the Delta Plan formulation process in the Netherlands. The Delta Plan formulates Strategies both on the national level and on the level of Hotspots. A comprehensive database system and a knowledge portal was required to support the planners in participatory and interactive planning process for ensuring adaptive management of Bangladesh Delta. The overall objective of the knowledge portal was to develop a common and inclusive database on water, land and related natural resources as well as collected and generated knowledgebase information in support of the preparation, implementation and dissemination of the Bangladesh Delta Plan.

The knowledge portal consists of four major components. They are as follows:

1. Home Page
2. Data Explorer
3. Metadata Viewer
4. Export Tool

Home Page

This page contains an overview of the Knowledge Portal. The user can also navigate to other components from this page.

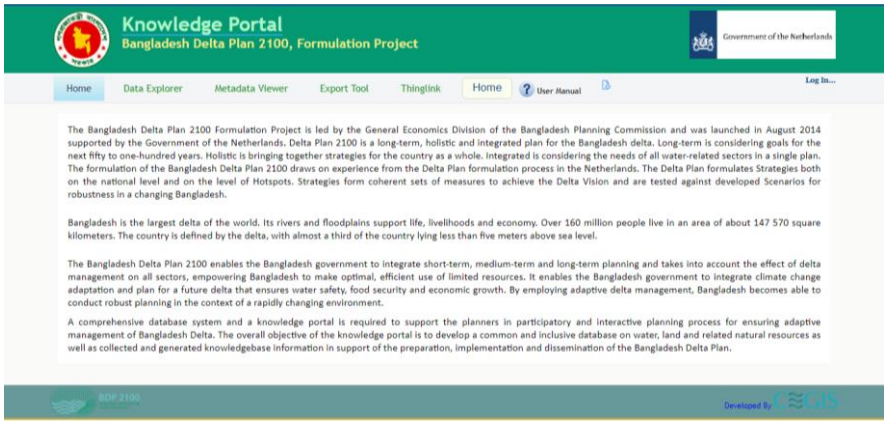


Figure 2.14: Home page of Knowledge Portal, BDP 2100

Data Explorer

This is the main component of the portal. This tool has been designed to display spatial and attributes data. Zoom in, zoom out, pan, super imposed and other standard facilities of spatial

data viewer has been incorporated into the tool. The Map Explorer also provides facilities to view identity and attribute information of the spatial data layers. The Map Explorer interface contains three separate panels: Left Panel, Middle Panel and Right Pane.

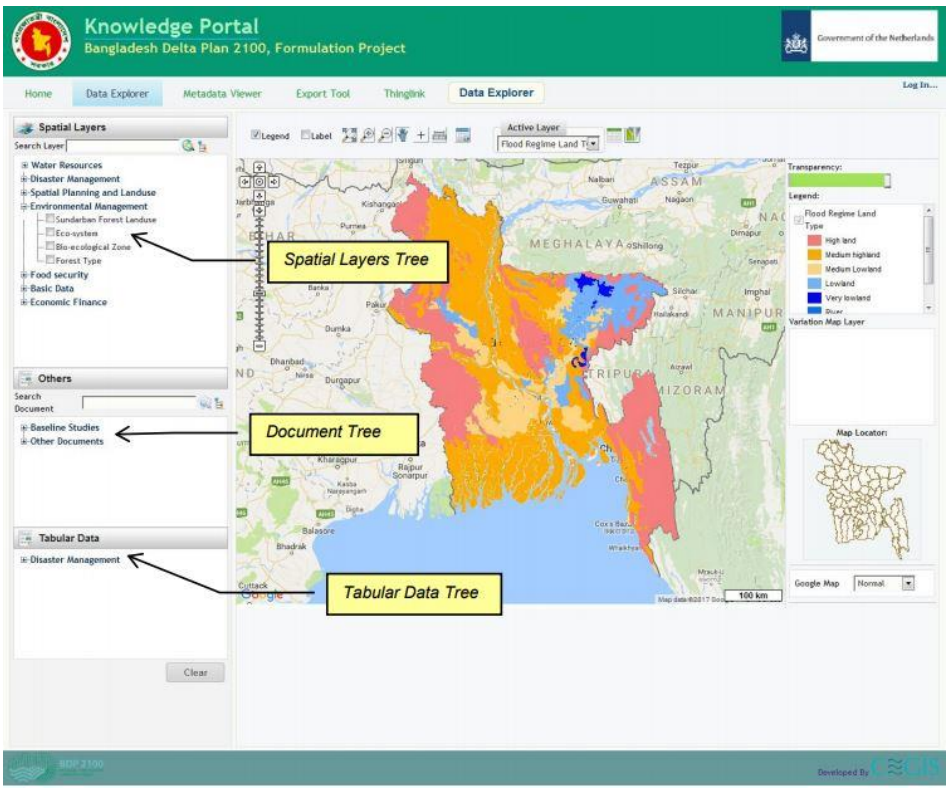


Figure 2.15: Data Explorer Window of Knowledge Portal, BDP 2100

Spatial Layers Tree

The data available in the database are categorized into different data groups for better management. Each data group contains several data layers.

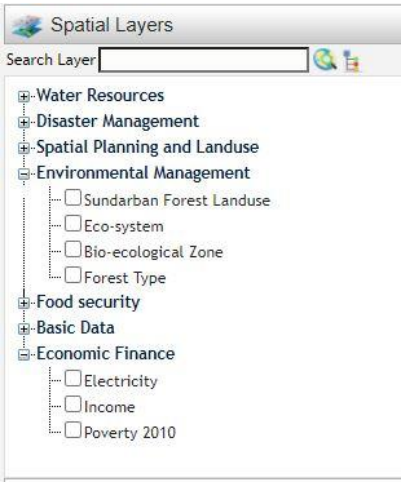


Figure: Spatial Layers Tree of Knowledge Portal, BDP 2100

The Spatial Layers Tree contains different data groups as parent nodes and corresponding data layers as child nodes. Table 2.1 shows data groups and corresponding data layers used in the system.

Table 2.1: Data Grouping of Knowledge Portal, BDP 2100

Sector	Data Layers	
Water Resources	Detail River	Haor Boundary Type
	Transboundary River	River Flood Return Period
	Waterbodies 2010	Proposed Structure
	Soil Salinity 2009	Embankment
	Arsenic	Rennels River System
	Bankline 2014	Haor Boundary
	BWDB Project	Irrigation Demand
	Catchment	LGED Project
	Transboundary Catchment	GBM Basin
	Channel Jamuna	Ground Water Zone
	Char Land	Hydrological Region
	Drainage Map	Flood Regime Land Type
	Coastline 1973 - 2010	Polder Boundary
Disaster Management	Seismic Zone	Average minimum temperature
	Rabi Drought	Average length largest period of dry days
	Average precipitation	Average maximum temperature
	Length of dry spells (Avg consecutive dry)	Flood Zone
	Average rainy days above 10 mm	Hazard Area
	Average rainy days above 20 mm	Length of wet spells (Avg. consecutive wet)
	Average number of wet days	Hazard Indices Map
	Average highest 1 day precipitation	Average length largest period of wet days
	Average highest 5 days precipitation	Flood Prone Area
	Average rain intensity	Difference between Max Temp and Min Temp

Sector	Data Layers	
	Cyclone Risk Area	SRDI Drought
	Number of days where Tmax > 25C	Drought Map Kharif I
	Number of days where Tmax > 30C	Average number of heatwaves
	Number of days where Tmax > 35C	Drought Map Kharif II
Spatial Planning and Landuse	Crop Suitability	Crop Area
	General Landuse	Dhaka Landuse 2010
	Physiographic	Erosion Accretion
Environmental Management	Sundarbans Forest Landuse	Bio-ecological Zone
	Eco-system	Forest Type
Food Security	Food Demand	DEM Bangladesh
Basic Data	Coastal Area	Division
	BIWTA Route	International Boundary
	Coastal Line	National Road
	Railway Line	Regional Road
	District Head Quarter	Zilla Road
	District	Upazilla Boundary
Economic Finance	Electricity	Poverty 2010
	Income	

Document Tree:

Various reports produced under the project are made available in the portal. These reports are categorized into different groups based on the type of reports. The Document Tree contains type of reports as parent nodes and corresponding report as child nodes.

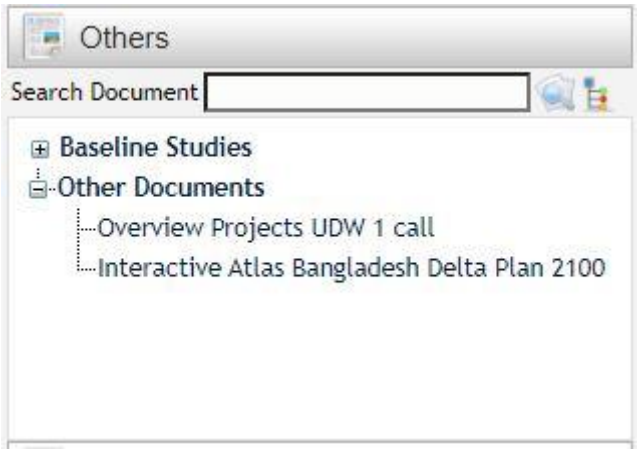


Figure 2.16: Document Tree of Knowledge Portal, BDP 2100

Tabular Data Tree:

Tabular information collected and generated are also made available in the portal. These data are categorized into different groups. The Tabular Data Tee figure contains different groups as parent nodes and corresponding data as child nodes.

Figure 2.17: Tabular Data Tree of Knowledge Portal, BDP 2100

Middle Panel

For spatial data, this panel contains two sub-panels: Top Panel and Map Window.

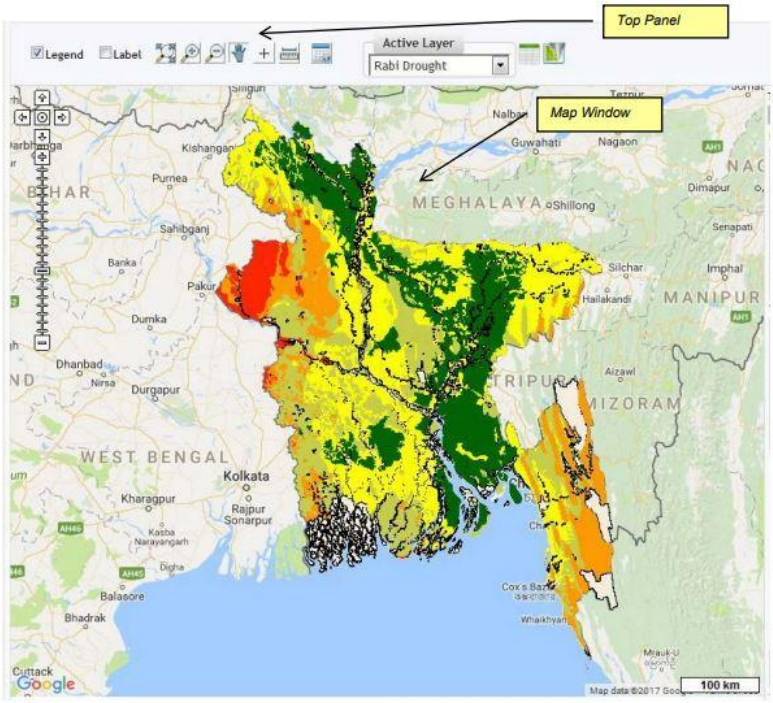


Figure 2.18: Middle Panel for Spatial Data of Knowledge Portal, BDP 2100

Top Panel

This panel contains Legend and Label checkboxes, Map Toolbar Active Layer combo box, and Attribute & Map Filter buttons.

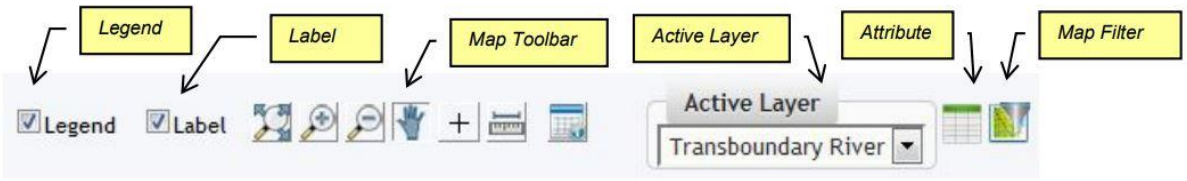


Figure 2.19: Top Panel of Knowledge Portal, BDP 2100

Legend: This Checkbox is positioned at the left most position of the Top Panel. It is used to activate/inactive the Map Legend by checking/un-checking it.

Label: This Check Box is used to make the Map Label visible/invisible.

Map Toolbar:

This contains several standard map tool buttons used for applying different functions on the maps available in the Map Window

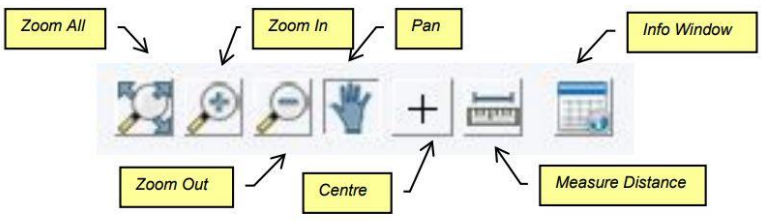


Figure 2.20: Map Toolbar of Knowledge Portal, BDP 2100

Active Layer: This dynamic dropdown list is used to make a particular layer active.

Attribute Table Viewer: This button is used to view attribute table in a new popup window.

Map Filter: This option can be used to filter data based on different values of map attributes.

Map Window: This window is available at the bottom of this panel and is used to display the selected layers.

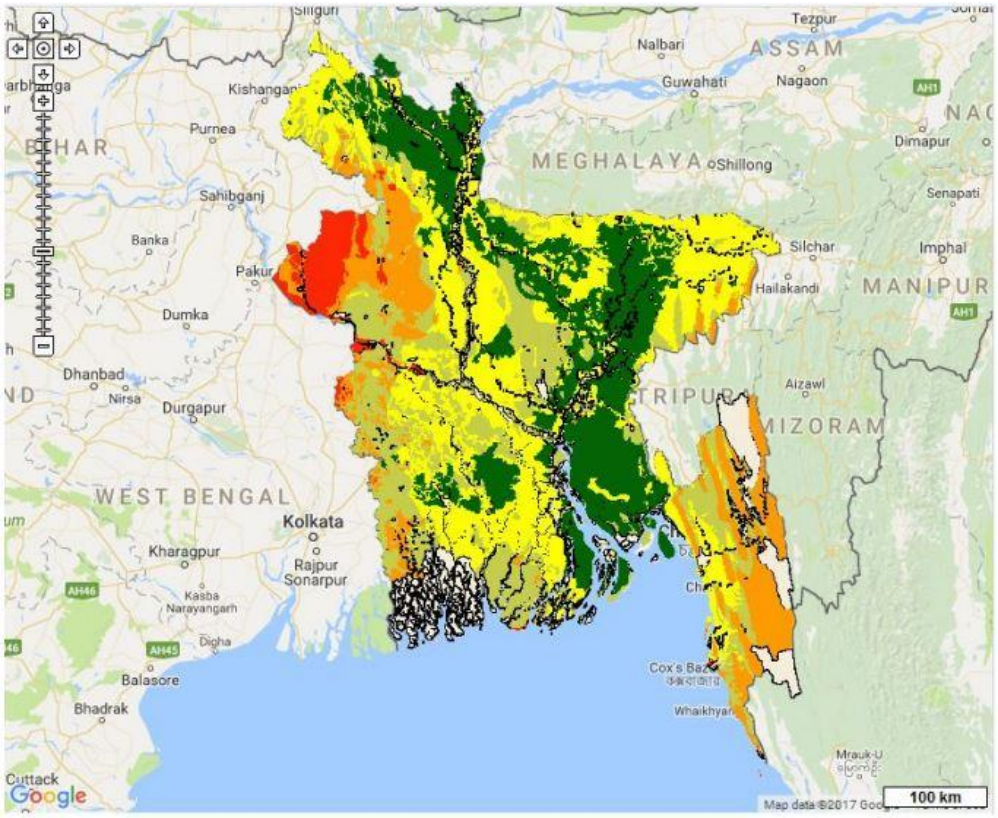


Figure 2.21: Map Window of Knowledge Portal, BDP 2100

Metadata Viewer

Metadata is information about data which describes the content, quality, condition, and other appropriate characteristics of data. Metadata Viewer helps to display metadata of each data layer.

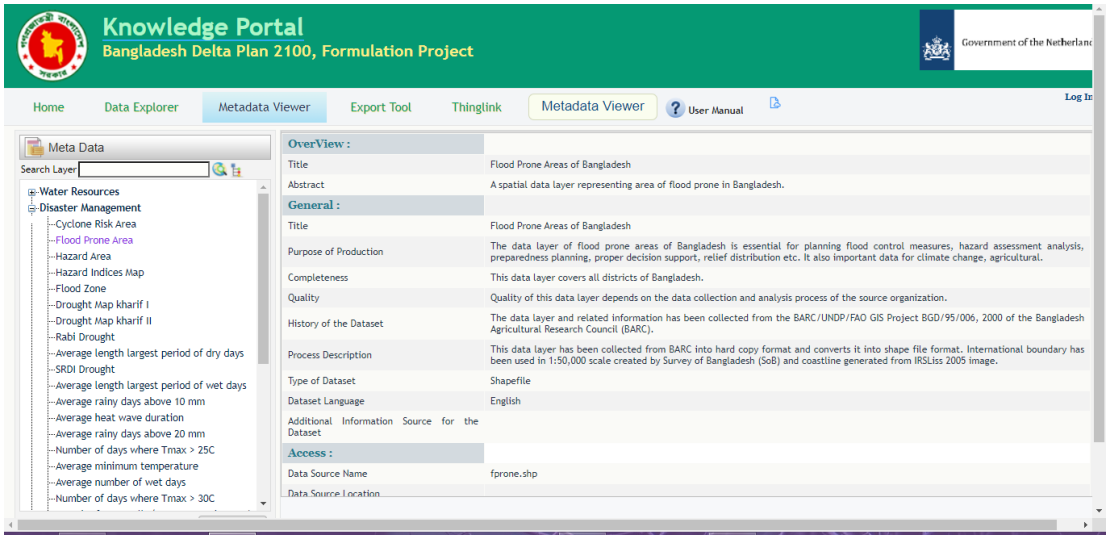


Figure 2.22: Metadata Viewer of Knowledge Portal, BDP 2100

Export Tool

This Menu helps to export data into selected format. Before exporting data, user will have to login to the system using his/her user ID and password. After successfully logged in, user can export the data and download it into their local computer.

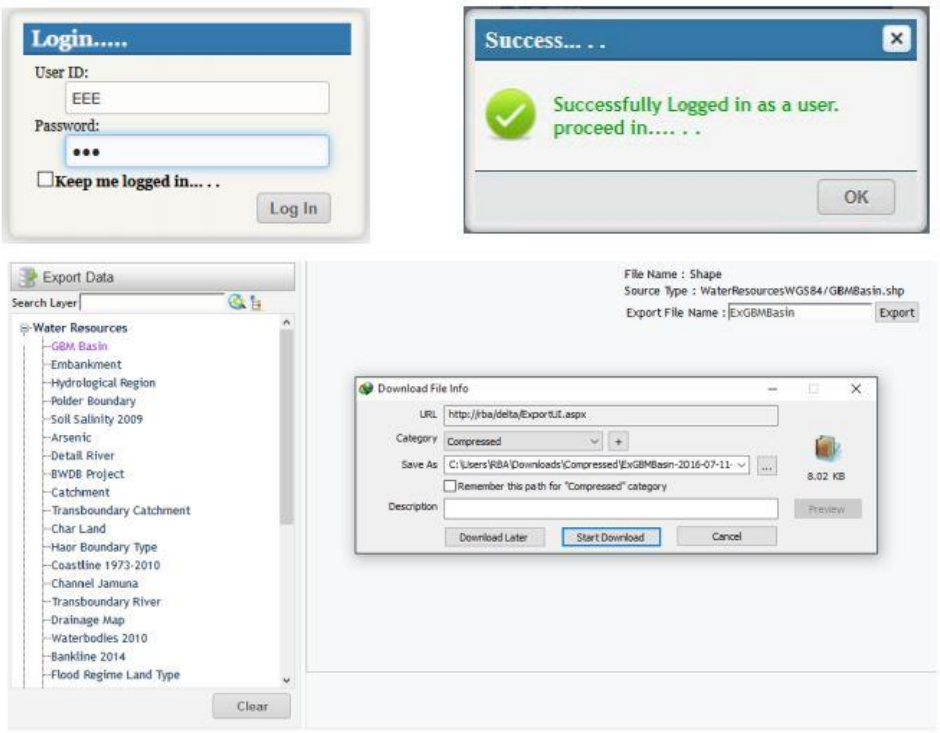


Figure 2.23: Export Tool of Knowledge Portal, BDP 2100

International Portals

2.2.14 Sri Lanka Disaster Risk Information Platform:

About the Portal

Sri Lanka risk information platform was established in 2011 to provide an overview of climate risk issues in Sri Lanka. It is a public platform for GIS Data to support development in Sri Lanka. The implementing partner of this portal are Disaster Management Center for Sri Lanka (DMC) of Ministry of Disaster Management, Global Facility for Disaster Reduction and Recovery (GFDRR) and World Bank Group. The DMC took the lead setting up and maintaining the online spatial data management, based on the GeoNode technology developed by GFDRR. Unlocking data from PDFs and creating a uniform format to store hazard, risk, exposure and base data is involved in this process. The main purpose of this platform is to allow the sharing of geo-spatial datasets in a collaborative multi-agency (or multi user) environment. The Sri Lanka Disaster Risk Information Platform can be accessed through this web link :(http://www.riskinfo.lk/)

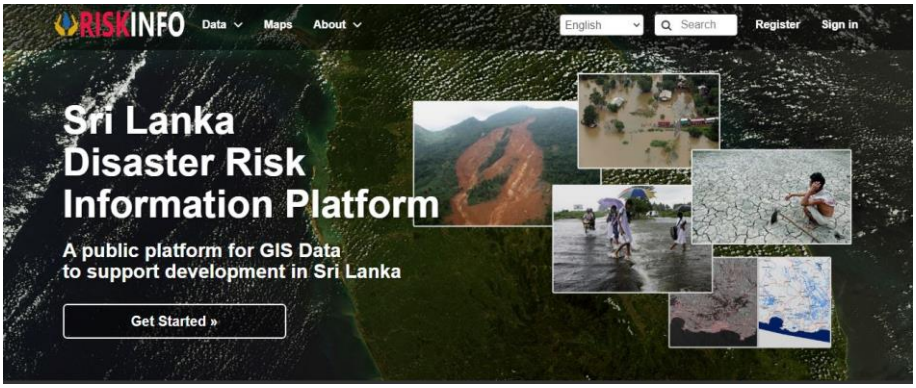


Figure 2.24: Sri Lanka Disaster Risk Platform

Data Availability and Format

The data available in this platform are-

- Layers
- Open street Map
- Documents

The categories of the data layers are-

Category	Category
Biota	Inland Water
Boundaries	Location
Elevation	Oceans

Environment	Planning Cadastre
Farming	Society
Geoscientific Information	Structure
Health	Transportation
Imagery Base Map Earth Cover	Utilities Communication

Hazard data such as Flood, Tsunami, Landslide, Sea Level Rice and exposure data such as population, roads, schools, hospital and land use are some of these. Data archive and map display are easily accessible. In addition to that, administration boundaries, elevation data, tsunami tower locations, Heli pads and police stations among the data sets available in the system. Survey Department, National Building Research Organization, Cost Conservation and Coastal Resource Management Department are the other main contributors in providing the spatial data. Moreover, past flood events derived from satellite data for the period of 2003 to 2018 were also available among the data sets.

The DMC provides daily Open Street Map extracts that can be used online. The layers are available both as raster layer and vector layer. There are 10 raster layer and 376 vector layer available in this portal. The documents are available as presentation, archive and others.

Functionality Available

The data are easily accessible to all. Users can view maps and layers and the documents can be downloaded. Besides user can create map and add desirable layers. Some layers are already uploaded in the platform like:

- My Geo-Server WMS
- Open Street Map Layers
- Bing Layers

To upload layer user need to have an existing account or register an account in the portal. The layers of health, transportation, population, utilities, emergency response, structure, agriculture are exposure type layers. The layers of flood, tsunami, elephant attack, landslide, cyclone, epidemic, man-made, drought, NDVI are hazard type layer.

2.2.15 Malawai Spatial Data Platform

About the Portal

Malawai Spatial data platform is a web based data sharing tool which was launched in 2012, managed by the National Spatial Center in the Department of Surveys, in collaboration National Statistics Office and other technical ministries. Government of Malawi is the source of data of this platform and covers environment, water resources, climate and ICT sectors. The Malawai Spatial data platform can be accessed through this web link: (http://www.masdap.mw/)

Figure 2.25: Malawai Spatial Data Platform

Data Availability and Format

There are mainly three type of data this portal provide and they are-

1. Layers
2. Documents
3. Remote Services

There are about 68 maps in this portal and user can explore these maps without any permission. The maps of this portal are categorized according to the following category-

- Elevation
- Environment
- Geoscientific Information
- Imagery Base Maps Earth Cover
- Location
- Structure

However, despite of all the above mentioned data and layer, this layer also provides datasets according to boundaries, buildings, climate, elevation, geology, health, land cover, nature, places, population, transportation, water. The included information of the datasets are given below-

- Boundaries dataset includes data layers of political and administrative boundaries, land use maps, zoning maps, cadastral surveys, and land ownership.
- Building datasets comprises data of buildings, museums, churches, factories, housings, monuments, shops, towers, energy, water and waste systems and communications, infrastructures and services, military bases, structures and services.
- Climate datasets include cloud cover, weather, climate, atmospheric condition, climate change, precipitation.
- Elevation datasets include layers of altitude, bathymetry, digital elevation models, slope, and derived products.
- Geology dataset includes data of geophysical features and processes, geology, minerals, sciences dealing with the composition, structure and origin of earth rocks, risk of earthquakes, volcanic activity, landslides, gravity information, permafrost, hydrogeology, and erosion.
- Health dataset include health services, human ecology and safety.
- Land cover dataset consists of imagery, topographic maps, unclassified images, annotations.
- Nature dataset comprise of wildlife, vegetation, biological sciences, ecology, wilderness, sea life, wetlands, habitat, environmental resources, protection and

conservation, agriculture, irrigation, aquaculture, plantations, herding, pest and diseases affecting crops and livestock.

- Places datasets include addresses, geodetic networks, control points, postal zones and services, place names.
- Population datasets comprise of settlement, anthropology, education, traditional beliefs, economic activities, conditions and employments etc.
- Transportation dataset includes roads, airports/airstrips, shipping routes, tunnels, nautical charts, vehicle or vessel location, aeronautical charts, railways.
- Water datasets include rivers and glaciers, salt lakes, water utilization plans, dams, currents, floods, water quality, hydrographic charts, tides, tidal waves, coastal information, reefs.

The layers are available in raster and vector format. There are 90 raster layers and 238 vector layers in this portal.

Functionality Available

Data of MASDAP are easily accessible to public and public can download the data without any permission but to upload data like layers or map user need a registered account of this portal.

If a user want to download the data as image format then the user can download the layers in 3 ways-

- PDF
- PNG
- JPEG

Otherwise the data can also be downloaded as-

- Original Dataset
- GZIP
- Geo-TIFF

The document type of data available in this portal can be easily downloaded. The documents are available in the type of text, images and presentations. There are 4 texts, 55 images and 18 presentations available in this portal. The categories of the documents are –

Category	Category
• Boundaries	• Farming
• Climatology Meteorology	• Geoscientific Information
• Economy	• Health
• Elevation	• Inland Waters
• Environment	• Location
• Society	

There exist a function in this portal that a user can create a map using an existing layer as per his/her desire. The metadata of layers can be downloaded as full metadata and standard metadata- XML format.

2.2.16 Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI)

About the Portal

The Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) established in 2017 is a joint initiative of SOPAC/SPC, World Bank and the Asia Development Bank with the financial support of the Government of Japan and the Global Facility for Disaster Reduction and Recovery (GFDRR) and technical support from AIR Worldwide, NZ GNS Science, Geoscience Australia, Pacific Disaster Center (PDC), OpenGeo and GFDRR Labs. The Pacific Catastrophe Risk Assessment and Financing Initiative can be accessed through this web link: (http://pcrafi.spc.int/).

Figure 2.26: Framework of Pacific Risk Information System

This platform aims to provide the Pacific Island Countries with disaster risk modeling and assessment tools and with this regard this platform provides 15 countries with risk assessment tools to help them better understand, model, and assess their exposure to natural disaster. This platform also aims to engage in a dialogue with the PICs on integrated financial solutions for the reduction of their financial vulnerability to natural disasters and climate change.

Data Availability and Format

This platform consists of 405 raster data and 432 vector data which are related to the following thematic areas or layers-

- Exposure
- Bathymetry
- Hazard
- Landuse
- Soil
- Topography
- Imagery Satellite Aerial

For hazard modeling in the following region this platform assembled, processed, developed, and organized the largest collection of geo-referenced data including:

- Satellite imagery
- Topographic maps
- Bathymetry maps
- Surface geology maps
- Land Cover/Land Use maps
- Geodetic and fault data
- Historical catalogs of tropical cyclones and earthquakes

Functionality Available

This platform has produced detailed probabilistic hazard models for all 15 countries such as tropical cyclones with winds, storm surge, rain earthquake with ground-shaking, and tsunami. The outputs of this platform can be broadly classified in two categories:

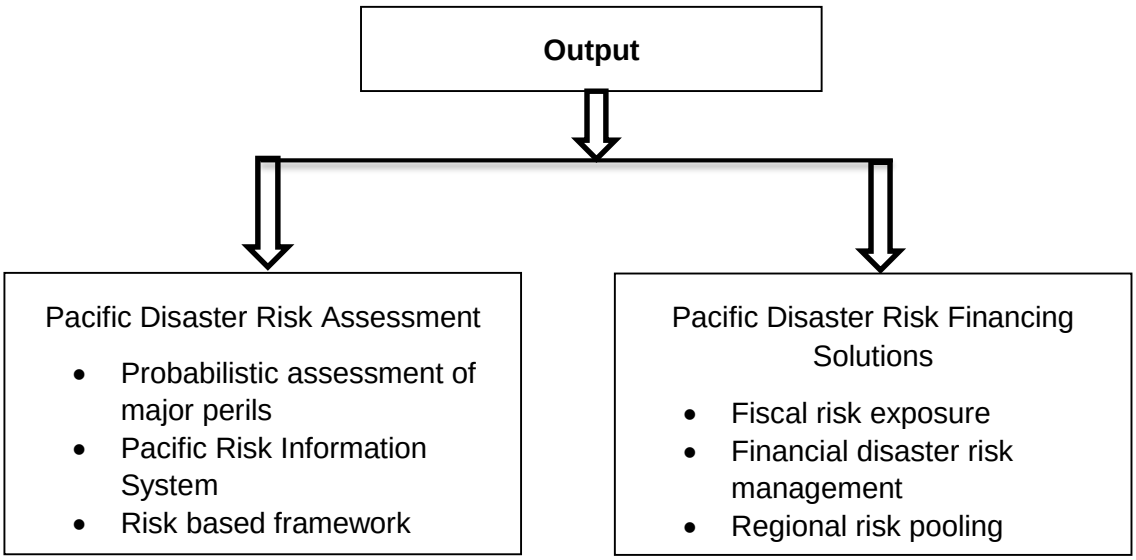


Figure: Output of Pacific Risk Information System

PCRAFI provides exposure and hazard data of Pacific Island Countries. The data is accessible to user as user can easily download map layer, create a new map using the same layer, find out the maps creating from same layer but to upload the layer user need to register an account. The map layer can be downloaded in following format-

Images	Data
• JPEG	• GZIP
• PDF	• GeoTIFF
• PNG	
• KML	

• View in Google Earth	
• Tiles	

User can also download metadata details in the following format-

Standard Metadata- XML Format	Full Metadata
• Atom	• Text Format
• DIF	• HTML Format
• Dublin Core	
• ebRIM	
• FGDC	
• ISO	

2.2.17 Aqueduct Global Flood Analyzer

About the Portal

The Aqueduct Global Flood Analyzer is an interactive platform which measures river flood impacts by urban damage, affected GDP and affected population at the country, state, and river basin scale across the globe. World Resources Institute (WRI) has been committed to providing open access to reliable data and Aqueduct global flood analyzer is one the initiative of WRI. The aim of this platform is to map water risks such as floods, droughts, and stress, using open-source data for all over the world. The Aqueduct Global Flood Analyzer can be accessed through this web link: (http://floods.wri.org/#/)

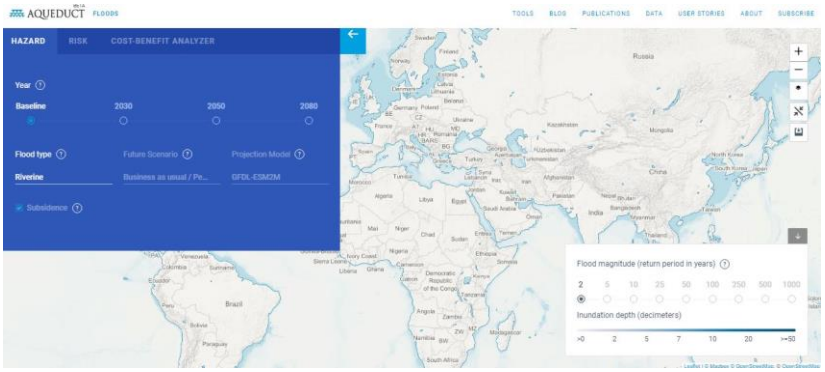


Figure 2.27: Aqueduct Global Flood Analyzer

Data Availability and Format

Hazard data like flood magnitude with return periods of 2, 5, 10, 25,50,100,250,500,1000 year, inundation depths of various decimeters for riverine flood and coastal floods are available for all countries. Future scenario like business as usual/pessimistic or optimistic and projected

model of interest like low, medium or high sea level rise can be specified for future years by user.

Risk data can be analyzed location wise and can be compared. The user need to select a socioeconomic or climate change scenario to project flooding in future year and perform risk analysis. These results of risk analysis can be downloaded in the form of embed widget, CSV, JSON, image, report.

There are also cost benefit analyzer where cost benefit analysis cab be done location wise and compared based upon selected future scenario. These cost benefit analysis can also be downloaded in the form of embed widget, CSV, JSON, image, report.

Functionality Available

Risk analysis for all countries are performed following some risk indicator which are mentioned below and the outputs under each indicators is also mentioned below-

Urban Damage	Affected population	Affected GDP
• Annual Expected Urban Damage • Urban Asset Value • % Annual Expected Urban Damage • Estimated Flood Protection Level	• Annual Expected Affected Population • Total Population • % Annual Expected Affected Population • Estimated Flood Protection Level	• Annual Expected Affected GDP • Total GDP • % Annual Expected Affected GDP • Estimated Flood Protection Level

Besides to identify and evaluate water risks around the world Aqueduct Global Analyzer provides following tools:

1. **Aqueduct Water Risk Atlas**: Map and analyze current and future water risks across locations.
2. **Aqueduct Country Rankings**: Understand and compare national and sub-national water risks.
3. **Aqueduct Food**: Understand and identify current and future water risks to agriculture and food security.
4. **Aqueduct Floods**: Identify coastal and riverine flood risks and analyze the costs and benefits of investing in flood protection.

There are some restrictions in accessibility of data like data can be downloaded easily and user need to subscribe to the WRI Water newsletter to stay updated on latest research, blogs, job openings, and updates across the projects including Aqueduct, natural infrastructure, corporate water stewardship, and water security.

2.2.18 Global Integrated Drought Monitoring and Prediction Systems (GIDMaPS)

About the Portal

The Global Integrated Drought Monitoring and Prediction System (GIDMaPS) is a drought monitoring and prediction system providing near real-time drought information based on multiple drought indicators and input datasets. Basically the system provides meteorological

and agriculture drought information based on multiple satellite-, and model based precipitation and soil moisture data sets. The Global Integrated Drought Monitoring and Prediction System can be accessed through this web link: (http://drought.eng.uci.edu/)

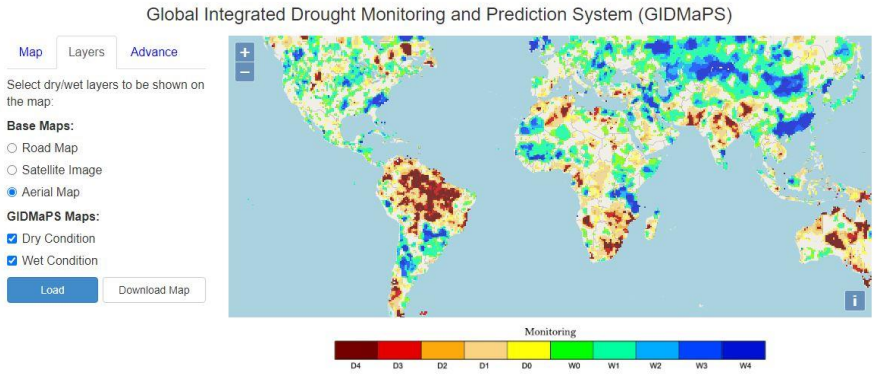


Figure 2.28: Global Integrated Drought Monitoring and Prediction System

Data Availability and Format

The input datasets of this website are in the form of:

- **MEERA**: NASA Modern-Era Retrospective analysis for Research and Application-Land
- **NLDAS**: NASA North American Land Data Assimilation System
- **GLDAS**: NASA Global Land Data Assimilation System
- **GDCDR**: Global Drought Climate Data Record

Functionality Available

The maps can be viewed as Road Map, Satellite Image, Aerial Map and this map can be downloaded easily. Besides the map layers are provided in dry condition and wet condition. The maps and data layers of this platform are used in defining the socioeconomic impact of climate change mainly in agricultural sector. Which region is more vulnerable and exposed to drought can be identified using this platform data and from this changes in cropping pattern can be detected in desired region and measures can be taken to produce climate resilient crop pattern.

2.2.19 Global Risk Data Platform

About the Portal

The PREVIEW Global Risk Data Platform is a multiple agencies effort to share spatial data information on global risk from natural hazards from where users can visualize, download or extract data on past hazardous events, human & economical hazard exposure and risk from natural hazards. It covers tropical cyclones and related storm surges, drought, earthquakes, biomass fires, floods, landslides, tsunamis and volcanic eruptions. This portal was developed as a support to the Global Assessment Report on Disaster Risk Reduction (GAR) and replace

the previous PREVIEW platform already available since 2000. The Global Risk Data Platform can be accessed through this web link (: https://preview.grid.unep.ch/)

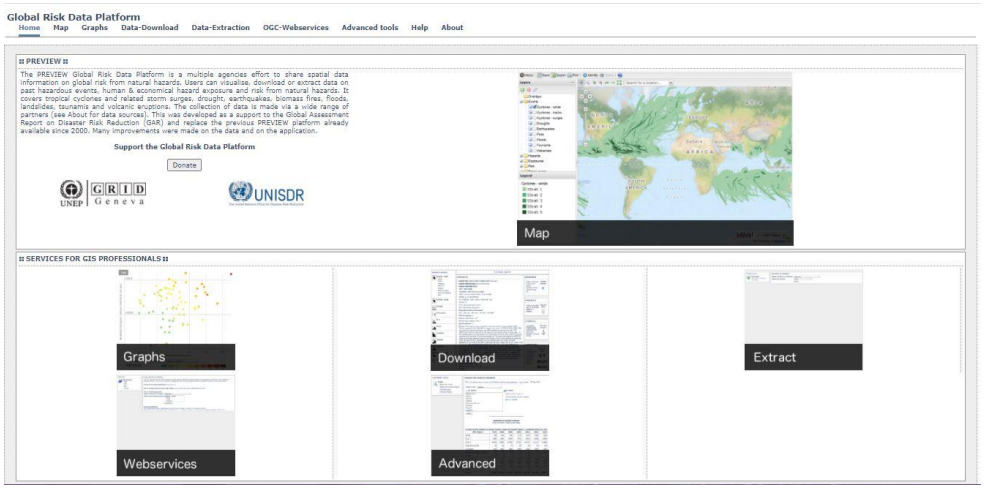


Figure 2.29: Interface of the PREVIEW Global Risk Data Platform

Data Availability and Format

There are several data layers available in this website. They are as followings:

1. **Contextual Layers**

Exposed Economic Stock	Urban Assets
Rivers	National Parks
Lakes	Subnational Borders
Country Borders	

2. **Past Events Layer**

Tropical Cyclones Sum Wind	Fires (Vegetation Density)
Tropical cyclones intensity	Earthquake Events
Tropical cyclones frequency	Floods(Riverine)
Tropical cyclones tracks	Drought Events
Tropical cyclones buffers	Volcanic Eruptions

3. **Risks Layer**

Multi Hazards Mortality Risk	Earthquake Average Annual Loss (USD$ million)

Landslides mortality risk - PR	Earthquake relative Average Annual Loss ‰
Flood mortality risk	Flood Average Annual Loss (USD$ million)
Tropical cyclones mortality risk	Flood relative Average Annual Loss ‰
Cyclone wind relative Average Annual Loss ‰	Flood relative Average Annual Loss ‰
Storm Surge Average Annual Loss	Storm Surge Average Annual Loss (%)
Storm Surge Relative Annual Loss	Tsunami Relative Average Annual Loss
Volcano Average Annual Loss	Multi-Hazard Relative Average Loss

4. Exposure Layer

Tsunami Population Exposed	Tsunami Economy Exposed
Landslides PR Population Exposed	Landslides EQ Population Exposed
Floods Population Exposed	Floods Economy Exposed
Landslides PR Economy Exposed	Landslides EQ Economy Exposed
Tropical Cyclone Population Exposed	Tropical Cyclones Economy Exposed
Drought Population Exposed	Drought Economy Exposed

5. Hazards Layer

Landslides EQ	Landslides PR
Cyclone Wind 50 years return period	Cyclone Wind 100 years return period
Cyclone Wind 250 years return period	Cyclone Wind 500 years return period
Cyclone Wind 1000 years return period	Cyclone Wind Average Annual Loss
Flood Hazard 25 years(cm)	Flood Hazard 50 years(cm)
Flood Hazard 100 years(cm)	Flood Hazard 500 years(cm)
Flood Hazard 1000 years(cm)	Peak Ground Acceleration PGA 250 years(cm/seg2)
Peak Ground Acceleration PGA 475 years(cm/seg2)	Peak Ground Acceleration PGA 975 years(cm/seg2)
Peak Ground Acceleration PGA 1500 years(cm/seg2)	Peak Ground Acceleration PGA 2475 years(cm/seg2)
Spectral acceleration 0.2 sec 250 years (cm/seg2)	Spectral acceleration 0.2 sec 475 years (cm/seg2)

Spectral acceleration 0.2 sec 975 years (cm/seg2)	Spectral acceleration 0.2 sec 1500 years (cm/seg2)
Spectral acceleration 0.2 sec 2475 years (cm/seg2)	Spectral acceleration 0.5 sec 250 years (cm/seg2)
Spectral acceleration 0.5 sec 250 years (cm/seg2)	Spectral acceleration 0.5 sec 250 years (cm/seg2)
Storm Surge Hazard 10 years	Storm Surge Hazard 25 years
Storm Surge Hazard 50 years	Storm Surge Hazard 100 years
Tsunami Hazard (Run up) RP 500 years	Multi-hazard Average Annual Loss (USD$ million)

Files can be extracted from this portal in two ways: Vector Images and Raster Images.

- Vector images are provided in Shapefile Format
- Raster images are provided in Geo-Tiff Format

Functionality Available

This module provides a detail idea about Layer Panel and Legend, Saving, Exporting and Publishing Maps. The Global Risk Data Platform allows the visualization of data on natural hazards, exposure (both human and economic) and risk. Users may perform zooms, pan to a particular area, add different layers of general data including cities, national parks, etc. Different backgrounds can be chosen to highlight different components reflecting vulnerability, such as population distribution, GDP per capita, elevation, land cover. Layers of natural hazards can be added for both events and yearly average for tropical cyclones, droughts, earthquakes, biomass fires, floods, landslides and tsunamis.

2.2.20 CRiSTAL Tool

About the Tool

CRiSTAL is a project-planning tool that helps to design activities that support climate adaptation (i.e., adaptation to climate variability and change) at the community level. The word "CRiSTAL" stands for "Community-based Risk Screening Tool – Adaptation and Livelihoods". CRiSTAL emerged from the Livelihoods and Climate Change project, an initiative of the International Institute for Sustainable Development (IISD), the International Union for Conservation of Nature (IUCN), the Helvetas Swiss Inter cooperation and the Stockholm Environment Institute (SEI). The CRISTAL Tool can be accessed through the web link (http://www.cristaltool.org/)

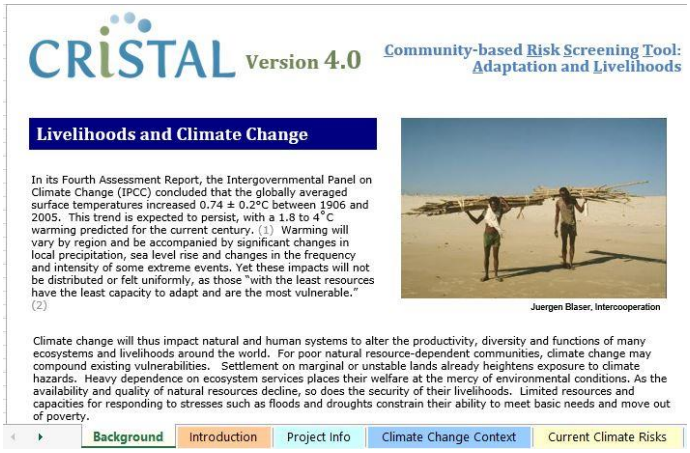


Figure 2.30: Interface of CRiSTAL Tool

Input Data for the Tool

For generating results through CRiSTAL Tool, a list of data need to be input; including:

- Hazard Data
- Impact Data
- Coping Strategy Data
- Livelihood Resources Data etc.

1. Hazard Data

Desertification	Drought
Extreme Cold	Extreme Heat
Floods	Hail Storms
Sand Storms	Snow Storms
Storm Surges	Tornadoes
Typhoons	Wild Land Fires

2. Impact Data

Crop Damage	Disruption of Transport

Damage to Dwellings	Fuel Shortage
Depletion of Grain Stores	Household Food Insecurity
Disease	Income loss
Loss of life	Loss of Savings
Loss of Trees	Personal Injury
Reduced Fish Stocks	Reduced Soil Fertility
Reduced Water Quality	Social Conflict
Unemployment	Water Shortage

3. Coping Strategy Data

Casual Labor	Common Property System
Crop Shifting	Food Rationing
Food Shortage	Gathering of Wild food
Income Diversification	Rainwater Harvesting
Selling of Personal Belongings	Tree/Crop Replanting

4. Livelihood Resources Data

Resources	Examples of Resources
Natural Resources	Trees, Land, Clean Air, Fish
Physical Resources	Roads, Water Tanks, Machines
Financial Resources	Cash, Savings, Jewelry, Pensions
Human Resources	Traditional Knowledge, Weaving Skills
Social Resources	Farmer Associations, Political Organizations

Functionality of the Tool

Applying the CRiSTAL Tool leads to three main outputs:

- List of livelihood resources that are most affected by climate hazards and most important for responding to climate impacts.
- Proposed adjustments to existing projects and new activities to support climate adaptation.
- List of desired adaptation outcomes and important influencing factors to be monitored.

CRiSTAL tool targets project planners and managers working at the local or community level. However, a wide range of other actors may also use the tool (including policy-makers and decision makers). CRiSTAL guides users through a number of analytical steps, which are divided into the following five steps and processes under three principal phases: understanding the livelihoods and climate context, evaluating the implications for the project and supporting monitoring and evaluation.

2.2.21 NAPAssess

About the Tool

NAPAssess is a decision support tool for use in the Sudan National Adaptation Programme of Action (NAPA) process. The NAPAssess model aims to assist in the process of identifying adaptation practical actions, and evaluate and prioritize adaptation initiatives. It is an interactive computer program providing a tool to facilitate the use of multi-criteria assessment techniques in order to identify the highest priority list of climate change adaptation programs, projects and policies that is summarized in NAPA Report. The NAPAssess Tool can be accessed through the web link (http://www.sei us.org/napassess/)

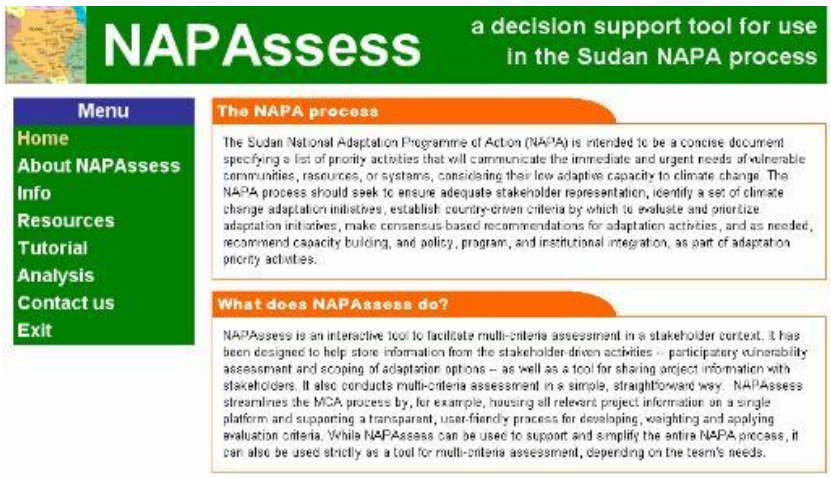


Figure 2.31: Opening Screen of NAPAssess Tool

Input Data for the Tool

1. Priority Vulnerability Inputs

In NAPAssess the term “priority vulnerability” refers to a group, natural resource, or system identified through the NAPA consultative process as requiring urgent attention. This is a key starting point in the multicriteria assessment process as the purpose of the NAPA process is to clarify and communicate a country’s urgent and immediate needs with regard to the needs of the most vulnerable to adapt to climate change

2. Stakeholder Community Information

After defining the priority vulnerability, the user can then proceed to the second module on stakeholders. The options in the stakeholder module allow the user to define, store, and access the types, names, and key interests of stakeholders who will eventually identify, score, and weight evaluation criteria.

3. Adaptation Initiatives

Having defined the priority vulnerability and the stakeholders to be engaged, the proposed adaptation initiatives are then considered and characterized. The options in the Adaptation

Initiatives module allow the user to define, store, and access the types of adaptation initiatives to consider in a multicriteria assessment.

Functionality of the Tool

The NAPAssess tool has been developed to accomplish three things:

Firstly, the tool is designed to provide guidance and a step-by-step reference point for the major activities in the NAPA process as defined by the guidelines developed by the LDC Expert Group (LEG) from synergy assessment, to stakeholder engagement, to project prioritization, to project portfolio development.

Secondly, the model is also intended to record, store and access output from each of the activities. In this regard, NAPAssess is particularly useful as a platform for sharing project information with stakeholders, and in turn, for storing information from the stakeholder-driven activities participatory vulnerability assessment and scoping of adaptation options.

Finally, the tool is used to conduct multi-criteria assessment in a simple, straightforward way. NAPAssess also streamlines the MCA process by housing all relevant project information on a single platform and supporting a transparent, user-friendly process for weighting project selection criteria.

2.2.22 Adaptation Wizard (UKCIP)

About the Tool

UKCIP is based at the Environmental Change Institute at the University of Oxford, which enables to partner world-leading academics working on critical climate change issues. The UK Climate Impacts Programme (UKCIP) provides scenarios that show how the climate might change and co-ordinates research on dealing with our future climate change scenarios using UKCIP tools. The tools focuses on 3 main categories of works: Decision-making for adaptation, Exchanging knowledge and ideas and Creative adaptation. The UKCIP tools portfolio framework follows 8-step synchronized process to assess vulnerability to climate change, and identify options to address key climate risks through a consecutive process form identifying the problem, assessing risks, appraising options to implement decisions and monitoring. . The UKCIP Tool can be accessed through the web link: (https://ukcip.ouce.ox.ac.uk/index.php?option=com_content&task=view&id=147&Itemid=297)

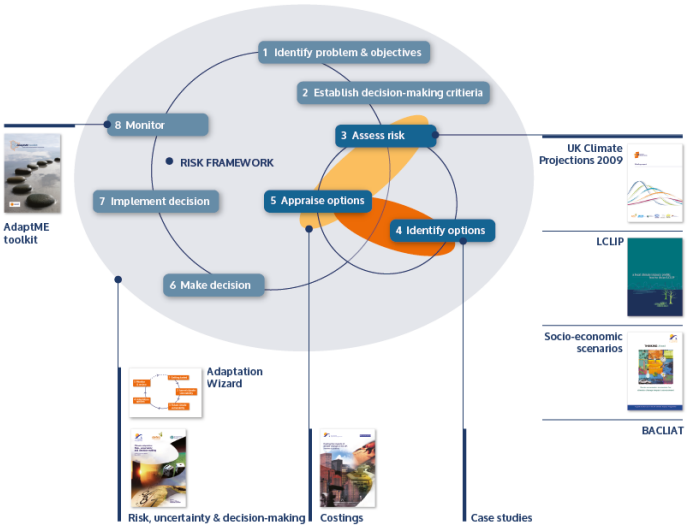


Figure 2.32: The tools portfolio of UKCIP

Functionality of the Tool

Functions of the output of Adaptation Wizard includes:

- Raising awareness of climate change and adaptation
- Accessing information, tools and resources
- Assessing vulnerability to climate change
- Developing a climate-resilient project, programme, policy or strategy
- Developing and implementing a climate change adaptation strategy.

For appraising probable options and making decisions, an adaptation wizard is used. Which follows a five steps process: getting started (defining objectives), assessing current and future climate vulnerability, identifying appropriate adaptation options and finally monitoring and review. The wizard provides a framework and resources to help generating information to inform adaptation strategies. The wizard helps to improve the flow of information between researchers and decision-makers, enhancing long-term relationships between the research, policy and practitioner communities. It needs to take developing country context into consideration in order to be of real use for developing countries.

Table 2.2: Summary of Review of International Portals

Name	Year of Establishment	Institutions / Country	Aim of platform	Data Archive	Data Download Option	Map Display	Map Manipulate/Generate Option	Lesson Learned (Feature, which can be picked for DRIP)	Web link
Sri Lanka: Risk Info	2011	Sri Lanka	To provide an overview of climate risk issues in Sri Lanka	Yes	No	Yes	No	▪ Diversified Categories of data layers. ▪ Users can create and project map over Bing, Open-Street Map Layers for display.	http://www.riskinfo.lk/
Malawi Spatial Data Platform	2012	Malawi	Using risk information to the key stakeholders	Yes	No	Yes	No	▪ User friendly interface. ▪ Simplest display of various layers on home page.	http://www.masdap.mw/
Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI)	2017	ADB, World Bank, GFDRR	To provide the Pacific Island Countries (PICs) with disaster risk modeling and assessment tools.	Yes	No		No	▪ User friendly interface. ▪ Layers can be uploaded.	http://pcrafi.spc.int/
Aqueduct Global Flood Analyzer		World Resources Institute, USA	To map water risks such as floods, droughts, and stress, using open-source data for all over the world	No	No	Yes	Yes	▪ Introduction of cost-benefit analyzer in the portal. ▪ Easy access of hazard data for various return periods and inundation depth.	http://floods.wri.org/#/
The Global Integrated Drought Monitoring and Prediction System (GIDMaPS)		University of California	To provide near real-time drought information	No	No	Yes	Yes	▪ Maps can be downloaded easily ▪ User friendly interface	http://drought.eng.uci.edu/

Name	Year of Establishment	Institutions / Country	Aim of platform	Data Archive	Data Download Option	Map Display	Map Manipulate/Generate Option	Lesson Learned (Feature, which can be picked for DRIP)	Web link
Global Risk Data Platform: PREVIEW	1999	UNISDR	Visualization of data on natural hazards, exposure	Yes	Yes	Yes	Yes	▪ Simplest Display of various layers at a time. ▪ Representation of various data by graphs. ▪ Background World Map Layer(Open Street Map)	https://preview.grid.unep.ch/

Table 2.3: Summary of review of risk screening tools

Title of tool/ guidance	Organization/ institution	Target Audience	Approach	Summary	Level	Costing exercise included	Practical application	Link/References
Adaptation Wizard	UK Climate Impacts Programme (UKCIP)	Planners and managers, UK	User-friendly info- and structuring computer based tool following a risk-based approach	5-step process to assess vulnerability to climate change, and identify options to address key climate risks. Needs to take developing country context into consideration in order to be of real use for developing countries.	Organization	Yes	UK	www.ukcip.org.uk/index.php?option=com_content&task=view&id=147&Itemid=297

Title of tool/ guidance	Organization/ institution	Target Audience	Approach	Summary	Level	Costing exercise included	Practical application	Link/References
The Community based Risk Screening tool – Adaptation and Livelihoods (CRiSTAL)	SDC, IISD, World Conservation Unit (IUCN), Stockholm Environment Institute (SEI) and Inter cooperation	Development project planners an managers	Participatory and vulnerability base approach , step-by-step, computer based method	User-friendly conceptual Framework, aimed at raising awareness on climate change adaptation and facilitating the identification and organization of an adaptation strategy.	Project	No	Mali,Tanzania,Sri Lanka, Nicaragua	http://www.cristaltool.org/
NAPAssess	Stockholm Environment Institute (SEI)	Stakeholders to the National Adaptation Programme of Action (NAPA) process and development practitioners	Participatory, Bottom up and consensus based approach drawing on multi-criteria analysis for the assessment and prioritizing of adaptation Initiatives.	NAPAssess is an interactive decision-support tool designed to facilitate a transparent and participatory NAPA formulation process in Sudan. The use of multicriteria analysis is also relevant in the context of climate screening	National/ sector	No	Sudan	http://www.sei-us.org/napassess/

2.3 Review of Existing Hardware and Hosting Environment

The consultant team visited NRP-PD premise as well as different stakeholder agencies to review the existing hardware and hosting environment. They observed that NRP-PD has their sufficient server and hosting environment. CEGIS Team noted the status of existing hardware and hosting environment as per their expert analysis and shared it with NRP-PD.

2.4 Review of DataSets

This section provides the short review of very key identified data sources for the DRIP and the data collection status:

ADB-8572: Action on Climate Change in South Asia: Establishing Climate Risk Screening for Mainstreaming Climate Change Adaptation into National Development Budgeting Activities

ADB-8752 database contains detailed qualitative data of Hazard, Exposure, Vulnerability and Risk at district level. The dataset contains data in GIS (Vector) formats. Therefore, no need to digitize these data. ADB had been approached and the dataset has already been collected.

Multi-Hazards Risk and Vulnerability Assessment, Modeling and Mapping (MRVAM)

The study entitled “Multi-Hazards Risk and Vulnerability Assessment, Modeling and Mapping” (MRVAM) carried out by Department of Disaster Management (DDM) contains detailed qualitative and quantitative data of Hazard, Vulnerability and Risk at the district and upazilla level. The documents of this dataset are available online in pdf format and therefore needed to be digitized to include into the DRIP. MRVAM related required data collection procedure from Department of Disaster Management is on process.

Nationwide Climate Vulnerability Assessment in Bangladesh (NCVA)

Nationwide Climate Vulnerability Assessment in Bangladesh (NCVA) contains detailed qualitative data of Exposure and Vulnerability at the district level. In addition to that, the document also provides detailed outline of probable impact and adaptive options. The document is available online in a pdf format. Therefore, this dataset is needed to be digitized. NCVA related required data collection procedure from Department of Environment is also on process.

Bangladesh Disaster- related Statistics 2015

The study entitled “Bangladesh Disaster- related Statistics 2015, Climate Change and Natural Disaster perspective” carried out by Bangladesh Bureau of Statistics contains detailed statistical data of Exposure, Vulnerability and Risk at the district level. The document is available online in pdf format. Therefore, this tabular dataset is needed to be digitized. Data collection procedure form BBS has been initiated.

National Water Resources Database (NWRD)

This database contains qualitative, quantitative and sector wise statistical data (Fisheries, Forest, Environment, Surface water, Ground water), meteorological statistical data and Hazard data. The surface water layer of the database has been reviewed to extract flood frequency maps for different return periods. The maps are provided in Raster (tiff) format and

needed to be digitized. Water Resources Planning Organization (WARPO) has already been approached and the data collection procedure is ongoing.

Delta Knowledge Portal

The Delta Knowledge Portal contains detailed qualitative and quantitative data for Hazard, Exposure and Vulnerability at the district level. The data of this portal are provided in GIS (Vector) format and therefore not needed to be digitized. The General Economics Division (GED), Government of Bangladesh has been approached and the data collection procedure is on process.

The following table summarizes the review of existing datasets:

Dataset	Data Format of Available Data	Digitization Requirement	Data Type			Availability of Data			
			Qualitative	Quantitative	Statistical	Hazard	Exposure	Vulnerability	Risk
ADBTA-8572	GIS								
MRVAM	PDF								
NCVA	PDF								
BBS	PDF								
NWRD	GIS								
Delta Knowledge Portal	GIS								

*red means not required/not available, green means required/available

2.5 Understanding Existing and Potential Challenges of DRIP

CEGIS team deeply observed the existing and potential challenges of DRIP on the basis of different meetings and discussion sessions with different level of officials. The following challenges of DRIP has been identified by them:

Existing:

- Unavailability of the soft copy or shapefiles of datasets or even unavailability of a document version of report or excel version of a pdf version table
- Consistency of available datasets like variable projection systems, timelines, difference in risk classification and risk mapping approach, different timelines of data
- All available data and information collection within short time resources and from multi-level stakeholders
- Compilation of various and large number of information as per expectations of stakeholders within a short time and make it available for insertion like information of cost of DRR measures, resilience related information or residual risk related information and many other similar to these.

Potential:

- Update of datasets and risk information
- Maintenance and sustainability of the DRIP

3. Stakeholder Analysis and Key Findings

3.1 Key Stakeholders Mapping

Stakeholder mapping shows both the impact stakeholders may have on a component of thisproject and the impact the project's component may have on stakeholders.

The stakeholders of the proposed DRIP have been determined by the nature of its uses. DRIP is a planning based software which helps the development planners/ decision makers while DPP appraisal by assessing risk of natural disasters of a particular administrative boundary. It is revealed from the above information that, the key stakeholders of DRIP are those organizations those are directly or partially involved with DPP appraisal as well as formulation.

3.1.1 Setting the criteria

The study is framed around the core elements of DRIP as well as expected outcome while identifying the key and other stakeholder institutions. Since the primary objective of DRIP is DPP appraisal, Bangladesh Planning Commission have been considered as the primary stakeholders of DRIP. Government organizations those are directly or partially involved in DPP formulation, disaster related policy making have been considered as secondary stakeholder. The stakeholder selection process has been determined by the consultation with project authority (National Resilience Programme- Programming division) and on overall understanding of the ToR as well.

3.1.2 Planning Commission as a primary stakeholder

The connotative content of development planning and the structure of government administration in Bangladesh between them determine the functios of the Bangladesh Planning Commission. Planning commission is directly involved with DPP appraisal. In Planning commission following divisions are directly involved in DPP appraisal:

I. Programming division
II. Agriculture Water Resources and Rural Institutions
III. Physical Infrastructure division
IV. Industry and Energy division
V. Socio-Economic Infrastructure divison

3.1.3 Secondary Stakeholders

Secondary stakeholders are mainly the development planners and decision makers of several government organizations who formulate DPP. Development planners and decision makers have used a wide variety of tools to manage a broad range of environmental risks, including those posed by climate variability, for a long time. Some of these tools have also now been modified to take into account the risks posed by climate change. At the same time, there has been a recent emphasis in developing more dedicated tools which have an explicit focus on

screening for climate change risks and for facilitating adaptation. 1 So, before the mapping of stakeholders of DRIP, the planners and decision makers will widely use the tool and consider all risk matter while planning of a development project. While this analysis will not be limited to the risk of recently hazards but also climate change risks, there will be a provision of further analysis for the result of high to very high risk. The list of the secondary stakeholders are:

I. Departmnt of Disaster Management
II. Department of Environment
III. Bangladesh Water Development Board
IV. Department of Agricultural Extension
V. Water Resource and Planning Oganizations
VI. Banglaseh Bureau of Statistics
VII. Local Government Engineering Department

The number of secondary stakeholders of proposed DRIP are not confined to the DPP related issues only. This online based decision suppot tool will also help while preparing Disaster Management Plan, Disaster related policy guideline, National level adaptation plan and any other risk informed planning.

3.2 Stakeholder Consultation

Stakeholder consultation is a regulatory process to explore people's opinion about the project intervention. It is mandatory for establishing Digital Risk Information Platform (DRIP) study following the consultation with Programming Division, Planning Commission. It promotes understanding of the concern organization and acceptance of the proposed platform. In return, people's feedback used as constructive input for improving structure, design and other activities of proposed DRIP. In this way, the proactive involvement of government organization in decision making leads to strengthen overall structure of DRIP.

In this study, objectives and expected result from the proposed platform have been shared with concern organizations (both primary and secondary stakeholders) during interview, and tried to identify their concern with the suggested solution for the establishment of DRIP. The tentative findings were collected and suggested measures from concern organizations presented in this following section. One of the main objective of this study is to collected data which is related to disaster risk. Status of data collection from the stakeholders is also presented in the section below.

[1] Hammill, A. and T. Tanner (2011), "Harmonising Climate Risk Management: Adaptation Screening and Assessment Tools for Development Co-operation", OECD Environment Working Papers, No. 36, OECD Publishing.

Objectives of Stakeholder Consultation

Broad Objective

The broad objective of the stakeholder consultation isto inform the concern organizations (primary and secondary) about rationality, expected outcome of the DRIP and find out their suggestions to establish the platform in sustainable way.

Specific objectives

The specific objectives of the stakeholder consultation are to:

- Data collection from stakeholder organization
- Linking DRIP with related project
- Share the structure, design and get their feedback
- Identify the gaps and problems with comparing to the similar platform
- Identify the probable solution of the identifying gaps and problems
- Identify probable suggestions on the implementation of the proposed platform

List of the stakeholder organization:

Sl No.	Organization	Designation of the interviewee	Key discussion point
1	Department of Disaster Management (DDM)	Deputy Director (MIM)	Data support, suggestion on DRIP structure
2	Bangladesh Water Development Board (BWDB)	Superintending Engineer, Processing & Flood Forecasting Circle, BWDB	Data support, suggestion on DRIP structure
3	Department of Environment (DoE)	Director (Climate change & International Convention), DoE	Data support, suggestion on DRIP structure
4	Aspire to Innovation (a2i)	Technology Expert	Technical suggestions, Server hosting,
5	ICT Cell, Planning Commission	Senior System Analyst, ICT Wing	Server hosting
6	SDBM project, Planning commission	Project Director and Senior IT & MIS Specialist	Technical suggestions, Linking DRIP with similar project
7	Bangladesh Meteorological Department (BMD)	Director	Data support, Technical suggestions
8	Department of Agricultural Extension (DAE)	Deputy Director (Project Implementation and Monitoring)	Data support, suggestion on DRIP structure

9	GIZ	Principal Advisor	Data Support, suggestion on DRIP structure, Linking DRIP with similar project,
10	Bangladesh Bureau of Statistics (BBS)	Joint Director (Census Wing)	Data Support, suggestion on DRIP structure
11	Water Resources Planning Organisation (WARPO)	Principal Scientific Officer (Senior System Analyst)	Data Support, suggestion on DRIP structure
12	DIA Consultants		Suggestion on DRIP structure
13	PD, Delta Plan		Data Support
14	PID, Planning Commission		
15	World Bank		

3.2.1 Consultation Overview/Findings

Outcome matrix from the consultation:

Organization	Data Collection Status	Suggested Measures by the Stakeholders	Possible Measures from the Consultants
Government Organization			
Department of Disaster Management (DDM)	On process	1. Focus on the sustainability of the platform 2. Consider return period	1. The platform will design considering the sustainability issues 2. Return period will consider depending on availability odf data
Department of Environment (DoE)	On process		
Bangladesh Water Development Board (BWDB)	On process	DRIP will largely contribute while planning in agricultural sector	
Department of Agricultural Extension (DAE)	N/A		

Water Resources Planning Organisation (WARPO)	On process	1. Not to confine the platform only for DPP appraisal and formulation purposes, but also use the DRIP output for Disaster Management Plan 2. To consider man-made disaster like fire incident, building collapse etc.	1. The users of DRIP will not be confined in government agencies only. 2. Man-made disaster related risk might not consider within this limited time and for unavailability of data but there will be provision to add the related data later.
Local Governemt Engineeering Department (LGED)	On process		
Bangladesh Bureau of Statistics (BBS)	On process		
Related Project			
SDBM		It has been suggested to use the updated geocode of administrative boundary so that the project output can easily link up.	The consultant team will discuss time to time and follow the geocode accordingly.
ACCNLDP			
BDP 2100	On process		
Project Monitoring Agency			
a2i		1. Focus on the compatibility of the platform for standard development procedures.	1. The platform will design considering the standard securities measures.

3.2.2 System Features (Hardware and Software) Requirement Assessment

As per the requirement of stakeholders, the DRIP system has to be an online system with some dynamic and user friendly features. A basic idea about the infrastructure that will be required for the DRIP system is given below:

Operating System (Web and Application Server)	Windows Server 2016
Operating System (Database Server)	Linux
IPs	a) Private IP for Database Server b) Public IP for Web and Application Server

Storage	6x2TB SAS HDD
RAM	128GB RAM
DBMS	MySQL

3.2.3 Human Resources Assessment

NRP-PD has some IT professionals in their own premise. But they are already engaged in lots of predefined assignments of the department. They need some well-trained professionals for managing DRIP system. CEGIS Team assessed the status of existing human resources as per their expert analysis and shared it with NRP-PD. They also suggested the following list of required professionals to manage and operate this system:

Position	**No. of Professional**
System Analyst	1
Database Expert	1
Programmer	2
System Engineer	1

3.2.4 Institutional Readiness Assessment

The consultant team observed the infrastructure of NRP-PD along with other stakeholder agencies. They analyzed the overall status of the organization with respect to IT, hosted services, use of cloud or in-house systems, digitalization initiatives for establishing the DRIP system.

3.2.5 Data Sharing and Update

NRP-PD has no data sharing and update policy yet. As per the suggestion of consultant team, thay will prepare a policy for it. A draft version of the policy will be prepared by the CEGIS team and will share with NRP-PD and UNDP to finalize it.

3.2.6 Users of DRIP

The planners and decision makers will widely use the tool and consider all risk matter while planning of a development project. While this analysis will not be limited to the risk of recently hazards but also climate change risks, there will be a provision of further analysis for the result of high to very high risk.

It was discussed in the stakeholders mapping chapter that the key users of DRIP are directly involve with DPP appraisal process. As one of the main advantages of DRIP is that it will be easily accessible to the planners and easy to assess the climatic risk for development project and it DRIP will accumulate hazard data from various sources and give a comprehensive figure and analysis of risk level and its spatial variation throughout the country, the users of DRIP are not be limited only for government agencies. It can be largely used in private research organizations, institutions and other private sectors involved in DRR management.

3.2.7 Maintenance and Sustainability Issues

CEGIS will provide maintenance and support services for a year since activation of DRIP to ensure platform and system is working properly. A report providing information on the resolution of requests, errors, queries and concerns stated by users will be prepared and submitted at the end of this period. This report will include sustainability plan including data update guideline and maintenance policy for the platform. During this maintenance period the consultant will perform the following tasks:

- Application bugs will be fixed and minor changes as per user requirement will be incorporated into the application systems;
- Fix any software related problem within 2 days;
- Help database administrator to administer the database;
- Maintain back-up and recovery of data; and
- Assist the client to maintain and enhance the system through transfer of knowledge as required.

A team that can be formed selecting IT professionals from Programming Division for on the job training, can maintain the system. and If needed, one year maintenance contract can be made with CEGIS after completion of the project period. In this maintenance period, CEGIS will further train up the team to maintain system by providing on the job training. The training will cover following topics:

1) Add new user;
2) Assign user rights;
3) Add new data layers and prepare corresponding metadata;
4) Update existing data layer; and
5) Back up database and the system.

The sustainability issues will be discussed with Programming Division and UNDP through stakeholder analysis and CEGIS will make a plan for sustainability of the platform including preparing strategy for post project operations, forming team and training them for post project operation. The same plan will be provided in the DRIP outline and Design report.

4. Data Collection, Processing and Inventory

4.1 Data Collection and Processing Requirement

All individual hazards and sub-component data of exposure and vulnerability will be typically collected, processed and convertefd into GIS environment for map preparation. Broadly the data will be used for this study are categorized into two major type: Spatial and Non-spatial data.

Spatial data: Collected spatial data will be converted into same projection and datum system. ArcGIS software will be used to perform all GIS related tasks.

Non-spatial data: One of the main challenges of this study will be mapping the sub-components of exposure and vulnerability from non-spatial dataset. The dataset having in hardcopy form and collected from different organizations, will be converted and processed into digital format.

4.1.1 Data Quality, Formatting and Compatibility Checking

Geo-spatial database will be designed and developed as per the requirement identified from the needs assessment. Spatial dataset will be collected from different organization in different coordinate systems. All these spatial data will be converted into an unique coordinate systems to feed into DRIP. Metadata for the converted data will be created and metadata for existing spatial data will be updated. Converted data then will be uploaded into DRIP.To avoid data redundancy and inconsistency, the database will be normalized and a number of tables will be used to store in spatial attribute table.

4.1.2 Data Conversion

Collected data sources identified from requirement analysis. CEGIS will identify and convert a list of data into digital formats (either in table or in spatial format). Data collected from different organization will be in different coordinate systems. All these spatial data will be converted into an unique coordinate systems to feed into DRIP. Metadata for the converted data will be created and metadata for existing spatial data will be updated. Converted data then will be uploaded into DRIP. In consultation with data sources, CEGIS will develop data standards for data uploaded to DRIP including periods for updating, and data processing required for transforming available and newly collected data into the format required by the DRIP.

5. Platform Design and Architecture of DRIP

5.1 Contents of DRIP

This section outlines the elements and associated issues of DRIP at a glance to give an overview of the Disaster Risk Information Platform (DRIP) answering following six key questions:

- What are the elements or contents of DRIP?
- What will be the sources of datasets used and how it will be acknowledged?
- How risk information will be integrated into DRIP from different sources?
- How DIA appraisal will be performed using the DRIP?
- How Project development will be facilitated through DRIP?
- What will be the outlook of the DRIP?

The contents of DRIP have been identified and set upon feedback of different stakeholders' consultation, feedback of DIA consultants on DIA framework and its requirement for appraisal, review of past national initiatives, generating ideas from global risk platforms, review of available datasets and information, existing policy, plans and regulatory documents.

Amalgamating and analysing all mentioned information following contents (Table 5.1) of DRIP have been anticipated with a view to facilitate integration of disaster risk information into development planning, policies, budgeting and programs particularly for Agriculture and Infrastructure sectors:

Table 5.1: Overview of Contents of Disaster Risk Information Platform (DRIP)

SL. No.	Contents Category	Details of Contents	Potential Data/Information Sources	Required Tools and Functionality
1	**Hazard**	Historical Disasters Extent Map	NWRD, FFWC, BMD, DDM, CEGIS, BWDB	Visualize, Print, Export and Map with Different Styles
2		Hazard Affected Area (without return period)	ADBTA:8572, MRVAM DDM, Delta Knowledge Portal	
3		Hazard for Different Return Periods	MRVAM DDM, Delta Knowledge Portal, NWRD	
4		Hazard for Combined Return Period	MRVAM DDM, Delta Knowledge Portal, NWRD	
5		Hazard for Climate Change Scenario	ADBTA:8572, NCVA	
6	**Exposure**	Exposures or Elements at Risk (both socio-economic and bio-physical)	BARC, LGED, RHD, BBS, ADBTA:8572, MRVAM DDM, NCVA, Delta Knowledge Portal	
7	**Vulnerability**	Sensitivity (both socio-economic and bio-physical)	BARC, LGED, RHD, BBS, ADBTA:8572, MRVAM DDM, NCVA, Delta Knowledge Portal	
8		Adaptive Capacity	BARC, LGED, RHD, BBS, ADBTA:8572, MRVAM DDM, NCVA, Delta Knowledge Portal, BWDB	
9	**Risk Mapping**	Qualitative Risk Mapping due to Selecting Individual Hazard	ADBTA:8572, MRVAM DDM, Dynamic Risk Assessment following ADBTA:8572 Algorithm from Backend of Web	
10		Qualitative Risk Mapping due to Multi-Hazards (Permutation and Combination of Identified Hazards in Hazard Section)	ADBTA:8572, MRVAM DDM, Dynamic Risk Assessment following ADBTA:8572 Algorithm from Backend of Web	
11		Losses and Damages (Quantitative Risk) for Historical Disasters	BBS-Climate and Disasters Statistics, DDM	
12	**Possible DRR Measures and Cost**	Possible Generic DRR Measures against Addressing Hazard and Vulnerabilities for Agriculture	TNC, DoE, BARC, HILIP-CALIP-LGED, RHD, BCCSAP, CDMP Reports, Numerous Publications	

SL. No.	Contents Category	Details of Contents	Potential Data/Information Sources	Required Tools and Functionality
13		Possible Generic DRR Measures against Addressing Hazard and Vulnerabilities for Infrastructures	TNC, DoE, BARC, HILIP-CALIP-LGED, RHD, BCCSAP, CDMP Reports, Numerous Publications	
14		Tentative Per Unit Cost of DRR Measures	BARC, CEIP, LGED, RHD, DAE, CDMP, BWDB	
15		Available Technical Guidelines about DRR Measures	BNBC, Guidelines of LGED and RHD, BARC, DAE, BRRI, BARI, BINA, BWDB	
16		Available Regulatory Guidelines about DRR Measures	SOD, Disaster Management Act, NPDM, Flood Shelter Construction Guideline, Cyclone Shelter Construction Guideline, Test Relief Guideline, KABITA, Food for Work, Humanitarian Assistance Guidelines, BNBC, Water Act etc.	
17		Available Directives or Priorities of Government	BDP2100, Perspective Plan 2041, FYP, SDG Action Plan, Newspaper	
18	**Resilience Information**	Existing Emergency Management Plan	SOD, CDMP, Development Partners, Humanitarian Organization, DDM	
19		Potential Recovery Time	SOD, CDMP, Development Partners, Humanitarian Organization, DDM, Disaster Management Act, Flood Shelter Construction Guideline, Cyclone Shelter Construction Guideline, Test Relief Guideline, KABITA, Food for Work, Humanitarian Assistance Guidelines	
20	**Residual Risk Information**	Information on Possible Residual Risk	Published Reports and Available Literatures, DDM	
21	**Glossary**	Definition of Disaster Risk Elements	SFDRR, CDMP, IPCC AR5, DDM, UNISDR, UNDRR	Visual and Print
22	**Relevant Important Documents and Links**	National: SOD, NDMP, Delta Plan 2100, Water Act, Coastal Zone Policy and Plan, Adaptation Plan etc.	Mentioned Documents	Viewer, Print and Download

SL. No.	Contents Category	Details of Contents	Potential Data/Information Sources	Required Tools and Functionality
23		Global: SFDRR, UNDRR, UNSDR, UNFCCC, Paris Agreement, SDG		
24	**Relevant SDG Goals**	SDG Goals	SDG2030	Visual and Print
25	**Data Extraction and Download**	Meta Data	Developed Meta Data	Visual, Print and Download
26		Data Attribute		
27		Map Extractions		
28		Web Services for Sharing		
29	**Advance Tools**	Query Builder, Analysis, Mapping	Dependent on Hazard, Exposure, Vulnerability and Risk Segments	Visual, Export and Print
30	**Project Development and Appraisal Tool**	Navigate to Project Location	Dependent on Hazard, Exposure, Vulnerability and Risk Segments	Visual, Map with Different Styles, Report Generate in PDF, Print and Export/Download
31		Select Hazard or Multi Hazards		
32		Select Exposure		
33		Select Vulnerability		
34		Calculate Risk		
35		Auto Select DRR Measures and Cost, Guidelines and Directives, Available Resilience and Residual Risk Information		
36		Generate Report in PDF addressing 6 Questions of DIA Framework including Maps		
37	**Linked Past Initiatives**	Hyperlinked Past Initiatives	PLIS, A2i, NCVA, MRVAM DDM, NWRD, LGED GIS MIS, RHD RMMS, ADBTA:8572, SDBM, Digital ECNEC etc	Visual, Print and Download

SL. No.	Contents Category	Details of Contents	Potential Data/Information Sources	Required Tools and Functionality
38	**Frequently Asked Questions (FAQ)**	Answers of Some Frequently Asked Questions	Questions need to be developed	Print
39	**About DRIP**	Vision	State the vision	Print
40		Mission	State the mission	
41		Objectives	List the objectives	
42		Data Sources	List the data sources	
43		Host of DRIP	Brief about the host	
44		Partners	Brief about partners	
45		Technology	List the technologies used	
46	**User Guidelines**	DRIP Use Guidelines for Project Development and Appraisal	Developed User Guidelines	PDF viewer, Print, Export/Download
47		Data Use and Disclaimers	Terms of Use and Disclaimers	
48	**Feedback**	Feedback of User	Feedback Submission Provision	Form

The following sub-sections describe each of the contents of DRIP in detailed:

5.1.1 Hazard

Historical Disaster Information

This sub-section will contain historical maps and information on tabular format which are available to give ideas of the historical occurrence of disaster in the particular area of interest. For instances, flood extent map of 1988, 1998, 2004, 2007, 2010, 2012, 2017 etc. and their corresponding losses and damages will be added here. Similarly, historical cyclones, flash floods, storm surges, earthquakes, landslides and their available information will also be added in this sub-section. These historical information w3ill be collected from NWRD, FFWC, BMD, DDM, CEGIS, BWDB and other authentic sources.

Hazards for Risk Mapping

The DRIP will include following 14 hazards shown in Table below, among which 13 will be used from the ADBTA:8572. However, intensity of hazard i.e. return period is a very important parameter to understand the risk. Therefore, efforts will be made to collect additional hazard data layers for different return periods which are available in MRVAM study of Department of Disaster Management (DDM) and Delta Knowledge Portal. These additional hazard layers with risk level will be an added value for the DRIP, if shapefile is possible to collect for mentioned sources. Otherwise digitization would be required from the document.

The risk information for these additional hazards can be mapped using the same algorithm and exposure and vulnerability indicators as followed by the ADBTA:8572.

Table: Selected Hazards for the DRIP

Sl. No.	Hazard	Generally Hazard Affected Area	Climate Change Scenario		Return Period							
			RCP4.5	RCP8.5	10	25	50	100	150	200	500	1000
1	Cyclone	ADBTA:8572										
2	Pre Kharif Drought	ADBTA:8572			MRVAM		MRVAM	MRVAM				
3	Kharif Drought	ADBTA:8572			MRVAM		MRVAM	MRVAM				
4	Earthquake	ADBTA:8572						MRVAM			MRVAM	MRVAM
5	Erosion	ADBTA:8572										
6	Floods	ADBTA:8572				Delta Portal/MRVAM	Delta Portal/MRVAM	Delta Portal/MRVAM				
7	Flash Floods	ADBTA:8572										
8	Storm Surge	ADBTA:8572				MRVAM	MRVAM	MRVAM				
9	Sea Level Rise	ADBTA:8572										
10	Surface Water Salinity		CEGIS	CEGIS								
11	Soil Salinity	ADBTA:8572										
12	Landslides	ADBTA:8572										
13	Temperature Rise	ADBTA:8572	ADBTA:8572	ADBTA:8572								
14	Rainfall Anomalies	ADBTA:8572	ADBTA:8572	ADBTA:8572								

5.1.2 Exposure

The DRIP will include following 11 exposures identified and analyzed in the ADBTA:8572 as shown in Table below. The exposure list includes representative indicator from Agriculture and Infrastructure sectors. Similar to hazards, additional exposure or elements at risk can also be added under the exposure list which are available either in MRVAM or NCVA study revealed during the datasets review. Study team is trying to collect available datasets from these two sources and will be included in the exposure list later, if data collection was successful. For instances, growth center, rural market, bridges, railway, power stations, fire stations, educational institutes etc. can be added considering the Infrastructure sector and livestock, fisheries etc. can be added under the Agriculture sector.

Table: Selected Exposures for the DRIP

Sl. No.	Exposure	Indicators	Data Source
1	**Population**	Population Density	ADBTA:8572
2	**Housing**	Number of Household	ADBTA:8572
3	**Crop Yield**	Aus	ADBTA:8572
4		Aman	ADBTA:8572
5		Boro	ADBTA:8572
6		Jute	ADBTA:8572
7		Potato	ADBTA:8572
8		Wheat	ADBTA:8572
9		Maize	ADBTA:8572
10	**Infrastructure**	Road Length	ADBTA:8572
11	**Forest**	Forest Area	ADBTA:8572

5.1.3 Vulnerability

Similar to Exposure list, vulnerability has been selected as per following Table which will be based on the ADBTA:8572:

Sl. No.	Vulnerability		Indicators	Data Source
1	**Sensitivity**	**Poverty**	Poverty Lower Line	ADBTA:8572
			Poverty Upper Line	ADBTA:8572
2		**Education**	Literacy Rate	ADBTA:8572
3		**Gender**	Female Literacy Rate	ADBTA:8572
4		**Livelihood**	Percentage of Household Dependent on Agriculture	ADBTA:8572
5	**Adaptive Capacity**	**Medical Facilitiy**	Population/No. of Doctor	ADBTA:8572
6		**Embankment**	District Area/Length	ADBTA:8572
7		**Cyclone Shelter**	Population/No. of Cyclone Shelter	ADBTA:8572
8		**Irrigation Facility**	Irrigated Area	ADBTA:8572

Apart from these, a large list of sensitivity and adaptive capacity indicators and maps are available in both MRVAM and NCVA study which can also be included in the DRIP if the collection of shapefiles is possible. For instances, disabilities, unemployment, income, landless people, elderly people, household type, fish pond area, fisheries dependent livelihood can be included as sensitivity and educational institutes, agriculture activities, mechanization, medical institutes, irrigation water availability etc. can be added as adaptive capacity indicators as part of vulnerability.

5.1.4 Risk Mapping

Risk due to Individual and Multi-Hazards

This section will enable users to map in different styles the risk level due to individual hazards or multiple hazards. The risk map produced under the ADBTA: 8572 for selected hazards will be displayed when user will use this mapping tool.

Apart from the risk map of ADBTA:5782, efforts will be made to collect MRVAM datasets and shapefiles to enrich the risk mapping section as well as DRIP. Moreover, the user will be able to generate risk map using the hazard layers of different return periods collected from MRVAM

or other authentic sources, with same algorithm and weights used in the ADBTA:5782, which was developed after rigorous trial and errors and validation.

ADBTA:8572 adopted very well acknowledged concept of the risk from the IPCC SREX report, i.e.

Risk=f (Hazard, Exposure and Vulnerability) or

R=H*E*V, which is also known as HEVR analysis

For each of the Hazard (H) value, Exposure (E) and Vulnerability (V) values have been calculated for every district. Depending on the nature of Hazard (H), sub-components of E and V are calculated using weighted average method. Weights are assigned to each sub-component out of 100% or total contribution.

However, the exposure and vulnerability indicators will remain same as the ADBTA:5782 or as shown in Table above, just the hazard layer will be changed, as any changes in exposure or vulnerability indicators will deviate the developed algorithm and weights, which will demand validation risk map further.

The DRIP user will be able to get only the level of the exposure or vulnerability indicators itself if any new indicators are added as per recommendations of the earlier sections, but not the combined risk level of hazard, exposure and vulnerability.

In addition, the user will be able to generate multi hazard risk map selecting the list of combination of hazards from the drop-down list. The ADBTA:8572 did not produce maps of multi-hazards. Therefore, the multi hazards score will be calculated, normalized and classified dynamically from the back end of the web. In calculation of multi-hazard risk, equal weight will be considered. The standardized normalization formula based on functional relationship will be used to normalize the aggregated score.

All the risk map will be up to the district level. However, upazilla level boundary will be overlaid to provide provision of generating map up to upazilla level when hazard, exposure and vulnerability maps will be updated up to the upazilla level.

Loss and Damages (Quantitative Risk) Information

Bangladesh Bureau of Statistics (BBS) published climate change and disaster related statistics in 2015 performing household survey, which include a large set of division and district level loss and damage related data during the period of 2009-14 due to natural and climate change induced disasters. This sub section will contain maps of those quantitative risk information which is being collected from the BBS. This quantitative risk information will enable user to get specific ideas on loss and damage potentiality from historical statistics, which will enrich the report for project development or appraisal. Following figures illustrates the distribution of affected area and losses of major crops during 2009-14 due to disasters.

Figure: Distribution of affected area and losses of major crops due to disasters during 2009-14

Division/District	Paddy		Potato		Wheat/ Maize		Jute	
	Affected land (acre)	Value (in Million tk)	Affected Land (acre)	Value (in Million Tk.)	Affected land (acre)	Value (in Million Tk.)	Affected land (acre)	Value (in Million Tk.)
1	2	3	4	5	6	7	8	9
Jhalokati	17427	267.50	413	5.09	569	1.70	206	15.42
Patuakhali	78604	1471.60	95	1.09	0	0.00	0	0.00
Pirojpur	16545	288.64	556	24.73	85	0.78	197	3.62
Chittagong Divition	189138	4369.01	1591	24.53	1201	10.60	599	40.96
Bandarban	1139	25.57	126	3.61	3	0.02	0	0.01
Brahmanbaria	3507	91.47	12	0.35	69	1.39	24	1.55
Chandpur	24797	495.98	970	10.83	98	1.46	535	37.35
Chittagong	31763	702.82	309	4.73	25	0.41	8	0.19
Comilla	15277	295.47	22	1.14	641	5.32	2	0.14
Cox's Bazar	3410	83.44	27	0.88	0	0.00	0	0.00
Feni	26832	668.44	1	0.01	9	0.13	0	0.00
Khagrachhari	5154	93.84	4	0.14	35	1.09	0	0.00
Lakshmipur	7848	89.80	10	0.40	230	0.30	2	0.07
Noakhali	68436	1809.46	110	2.44	91	0.46	28	1.66
Rangamati	976	12.71	0	0.00	0	0.00	0	0.00

5.1.5 Potential DRR Measures and Cost

This section will include the potential DRR measures to address both hazard and vulnerability for a particular area of interest. The sectoral issues will be considered during providing this generic measures. This list of possible measure will generate idea in the mind of the planning officials about possible DRR measures and enable them to cross check with the provided measures inside the DIA study.

The potential DRR measures will be listed out reviewing a number of published reports, journal or publications like CDMP reports, Third National Communication, National Adaptation Plan, Reports Published by the Department of Disaster Management, Nationwide Climate Vulnerability Report, Various Previous Reports of CEGIS, IWFM, Researchers and Academicians etc. Relevant strategic measures outlined in the Bangladesh Delta Plan 2100, Perspective Plan 2100 or 8th Five Year Plan will also be included. Relevant technical or regulatory guidelines and special Government directives will also be included or kept provision for future to update further.

For instances, following table represents the possible DRR measures very preliminary identified, which will be improved further during the study period:

Hazard	Components	Possible DRR Measures
Flood	Time of occurrence	Strengthened Early-warning systems
		Dissemination of flood forecasting news at the root level over digital platforms
	Inundation Depth	Plinth level of the infrastructures above historically highest inundation depths
	Inundated Area	Enhanced flood protection over historically highest inundated areas

Hazard	Components	Possible DRR Measures
	Flood Duration	Enhanced Flood Tracking and Propagation system
		Coordinated Emergency Response and Rescue and Recovery during and post flood period
	River Erosion	Increased carrying capacity and drainage of canals and rivers by dredging
		Appropriate flood protection (Dam, Embankment) and drainage schemes
	Agricultural Lands	Elevated seed bed
		Floating Agriculture Method
		Flood resistant crop harvesting
	Livestock and Fisheries	Elevated platforms for keeping livestock's safe
		Barrier around fish ponds.
		Reservoir based fisheries system
	Infrastructural vulnerability	Establishing infrastructures considering characteristics of flood on that area
		Providing assistance in re-establishing infrastructures (houses, roads etc.)
	Access to necessary utility facilities	Emergency lighting facilities
		Emergency fuel supply
	Availability of Food and Drinking Water	Proper distribution of drinking water and relief goods
	Sanitation Facilities	Establishment of mobile sanitation facilities
	Medical Facilities	Emergency medical facilities with free distribution of drugs
	Profession	Capacity building among affected people for switching to alternate profession
Cyclone and Storm Surge	Time of occurrence	Strengthened Early-warning and Cyclone forecasting systems
	Wind	Max wind speed considered as per BNBC
	Surge Height	Plinth level of the infrastructures above historically highest inundation depths.
	Surge Area	Enhanced cyclone protection over historically highest inundated areas
	Salinity Intrusion	Thicker covering around infrastructures
		Apprropiate polder height and extent in the coastal region
		Modular Construction of infrastructures
	Agricultural Lands	Elevated seed bed
		Cyclone resistant crop harvesting
	Livestock and Fisheries	Elevated platforms for keeping livestock's safe
		Barrier around fish ponds.
		Reservoir based fisheries system.
	Population	Establishment of multipurpose cyclone shelters
	Infrastructural vulnerability	Establishing infrastructures considering characteristics of Cyclone on that area
		Providing assistance in re-establishing infrastructures (houses, roads etc.)
	Access to necessary utility facilities	Emergency lighting facilities
		Emergency fuel supply

Hazard	Components	Possible DRR Measures
	Availability of Food and Drinking Water	Proper distribution of drinking water and relief goods
	Sanitation Facilities	Establishment of mobile sanitation facilities
	Medical Facilities	Emergency medical facilities with free distribution of drugs.
	Profession	Capacity building among affected people for switching to alternate profession during post cyclone period.
Drought	Time of occurrence	Strengthened Early-warning Drought monitoring system
		Dissemination of drought forecasting news at the root level over digital platforms
	Drought Affected Area	Enhanced precaution over historically highest drought affected areas
	Drought Duration	Coordinated Emergency Response and Rescue and Recovery during and post drought period
	Agriculture	Strengthening field bunds to conserve more rain water
		Adopting drought- resistant crops
		Adopting Water-efficient irrigation system
		Minimizing wastage of water during crop production
		Emergency irrigation facilities for the farmers
		Increase of Wetland.
		Enhanced public awareness by arranging Training Programs, Workshops, and Group Discussions at the root level
	Livestock and Fisheries	Adopting Water-efficient livestock rearing and farming system
		Adopting livestock foods requiring minimum water
		Adopting small scale livestock food production program
		Usage of stored rainwater for livestocks during drought
		Emergency livestock feed supply during post-disaster period
	Infrastructural vulnerability	Drought proofing to reduce cracking in earthen infrastructures
	Availability of Food and Drinking Water	Proper distribution of drinking water and relief goods
	Medical Facilities	Emergency medical facilities with free distribution of drugs
	Profession	Capacity building among affected people for switching to alternate profession
Thunderstorm	Time of occurrence	Strengthened Early-warning and Thunderstorm forecasting systems
		Dissemination of Thunderstorm forecasting news at the root level over digital platforms
	Surge Height	Plinth level of the infrastructures above historically highest inundation depths.
	Surge Area	Enhanced cyclone protection over historically highest inundated areas
	Duration of Storm	Enhanced Thunderstorm Tracking and Propagation system.
		Coordinated Emergency Response and Rescue and Recovery during and post disaster period.
		Elevated seed bed

Hazard	Components	Possible DRR Measures
	Agricultural Lands	Thunderstorm resistant crop harvesting
	Livestock and Fisheries	Elevated platforms for keeping livestock's safe
		Barrier around fish ponds.
		Reservoir based fisheries system.
	Infrastructural vulnerability	Establishing infrastructures considering characteristics of Thunderstorm on that area.
		Planting coconut and palm trees around infrastructures
		Providing assistance in re-establishing infrastructures (houses, roads etc.)
	Access to necessary utility facilities	Emergency lighting facilities
		Emergency fuel supply
	Availability of Food and Drinking Water	Proper distribution of drinking water and relief goods
	Medical Facilities	Emergency medical facilities with free distribution of drugs during post disaster period.
Earthquake	Time of occurrence	Strengthened Early-warning systems
		Dissemination of probable earthquake forecasting news at the root level over digital platforms
	Magnitude	Establishment of Earthquake Magnitude Tracking system
	Infrastructural vulnerability	Establishing infrastructures considering occurrence of Earthquake on that area.
		Providing assistance in re-establishing damaged or cracked infrastructures (houses, bridges, roads etc.)
	Population	Coordinated Emergency Response, Rescue and Recovery during and post disaster period
		Proper distribution of relief goods
Flash Floods	Time of occurrence	Establishment of Early-warning Flash Flood forecasting system
		Dissemination of flash flood forecasting news at the root level over digital platforms
	Inundation Depth	Plinth level of the infrastructures above historically highest inundation depths.
	Inundated Area	Enhanced flood protection over historically highest inundated areas
	Flood Duration	Establishing Flash flood Tracking and Propagation system
		Coordinated Emergency Response, Rescue and Recovery during and post flash flood period.
	Agricultural Lands	Early harvesting of crops
		Farming crops of short maturing period
		Elevated seed bed
		Floating Agriculture
		Submersible embankments around agricultural fields.
		Flood resistant crop harvesting
	Livestock and Fisheries	Elevated platforms for keeping livestock's safe
		Caged fisheries during flash flood.
		Barrier around fish ponds.

Hazard	Components	Possible DRR Measures
		Reservoir based fisheries system
	Infrastructural vulnerability	Establishing infrastructures considering characteristics of flash flood on that area.
		Providing assistance in re-establishing infrastructures (houses, roads etc.)
	Access to necessary utility facilities	Emergency lighting facilities
		Emergency fuel supply
	Availability of Food and Drinking Water	Proper distribution of drinking water and relief goods
	Sanitation Facilities	Establishment of mobile sanitation facilities during post flash flood period
	Medical Facilities	Emergency medical facilities with free distribution of drugs
	Profession	Capacity building among affected people for switching to alternate profession during flash flood.
Storm Surge	Time of occurrence	Strengthened Early-warning and Storm surge forecasting systems
	Wind	Max wind speed considered as per BNBC
	Surge Height	Plinth level of the infrastructures above historically highest inundation depths.
	Surge Area	Enhanced cyclone protection over historically highest inundated areas
	Salinity Intrusion	Thicker covering around infrastructures
		Modular Construction of infrastructures
	Agricultural Lands	Elevated seed bed
		Storm surge resistant crop harvesting
	Livestock and Fisheries	Elevated platforms for keeping livestock's safe
		Barrier around fish ponds.
		Reservoir based fisheries system.
	Infrastructural vulnerability	Establishing infrastructures considering characteristics of Storm surge on that area.
		Rehabilitating polders on coastal area.
		Providing assistance in re-establishing infrastructures (houses, roads etc.)
	Access to necessary utility facilities	Emergency lighting facilities
		Emergency fuel supply
	Availability of Food and Drinking Water	Proper distribution of drinking water and relief goods
	Medical Facilities	Emergency medical facilities with free distribution of drugs.
	Profession	Capacity building among affected people for switching to alternate profession
Landslides	Time of occurrence	Strengthened Early-warning and Landslides forecasting systems
	Region of occurrence	Precautionary measures in forecasted region for occurance of landslides
		Rehabilitating people of the landslide vulnerable region
		Establishing infrastructures considering characteristics of Landslides on that area.

Hazard	Components	Possible DRR Measures
	Infrastructural vulnerability	Providing assistance in re-establishing infrastructures (houses, roads etc.)
	Agricultural Lands	Choosing less landslide susceptible lands for agriculture
	Livestock and Fisheries	Choosing less landslide susceptible lands for livestock farming and fisheries.
	Availability of Food and Drinking Water	Proper distribution of drinking water and relief goods
	Sanitation Facilities	Establishing emergency sanitation facilities
	Medical Facilities	Emergency medical facilities with free distribution of drugs during post disaster periods
Hailstorm	Time of occurrence	Strengthened Early Hail storm warning system.
		Dissemination of Hail storm forecasting news at the root level over digital platforms
	Intensity	Establishment of Hailst rom intensity Tracking system.
	Duration	Coordinated Emergency Response, Rescue and Recovery during and post hail storm period.
	Agricultural Lands	Early harvesting of crops
		Using frost blanket, cloche or row cover material (not plastic) to insulate the ground around plants during hailstorm.
		Hailstorm resistant crop harvesting
	Livestock and Fisheries	Using frost blanket, cloche or row cover material to insulate the livestock animals
		Proper medical precautions following the guidance of veterinary doctor
	Infrastructural vulnerability	Establishing infrastructures considering characteristics of hailstorm on that area.
Cold Snap	Time of occurrence	Strengthened Early Cold snap warning system.
		Dissemination of Cold snap forecasting news at the root level over digital platforms
	Duration	Coordinated Emergency Response,Rescue and Recovery during and post cold snap.
	Agricultural Lands	Early harvesting of crops
		Using frost blanket, cloche or row cover material (not plastic) to insulate the ground around plants during cold snap.
		Cold-snap resistant crop harvesting
	Livestock and Fisheries	Using frost blanket, cloche or row cover material to insulate the livestock animals during cold snap
		Arranging dry bedding for the livestock using gunny bags,plastic,straw etc.
		Arranging heat lamps, bulbs to keep the livestock warm.
		Proper medical precautions following the guidance of veterinary doctor
	Infrastructural vulnerability	Using Cold-snap proofing materials around the infrastructures.
	Medical Facilities	Emergency medical facilities with free distribution of drugs.
	Profession	Capacity building among affected people for switching to alternate home based profession during cold-snap

The cost estimation of DRR measures is very important to understand the economic viability of measures. The study team will provide some of the preliminary identified per unit cost of DRR measures reviewing past reports and literatures. The gaps in the cost can be updated in future development stage of the DRIP.

5.1.6 Resilience Information

Existing resilience assessment is one of the important steps of the DIA guidelines. DRIP will integrate this including two types of information i.e. giving ideas of existing emergency management plan and possible recovery times.

For instances we already have Disaster Preparedness and Management Guidelines like Flood Response Preparedness Plan 2015, Early Recovery Guiding Principles, Cyclone Preparedness Plan 2016, Cyclone Shelter, Flood Shelter, Resilient House, Embankment, Solar Home System etc. Construction Guidelines, Emergency Response related Documents like Humanitarian Assistant Operational Manual, Emergency preparedness Plan for Cyclone etc. Further a several guidelines and technical notes have been developed under the different phases of the Comprehensive Disaster Risk Management Programs, which will also be explored to extract relevant information to support this section.

The study team will review relevant past reports, guidelines, and publications to provide these two types of information. Certain gaps of this information can be updated even later gradually through out the development process of DRIP.

5.1.7 Residual Risk Information

Provision will made to insert residual risk information for future.

5.1.8 Glossary

This page will list down the glossary of some of the noteworthy terminologies to facilitate understanding the Disaster Risk Information, which are as following, but not limited to:

Hazard, Exposure or Elements at Risk, Sensitivity, Adaptive Capacity, Vulnerability, Impact, Risk (Quantitative and Qualitative), Disaster Mitigation, Disaster Preparedness, Disaster Risk Reduction, Response and Recovery, Resilience, Build Back Better, Climate Change, Climate Change Adaptation, Climate Change Mitigation, RCPs etc.

5.1.9 Relevant Important Documents and Links

This section will upload and hold the relevant important documents which will be useful to the project proponents or planning officials to understand the context, science and development with respect to the Disaster Risk Reduction (DRR). Both national and international documents will be included in this page as following:

National Important Documents:

- Disaster Impact Assessment (DIA) Guidelines
- Standing Order on Disaster, 2019
- Disaster Management Act, 2012
- National Disaster Management Policy (2016-2020)

- Disaster Preparedness and Management Guidelines like Flood Response Preparedness Plan 2015, Early Recovery Guiding Principles, Cyclone Preparedness Plan 2016
- Cyclone Shelter, Flood Shelter, Resilient House, Embankment, Solar Home System etc. Construction Guidelines
- Emergency Response related Documents like Humanitarian Assistant Operational Manual, Emergency preparedness Plan for Cyclone etc.
- Bangladesh Climate Change Strategy and Action Plan
- National Adaptation Plan
- Third National Communication
- Nationwide Climate Vulnerability Assessment Report
- Multi-Hazard Risk and Vulnerability Assessment, Modeling and Mapping
- Bangladesh Delta Plan 2100
- Perspective Plan 2041
- 8th Five Year Plan

Global Important Documents:

- Sendai Framework for the Disaster Risk Reduction
- Paris Agreement
- Kyoto Protocol
- Latest IPCC Reports

Links:

Further, various important DRR related national and international web portal links will be attached in this page. For instances:

- Global Risk Information Platform
- UNDRR
- UNISDR
- IPCC
- UNFCCC
- DDM
- BBS
- Planning Commission
- WARPO
- BARC
- LGED GIS MIS
- RHD RMMS
- DoE
- etc

5.1.10 SDG Goals

This section will include the list of SDG goals and targets particularly set by the Bangladesh Government. The link (http://www.sdg.gov.bd/) of the SDG tracker website will be given in this page.

5.1.11 Data Extraction and Download

This option will enable user to view meta data of the selected datasets, attribute of the datasets and allow user to extract maps or share directly with popular web services.

5.1.12 Advance Tools

This section will contain some of the advance features to analyse and prepare maps in different styles from user end. To support that, query builder will be integrated into the advance tools along with the plot or graph generator tools. These tools will enable user to select certain parameters from drop down list and certain functionality of analysis through building a query in the query builder. For instances, overlaying upazilla boundary, analysing hazard, exposure, vulnerability and risk, extracting risk information with the selected boundary or given boundary providing coordinates in a bounding box. This will enable user to analyse different statistics of loss and damages and create charts or plots, print it and download it.

5.1.13 Project Development and Appraisal Tool

This section will hold the project development and appraisal tool to facilitate the project proponents during project development and planning officials during project appraisal with respect to the DIA framework. The developed DIA guideline has outlined following six steps whose information will be needed to include inside the Disaster Impact Assessment (DIA) report by the project proponent during feasibility stage or the availability of those specific information will be needed to be checked by the planning officials to appraise the proposed project:

a) Locating the project on hazard map
b) Identifying impact of hazards
c) Listing proposed countermeasures
d) Assessment of resilience
e) Estimating the cost of DRR measures
f) Reporting residual risk

The project development and appraisal tool of the DRIP will enable project proponent or planning officials to view in a pop-up window and generate report addressing the above-mentioned steps.

This tool will allow users to navigate to the project location entering the latitude and longitude in a bounding box or directly selecting from the maps or selecting the administrative boundaries of the project from the drop-down list. Once the project location information will be entered, the viewer map will be zoomed into the particular project location area. Flexibility of zoom in or zoom out to capture surrounding area of the project location will be there.

Once the project location or domain has been set, the users will be allowed to select once individual hazard or multi-hazards for different return periods to see the physical risk level of individual or multi-hazards. The user will be able to select historical disaster extent as well to understand the past occurrence of disasters particularly in that area.

Once the hazard will be selected, the users will be navigated to select the exposure and vulnerabilities in similar way. The selection of vulnerabilities will depend upon the sectoral issues. Like exposure for Agriculture will be different from Infrastructure sectors. The navigation by default will show the list of exposures and vulnerabilities separately for two sectors. Vulnerabilities means the information of sensitivity and adaptive capacity.

After selecting all three elements of disaster risk i.e. hazard, exposure and vulnerability, the risk due to individual or multi hazard will be calculated at the backend of the web and the color-coded map will be shown in map viewer with risk classes in the legend.

On the basis of the selection of hazards, exposures and vulnerability, the other 3 required information i.e. listing proposed countermeasures for DRR and its cost, available resilience and residual risk related information along with relevant technical and regulatory guidelines and special directives by the Government will be dynamically linked with the project risk information attribute at the backend of the web. However, flexibility will be given to select or deselect the option to make that information visual along with the risk level information.

Once all analysis and mapping has been done a pop-up window will appear with selected items and information as like following when the user will click on the project location:

DRI Element	Probability		Climate Change Scenarios	
	50%	20%	RCP4.5 (2050s)	RCP8.5 (2050s)
Hazard Information	**Hazard (Extent and Depth) Intensity**			
Flood	Medium	High	Medium	High
Drought	Low	Medium	Low	Medium
Storm Surge	High	Very High	High	Very High
Exposure Information	**Exposure Severity**			
Aged Population	High	Very High	Medium	High
Critical Infrastructure	Low	Low	Low	Low
Loss of Crop Land	High	High	High	High
Agri. Yield Loss	High	High	High	High
Risk Information	**Risk Level**			
Flood	High	Very High	Medium	High
Drought	Low	Low	Low	Low
Storm Surge	High	High	High	High
Multi Hazard Risk	High	Very High	Medium	High
Possible Ideas of DRR or CCA Measures	• Elevated Seed bed • Repair and Maintenance of Cyclone Shelter • Strengthening early warning and Dissemination System • Research and Development of Stress Tolerant Varieties			
Relevant Design Standard of Measures	• Seed bed formation level at least greater than design flood level 8 m PWD • Design wind speed should be at least 100 km/hr (BNBC) • Early warning lead time should be at least 3-4 days			

Figure: Sample pop-up window for visualization of risk information clicking on the project location

Further a pdf viewer will appear including all mentioned information in a report including the current extent map of hazard, exposure, vulnerability and risk after clicking on generate DRI report. Consequently, a report will be generated containing all mentioned information and maps. The preliminary illustration of the DRIR (Disaster Risk Information Report) is as following:

Disaster Risk Information for DIA Appraisal/Project Development

This report summaries the disaster risk information generated from the Disaster Risk Information Platform (DRIP) for supporting the project development/DIA appraisal process.

Any information provided by this report will give planners/project developers/evaluators to get an overarching idea on disaster or climate change risk based on available published literatures or research papers from different authentic sources.

To learn more about the definition of different terminologies or risk classification used in this report please visit: www.drip.gov.bd/glossary

Project Information

Project Name	Name of the project to be inserted by the user
Sector	Agriculture/Infrastructure to be selected by the user from dropdown list
Description	About the project area to be inserted by the user

Project Location

Project Area	The Upazilla Name to be selected by the User from dropdown list or selecting through providing coordinates of a bounding box
	District Name
	Division Name

The map below shows the selected project area:

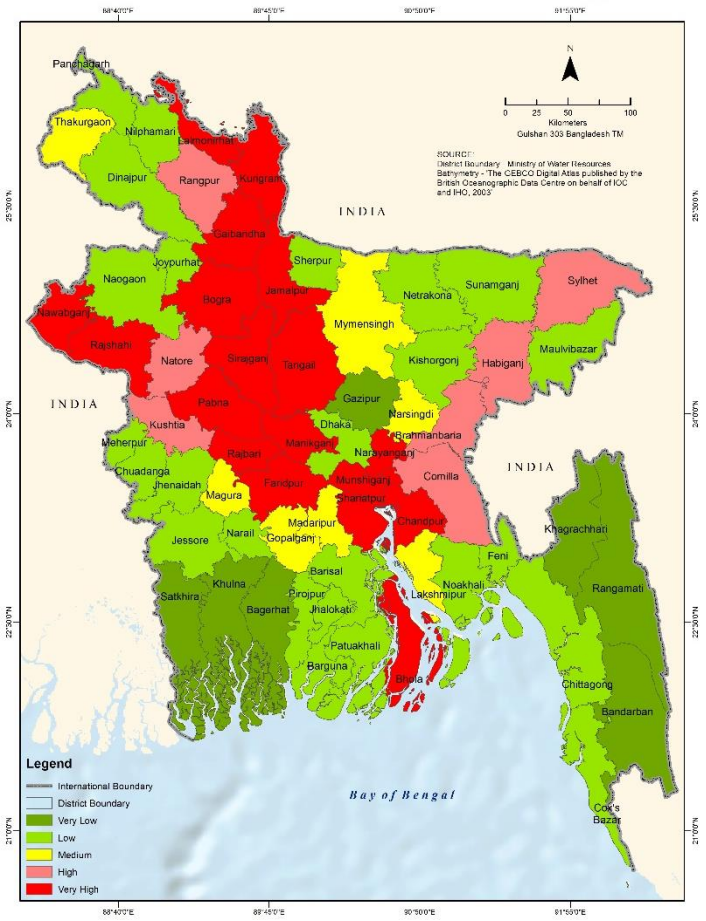
[About Contents: The map will contain base layers like administrative boundaries, rivers, roads, waterbodies, agriculture areas, settlements, head-quarters, growth center, police stations, educational institutes (school, college, madrasha, university etc), social services facilities like rural market, medical center/community clinic/institutes, hospital, godown etc. The map will be a zoomed layout of the selected project boundary and any above mentioned basic elements will be illustrated for the surrounding buffer areas, if exist.]

Disaster Risk Information

Hazard

[About Contents: This section will print the zoomed to project area maps for both historical events (if any particularly for selected area) and corresponding hazard color coded risk map with risk level for each of the selected hazards. The risk map may contain the overlaid very basic layers like roads, rivers, head quarters, growth center and police stations or other exposure elements selected by the user. If user does not select these exposure or basic layers, the map will be printed with administrative boundary only for the selected project area]

For instances, if user selects flood hazard, following map will be printed with a zoomed view of the project area:



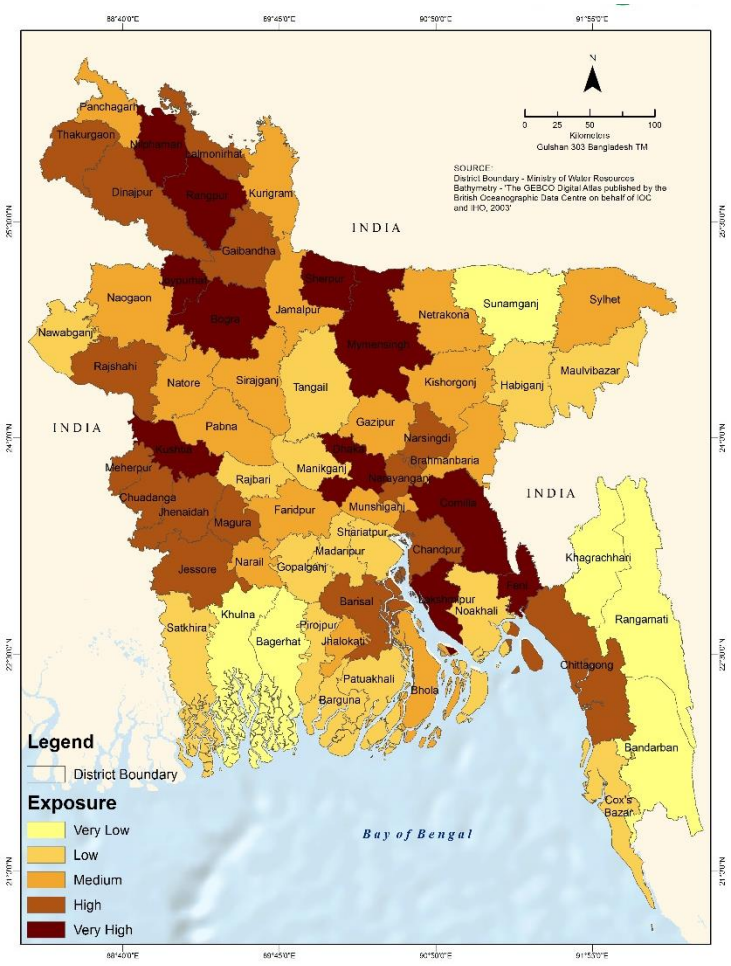
If user selected multiple hazards, multiple hazard maps will be printed separately.

If user selected multi-hazards, then multi-hazard maps will also be printed. The source of the maps will be printed on the maps.

Exposure

[About Contents: This section will print the zoomed to project area color coded maps for exposure or elements at risk map with level of exposure for each of the selected hazards. The exposure map may contain the overlaid very basic layers like roads, rivers, head-quarters, growth center and police stations or other exposure elements selected by the user. If user does not select these exposure or basic layers, the map will be printed with administrative boundary only for the selected project area]

For instances, the following map shows exposure due to storm surge, while user selected to know exposure risk information for storm surge:

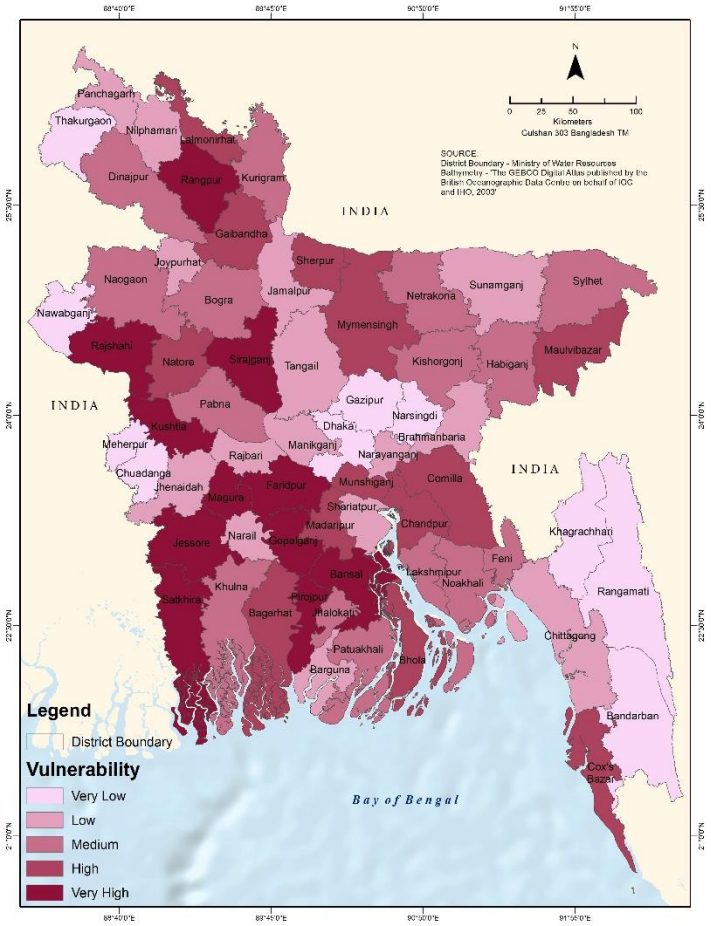


If user selected multiple hazards, multiple exposure maps will be printed separately. The source of the maps will be printed on the maps.

Vulnerability

[About Contents: This section will print the zoomed to project area color coded maps for vulnerability with level of vulnerability for each of the selected hazards. The vulnerability map may contain the overlaid very basic layers like roads, rivers, head-quarters, growth center and police stations or other exposure elements selected by the user. If user does not select these exposure or basic layers, the map will be printed with administrative boundary only for the selected project area]

For instances, the following map shows vulnerability due to flood, while user selected to know exposure risk information for flood:

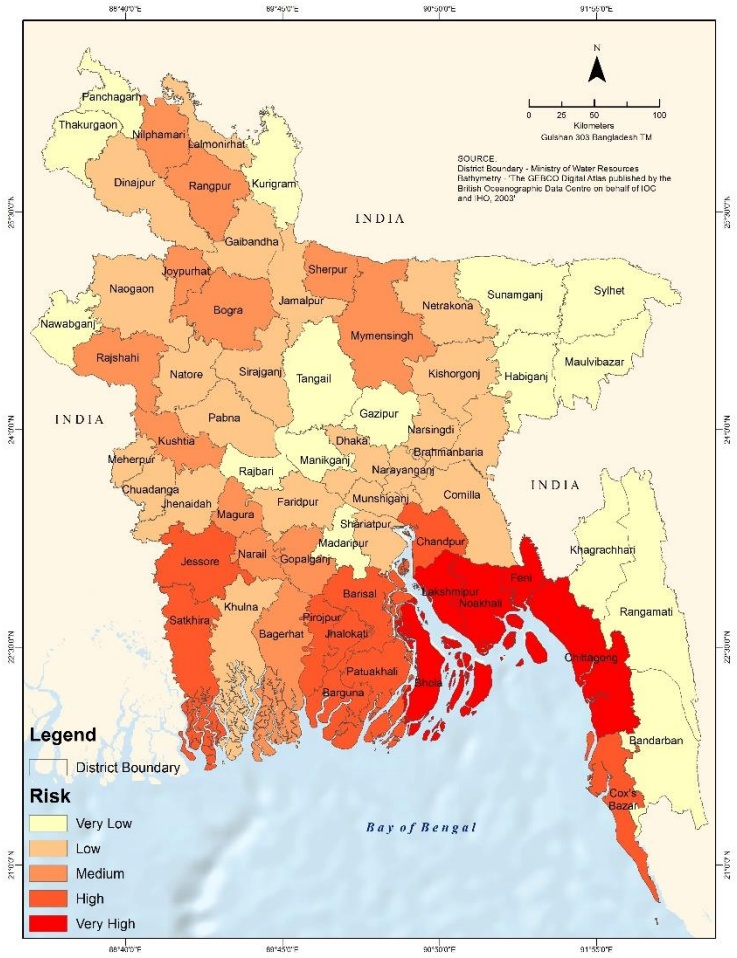


If user selected multiple hazards, multiple vulnerability maps will be printed separately. The source of the maps will be printed on the maps.

Risk

[About Contents: This section will print the zoomed to project area color coded risk maps with level of risk for each of the selected hazards. The risk map may contain the overlaid very basic layers like roads, rivers, head-quarters, growth center and police stations or other exposure elements selected by the user. If user does not select these exposure or basic layers, the map will be printed with administrative boundary only for the selected project area. The user will be able to select any historical loss and damages related maps available here to understand the quantitative risk for the area of interest]

For instances, the following map shows risk due to storm surge, while user selected to know exposure risk information for storm surge:



If user selected multiple hazards, multiple risk maps will be printed separately.

If user selected multi-hazards risk map, then multi-hazard risk map will also be printed. The source of the maps will be printed on the maps.

Summary Risk Information

The summary information will be like following table:

DRI Element	Probability		Climate Change Scenarios	
	50%	20%	RCP4.5 (2050s)	RCP8.5 (2050s)
Hazard Information	**Hazard (Extent and Depth) Intensity**			
Flood	Medium	High	Medium	High
Drought	Low	Medium	Low	Medium
Storm Surge	High	Very High	High	Very High
Exposure Information	**Exposure Severity**			
Aged Population	High	Very High	Medium	High
Critical Infrastructure	Low	Low	Low	Low
Loss of Crop Land	High	High	High	High
Agri. Yield Loss	High	High	High	High
Risk Information	**Risk Level**			
Flood	High	Very High	Medium	High
Drought	Low	Low	Low	Low
Storm Surge	High	High	High	High
Multi Hazard Risk	High	Very High	Medium	High

Key Message and Considerations Need to Note from Risk Information

The disaster risk information depict that the project is located in a region which has experienced recurring major flood and river erosion events in the recent past and it falls under high risk zone. Therefore, following key considerations need to note/consider for this project location:

- **Q1:** Would the expected performance and maintenance of the project be impaired by flooding?
- **Q2:** Is there a plan to integrate climate change into a flood risk assessment for the project?
- **Q3:** Will the project include continuity plans which make provision for continued successful operation in the event of floods?
- **Q4:** Is the project located in the risk buffer zone of river erosion?
- **Q5:** Is there any possibility of the project to be affected by erosion in near future? If yes, what would be the mitigation measures?
- **Q6:** Is there a plan to integrate climate change into a river erosion risk assessment for the project?

[This key consideration or general guidance will be based on selected hazards. If user selects multi-hazards, the list will be combined list with respect to multi hazards]

Possible DRR measures and Cost

[About Contents: This section will print the list of possible countermeasures for Disaster Risk Reduction to generate ideas about possible measures for the area of interest and considering the selected hazard and vulnerability]

For instances, if user selects flood hazard, the potential counter measures with tentative per unit cost will be as following:

Hazard	Components	Possible DRR Measures	Tentative Per Unit Cost
Flood	Time of occurrence	Strengthened Early-warning systems	
		Dissemination of flood forecasting news at the root level over digital platforms	
	Inundation Depth	Plinth level of the infrastructures above historically highest inundation depths	
	Inundated Area	Enhanced flood protection over historically highest inundated areas	
	Flood Duration	Enhanced Flood Tracking and Propagation system	
		Coordinated Emergency Response and Rescue and Recovery during and post flood period	
	River Erosion	Increased carrying capacity and drainage of canals and rivers by dredging	
		Appropriate flood protection (Dam, Embankment) and drainage schemes	
	Agricultural Lands	Elevated seed bed	
		Floating Agriculture Method	
		Flood resistant crop harvesting	
	Livestock and Fisheries	Elevated platforms for keeping livestock's safe	
		Barrier around fish ponds.	
		Reservoir based fisheries system	
	Infrastructural vulnerability	Establishing infrastructures considering characteristics of flood on that area	
		Providing assistance in re-establishing infrastructures (houses, roads etc.)	
	Access to necessary utility facilities	Emergency lighting facilities	
		Emergency fuel supply	
	Availability of Food and Drinking Water	Proper distribution of drinking water and relief goods	
	Sanitation Facilities	Establishment of mobile sanitation facilities	
	Medical Facilities	Emergency medical facilities with free distribution of drugs	
	Profession	Capacity building among affected people for switching to alternate profession	

*If cost not available for non-structural measures or for any structural measures, that will be mentioned in remarks and may be updated in due course of time

Resilience Information

[About Contents: This section will print any available resilience related information presently existing for the project area or system of interest in terms of emergency response plan, historical recovery time for summarized risk information and selected hazards.]

For instances, for Cyclone or storm surge, Standing Order on Disaster (2019) can be mentioned.

Available Technical or Regulatory Guidelines

[About Contents: This section will print any available technical or regulatory guidelines for major DRR measures]

For instances, wind speed considerations or Richter scale considerations for construction of infrastructures as per BNBC in high risk cyclone prone or earthquake prone areas respectively.

Government Directives

[About Contents: This section will print any available noteworthy government directives to tackle any hazards or disasters]

For instances, any permanent infrastructure development inside the erosion prone risk areas or in floodplains are strictly prohibited as per Bangladesh Water Act or Government is emphasizing storm surge protection related infrastructure projects as a priority intervention.

Residual Risk Information

[About Contents: This section will print any available residual risk information. Provision will be made to update this information as there will be ample opportunity to update this information from the DIA study, where specifically this information should be contained in terms of pre project and post project condition impact and risk modeling]

For instances, the risk will be reduced from high to medium if these suggested DRR measures implemented.

Disclaimers

[About contents: This section will print some of the basic disclaimer to use this report generated from the DRIP]

For instances,

- This DRIP report may contain advice, opinions and statements of various information providers. The DRIP does not represent or endorse the accuracy or reliability of any advice, opinion, statement or other information provided by any information provider, any User of this Site or any other person or entity. Reliance upon any such advice, opinion, statement, or other information shall also be at the Users own risk.
- Neither the DRIP nor its affiliates, nor any of their respective agents, employees, information providers or content providers, shall be liable to any User or anyone else for any inaccuracy, error, omission, interruption, deletion, defect, alteration of or use of any content herein, or for its timeliness or completeness, nor shall they be liable for any failure of performance, computer virus or communication line failure, regardless of cause, or for any damages resulting therefrom.

5.1.14 Linked Past Initiatives

This section will consist of hyperlinks of past similar kind of initiatives containing disaster risk information. Like A2i Programme, Nationwide Climate Vulnerability Assessment, Multi-Hazard Risk and Vulnerability Atlas, Online Climate Change Database of DoE, Planning Information System (PLIS), Delta Knowledge Portal, Climate Risk and Vulnerability Assessment etc.

5.1.15 Frequently Asked Questions

This section will contain a number of Frequently Asked Questions (FAQ) and their easy understandable short answers to meet some of the very general queries usually arise by the user for this kind of web platform. For instances some FAQ may be as following, but not limited to:

- What is the purpose of DRIP?
- How to appraise the projects using information of DRIP?
- How to access or downloads the datasets of DRIP?
- What are the terms of use of DRIP?
- How risk mapping has been performed in the DRIP?
- How to cite the DRIP for reporting?

5.1.16 About DRIP

This About section will hold following six sub-sections:

- Aim
- Objectives
- Data Sources
- Host of DRIP
- Partners
- Technology

Aim

This sub-section will state the aim of this Disaster Risk Information Platform. The vision statement can be as following:

“The Digital Risk Information Platform (DRIP), a specialized software application, aims to strengthen the institutional capacity of the Government of Bangladesh for assessing, understanding and communicating disaster and climate related risks, with the goal of integrating disaster risk information into development planning & budgeting, policies and programs”

Objectives

This sub-section will be outlined objectives of the DRIP. The objectives of the DRIP can be as following:

- Integrate disaster and climate risk information into development projects, plans, programs and policies to ensure risk-informed public investment;
- Facilitate access to risk information from a common platform;

– Assist the Planning Officials in different ministries with available risk information in different sectors

Data Sources

This sub-section will present a list of data and information providers and acknowledge their contribution to prepare the DRIP.

Host of DRIP

This sub-section will describe about the host of the DRIP who are involved in planning, implementation and maintenance of the DRIP.

Partners

This sub-section will spell out the name of the supporting partners with logo to acknowledge their contribution.

Technology

This sub-section will list down the hyperlinked of technologies used in the DRIP in the frontend, system dependencies and code. For instances some common technologies are:

- OpenGeo Suite (PostgreSQL, PostGIS, GeoServer, Geowebcache, OpenLayers, GeoExt)
- PHP
- CSS3
- amCharts
- OpenLayers
- Openstreet map
- GeoNode
- Jquery
- Bootstrap
- Javascript
- Ajax
- Python and etc.

5.1.17 User Guidelines

DRIP User Guidelines

This section will hold developed DRIP user guidelines for project development and DIA appraisal. The developed DRIP user guidelines will outline the each and every navigation step to follow with infographics or diagram to generate the report including disaster risk information required to answer developed six questions of DIA Framework. The guideline will enable user to illustrate know how of generating the report and print or export or download the report in desired format.

Terms of Use and Disclaimers

Further this section will also contain the Terms of Use and Disclaimers to use the data and information generated from the DRIP. The copyright of the DRIP will be spelled out here. Any confidentially which should be maintained or any no guarantee clauses which are required will be included inside the Terms of Use and Disclaimer policy of DRIP.

5.1.18 Feedback of User

This section will allow external user to give their feedback through a feedback submission form as following:

If you are looking for personal contact, please find the email: ex@gmail.com or send your feedback directly with following form:

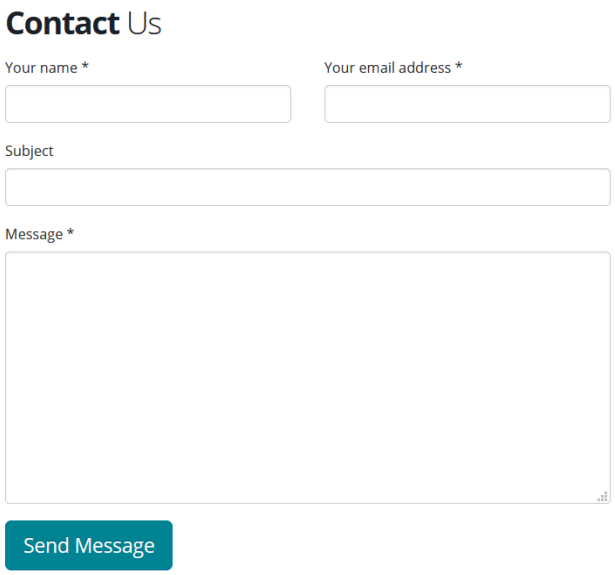


Figure: User Feedback Submission Form

5.2 Functional Business Requirement (FBR)

FBR-01: Log In

Requirement ID	FBR-01
Business Use Case Number	FBUC-001
Requirement Type	Component
Stakeholders(s)	DPP Creator, DPP Approval Authority, Planner, System Admin
Description/Business Logic	System should have authentication facilities that allow users to log in to the system using their credentials and have access to content allowed by the permissions defined in their account configurations.

FBR-02: Register

Requirement ID	FBR-02
Business Use Case Number	FBUC-002
Requirement Type	Component
Stakeholders(s)	DPP Creator, DPP Approval Authority, Planner
Description/Business Logic	System should have facilities to allow someone new to register an account into the system.

FBR-03: Add User

Requirement ID	FBR-03
Business Use Case Number	FBUC-003
Requirement Type	Component
Stakeholders(s)	System Admin
Description/Business Logic	System should have facilities to allow admin to add user accounts to the system.

FBR-04: View Information

Requirement ID	FBR-04
Business Use Case Number	FBUC-004
Requirement Type	Component
Stakeholders(s)	DPP Creator, DPP Approval Authority, Planner, System Admin
Description/Business Logic	System should have facilities to allow users to view data associated with Natural Disaster records visually presented on the map of Bangladesh based on past occurrences.

FBR-05: Search

Requirement ID	FBR-05
Business Use Case Number	FBUC-005
Requirement Type	Component
Stakeholders(s)	DPP Creator, DPP Approval Authority, Planner, System Admin
Description/Business Logic	System should have facilities to allow users to search data and find what they are looking for.

FBR-06: Upload Data

Requirement ID	FBR-06
Business Use Case Number	FBUC-006
Requirement Type	Component
Stakeholders(s)	System Admin
Description/Business Logic	System should allow admins to upload new data to the database.

FBR-07: Modify Data

Requirement ID	FBR-07
Business Use Case Number	FBUC-007
Requirement Type	Component
Stakeholders(s)	System Admin
Description/Business Logic	System should allow admins to modify currently existing data within the database.

FBR-08: View Metadata

Requirement ID	FBR-08
Business Use Case Number	FBUC-008
Requirement Type	Component
Stakeholders(s)	DPP Creator, DPP Approval Authority, Planner, System Admin
Description/Business Logic	System should have facilities to allow users to view metadata associated with data presented in the Information Viewer.

FBR-09: Perform Analysis

Requirement ID	FBR-09
Business Use Case Number	FBUC-009
Requirement Type	Component
Stakeholders(s)	DPP Creator, DPP Approval Authority, System Admin
Description/Business Logic	System should have facilities to allow users to perform various types of analysis on data.

FBR-10: Export Data

Requirement ID	FBR-10
Business Use Case Number	FBUC-010
Requirement Type	Component
Stakeholders(s)	DPP Creator, DPP Approval Authority, System Admin
Description/Business Logic	System should have facilities to allow users to export data in available formats.

FBR-11: Monitor Logs

Requirement ID	FBR-11
Business Use Case Number	FBUC-011
Requirement Type	Component
Stakeholders(s)	DPP Approval Authority, System Admin
Description/Business Logic	System should allow certain users to monitor logs related to other user's data exporting activities based on permissions associated with the account..

FBR-12: Delete Account

Requirement ID	FBR-12
Business Use Case Number	FBUC-012
Requirement Type	Component
Stakeholders(s)	DPP Creator, DPP Approval Authority, Planner
Description/Business Logic	System should have facilities to allow someone to delete an account from the system.

FBR-13: Edit Profile

Requirement ID	FBR-13
Business Use Case Number	FBUC-013
Requirement Type	Component
Stakeholders(s)	DPP Creator, DPP Approval Authority, Planner
Description/Business Logic	System should have facilities to allow someone to update an account's information on the system.

FBR-14: Activate/Deactivate Account

Requirement ID	FBR-14
Business Use Case Number	FBUC-014
Requirement Type	Component
Stakeholders(s)	System Admin
Description/Business Logic	System should have facilities to allow admins to activate or deactivate an account on the system.

FBR-15: Create Group

Requirement ID	FBR-15
Business Use Case Number	FBUC-015
Requirement Type	Component
Stakeholders(s)	System Admin
Description/Business Logic	System should allow admins to add new user groups to the database.

FBR-16: Edit Group

Requirement ID	FBR-16
Business Use Case Number	FBUC-016
Requirement Type	Component
Stakeholders(s)	System Admin
Description/Business Logic	System should allow admins to edit existing user groups on the database.

FBR-17: Assign Role to Group

Requirement ID	FBR-17
Business Use Case Number	FBUC-017
Requirement Type	Component
Stakeholders(s)	System Admin
Description/Business Logic	System should allow admins to assign roles to existing user groups on the database.

FBR-18: Activate/Deactivate Group

Requirement ID	FBR-18
Business Use Case Number	FBUC-018
Requirement Type	Component
Stakeholders(s)	System Admin
Description/Business Logic	System should allow admins to activate or deactivate existing user groups from the database.

FBR-19: Manage User-Group Distribution

Requirement ID	FBR-19
Business Use Case Number	FBUC-019
Requirement Type	Component
Stakeholders(s)	System Admin
Description/Business Logic	System should allow admins to manage user-group distributions within the database.

FBR-20: Monitor User Log History

Requirement ID	FBR-20
Business Use Case Number	FBUC-020
Requirement Type	Component
Stakeholders(s)	System Admin
Description/Business Logic	System should allow admin to monitor user log history.

5.3 System Requirement Specification (SRS)

Based on the users/stakeholder's demand, a system requirement specification has been prepared. This specification contains the functional requirements, user interface requirements, system features and non-functional requirements. A detail description of the above requirements has been given below:

5.3.1 Functional Requirements

Use Cases

UC-001: Log In

Use Case ID:	UC-001
BREQ ID:	FBR-01
User/Actors:	DPP Creator, DPP Approval Authority, Planner, System Admin
Detail Business Rule:	System should have authentication facilities that allow users to log in to the system using their credentials and have access

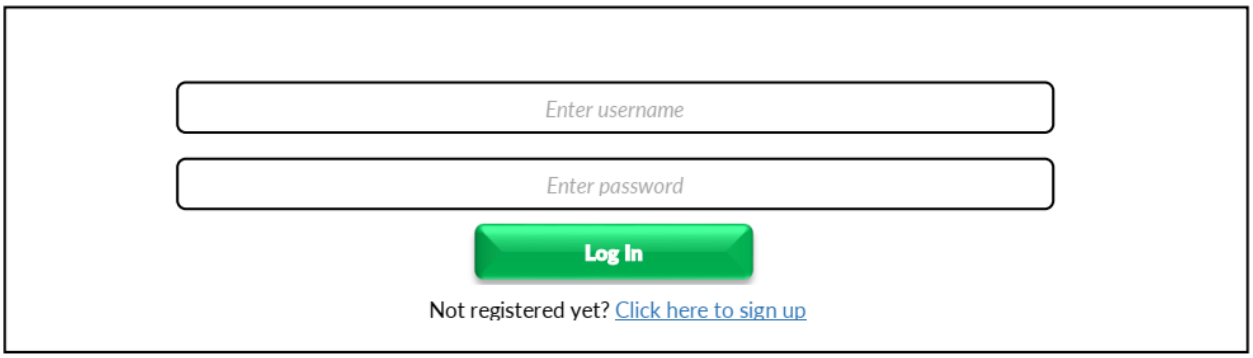
	to content allowed by the permissions defined in their account configurations.
Pre-Condition:	▪ User account must exist in the database for the user to be able to login to the system. ▪ User's registered account must be verified before the account can be logged into.
Main success scenario/steps	
Log In	
<<user>>	Clicks on "Log In".
<<system>>	Prompts the user for a username and password or to register a new account if the user does not already have one.
<<user>>	Enters username and password and then submits the form.
<<system>>	Creates a log of this event and checks if the user's account is active or not. Sets up the dashboard for an active user based on the user's type and associated permissions.
Post-Condition:	Dashboard will display user's information in the interface indicating a successful log in attempt. System would display an appropriate message to indicate any failed login attempt and ask the user to try again.
Alternative Courses/Exceptions	▪ When the user tries to submit an empty form the system would ask the user to fill up the form before submitting it. ▪ When the user inputs invalid information, the form would indicate why the input is invalid. ▪ When a deactivated user attempts to login, the system would notify the user that the account has been disabled and then provide contact information from where the user could collect more information or perhaps resolve the issue.

Data Requirements

Entity	Field Name	Data Type	Validation/Description
User Detail	UserId	INT	Auto-generated + unique
	UserRegistrationId	INT	Auto-generated + unique
	FullName	NVARCHAR	Mandatory

	FullNameBn Designation Address AddressBn SecurityQuestion Id SecurityQuestionAnswer IsProfileSubmitted	NVARCHAR NVARCHAR NVARCHAR NVARCHAR INT NVARCHAR BOOL	 Mandatory Mandatory Mandatory, Id of Question selected Mandatory True Or False
User Log History Detail	UserLogHistoryId UserId LoginDateTime MachineIPOrURL	INT INT DATE NVARCHAR	Auto-generated + unique Auto-generated + unique Auto-generated

Prototype



UC-002: Register

Use Case ID:	UC-002
BREQ ID:	FBR-02
User/Actors:	DPP Creator, DPP Approval Authority, Planner
Detail Business Rule:	System should have facilities to allow someone new to register an account into the system.
Pre-Condition:	▪ User account must not exist in the database for the user to be able to register a new account with the provided information. ▪ User must fill up all mandatory fields in the form.

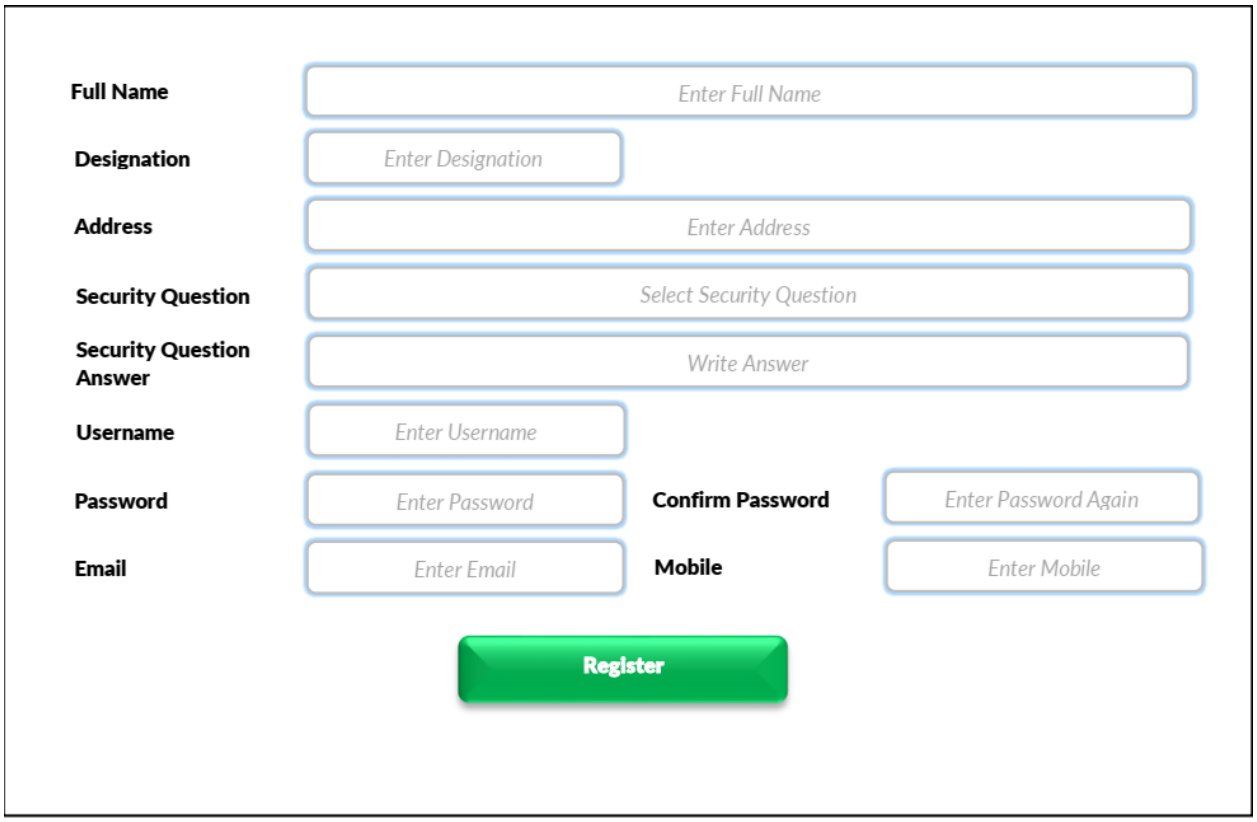
Main success scenario/steps	
Register	
<<user>>	Clicks on “Click here to sign up”.
<<system>>	Displays a form where the user is asked to provide detailed information for the account.
<<user>>	Enters all the information required in the form and then submits the form.
<<system>>	Verifies the information, creates the account and creates a log of this event. Asks user to verify the account.
<<user>>	Verifies the account.
<<system>>	Logs the user into the system automatically and creates another log of this event.
Post-Condition:	Dashboard will display user’s information in the interface indicating a successful registration attempt followed by a successful log in. System would display an appropriate message to indicate any failed registration attempt or login attempt and ask the user to try again.
Alternative Courses/Exceptions	▪ When the user tries to submit an empty form, the system would ask the user to fill up the form before submitting it. ▪ When the user inputs invalid information, the form would indicate why the input is invalid.

Data Requirements

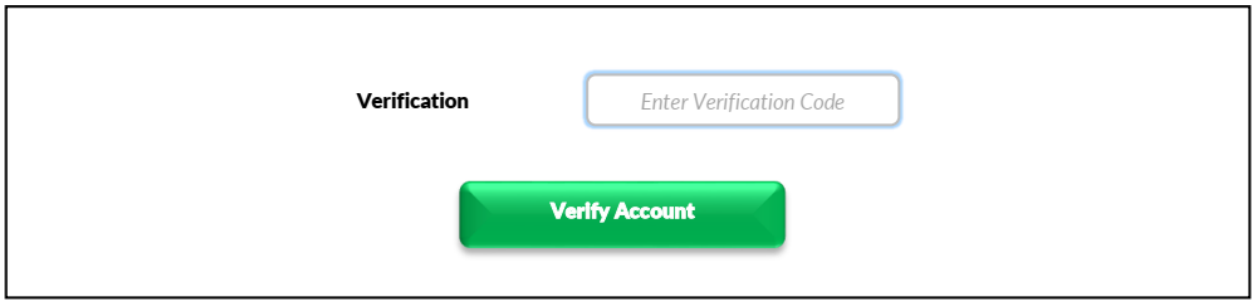
Entity	Field Name	Data Type	Validation/Description
User Registration Detail	UserRegistrationId	INT	Auto-generated + unique
	UserName	NVARCHAR	Mandatory + unique
	UserPassword	NVARCHAR	Mandatory + unique
	IsActive	BOOL	True or False
	UserEmail	NVARCHAR	Mandatory + unique
	UserMobile	NVARCHAR	Mandatory + unique
	DateOfCreation	DATE	Auto-generated
	LastModifiedDate	DATE	Auto-generated
	IsVerified	BOOL	True Or False
User Detail	UserId	INT	Auto-generated + unique
	UserRegistrationId	INT	Auto-generated + unique
	UserFullName	NVARCHAR	Mandatory
	UserFullNameBn	NVARCHAR	
	UserDesignation	NVARCHAR	Mandatory
	UserAddress	NVARCHAR	Mandatory
	UserAddressBn	NVARCHAR	
	SecurityQuestion Id	INT	Mandatory, Id of Question selected
	SecurityQuestionAnswer	NVARCHAR	Mandatory
	IsProfileSubmitted	BOOL	True Or False
User Hit Counter Detail	CountOfHit	INT	
User Log History Detail	UserLogHistoryId	INT	Auto-generated + unique
	UserId	INT	Auto-generated + unique
	LoginDateTime	DATE	Auto-generated
	MachineIPOrURL	NVARCHAR	

Prototype

Registration Page



Verification Page



UC-003: Add User

Use Case ID:	UC-003
BREQ ID:	FBR-03
User/Actors:	System Admin
Detail Business Rule:	System should have facilities to allow admin to add user accounts to the system.

Pre-Condition:	▪ User account must not exist in the database for the admin to be able to add a new account with the provided information. ▪ User must fill up all mandatory fields in the form.
Main success scenario/steps	
Register	
<<user>>	Clicks on “Add User”.
<<system>>	Displays a form where the user is asked to provide detailed information for the account.
<<user>>	Enters all the information required in the form and then submits the form.
<<system>>	Sends verification code to the user email and user mobile phone number used to create the user account.
Post-Condition:	System would display an appropriate message to indicate any failed.
Alternative Courses/Exceptions	▪ When the admin tries to submit an empty form, the system would ask the user to fill up the form before submitting it. ▪ When the user inputs invalid information, the form would indicate why the input is invalid.

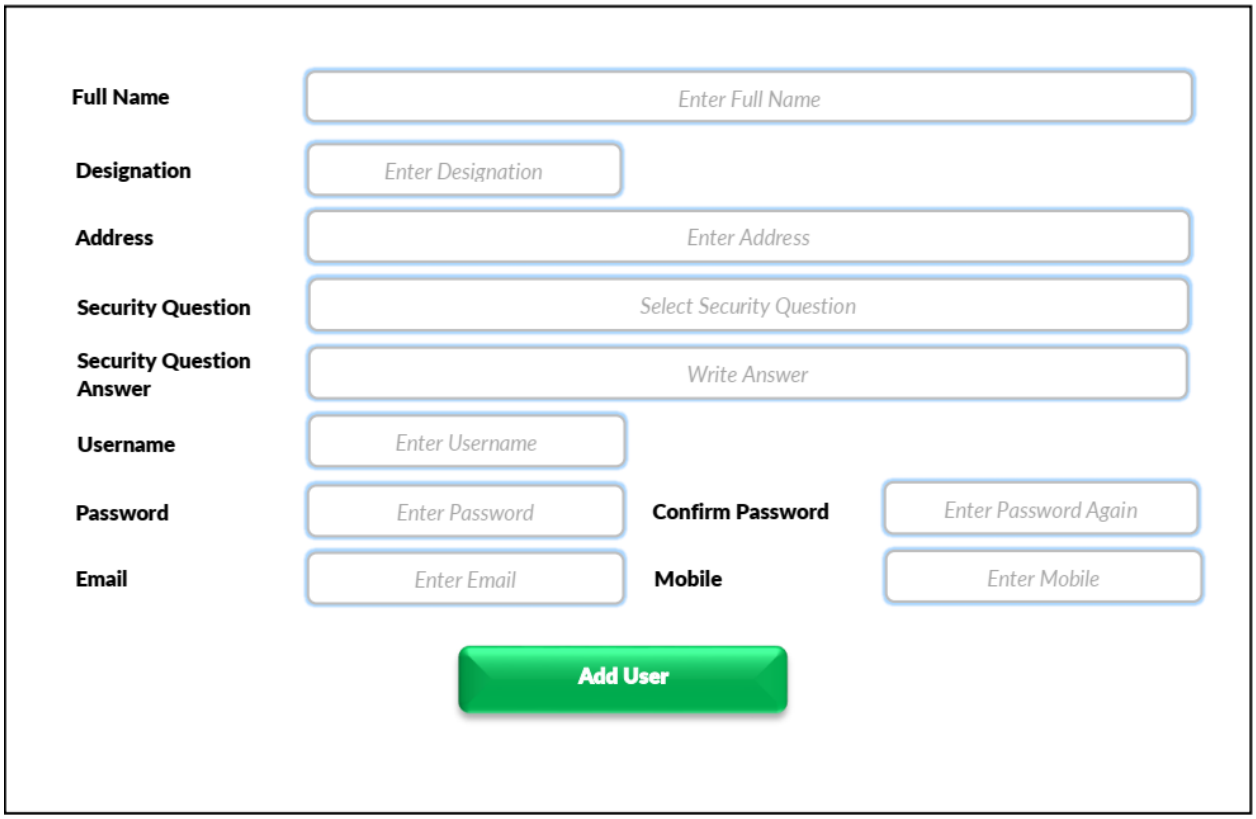
Data Requirements

Entity	Field Name	Data Type	Validation/Description
User Registration Detail	UserRegistrationId	INT	Auto-generated + unique
	UserName	NVARCHAR	Mandatory + unique
	UserPassword	NVARCHAR	Mandatory + unique
	IsActive	BOOL	True or False
	UserEmail	NVARCHAR	Mandatory + unique
	UserMobile	NVARCHAR	Mandatory + unique
	DateOfCreation	DATE	Auto-generated
	LastModifiedDate	DATE	Auto-generated
	IsVerified	BOOL	True Or False
User Detail	UserId	INT	Auto-generated + unique

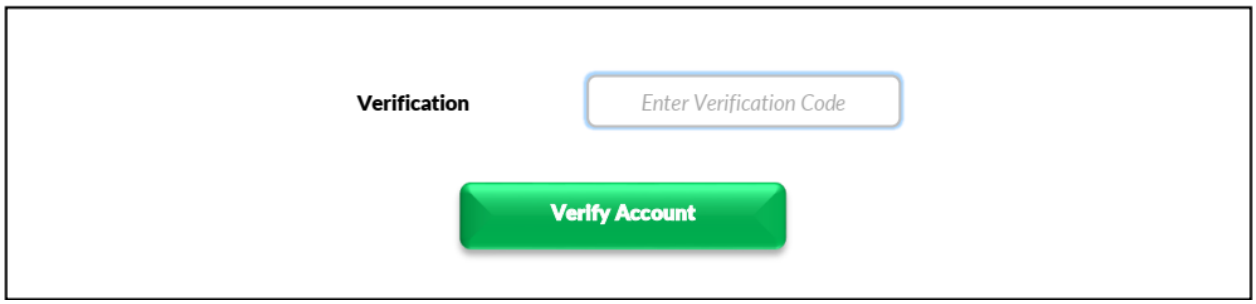
	UserRegistrationId UserFullName UserFullNameBn UserDesignation UserAddress UserAddressBn SecurityQuestion Id SecurityQuestionAnswer IsProfileSubmitted	INT NVARCHAR NVARCHAR NVARCHAR NVARCHAR NVARCHAR INT NVARCHAR BOOL	Auto-generated + unique Mandatory Mandatory Mandatory Mandatory, Id of Question selected Mandatory True Or False
User Hit Counter Detail	CountOfHit	INT	
User Log History Detail	UserLogHistoryId UserId LoginDateTime MachineIPOrURL	INT INT DATE NVARCHAR	Auto-generated + unique Auto-generated + unique Auto-generated

Prototype

Add User Page



Verification Page



UC-004: View Information

Use Case ID:	UC-004
BREQ ID:	FBR-04
User/Actors:	DPP Creator, DPP Approval Authority, Planner, System Admin
Detail Business Rule:	System should have facilities to allow users to view data associated with Natural Disaster records visually presented on the map of Bangladesh based on past occurrences.

Pre-Condition:	User must be logged in to gain the required authorization for access of data.
Main success scenario/steps	
View Information	
<<system>>	Displays a map of Bangladesh on screen and a list of Data Groups.
<<user>>	Selects Data Group from the list presented on the interface.
<<system>>	Expands a list of Data Sources from the selected Data Group.
<<user>>	Selects a Data Source from the provided list on screen.
<<system>>	Alters the map applying visual changes on the map to represent the data selected by the user. Creates a log of this event.
<<user>>	Modifies the view on the map by panning or zooming on the map to focus where the user wants to.
<<system>>	Continues updating the map based on further user selections.
Post-Condition:	System displays data visually on screen and applies multiple selections together where possible
Alternative Courses/Exceptions	If a user tries to access the map but is not logged in, the user is redirected to the log in page to log in before the user can continue to the map.

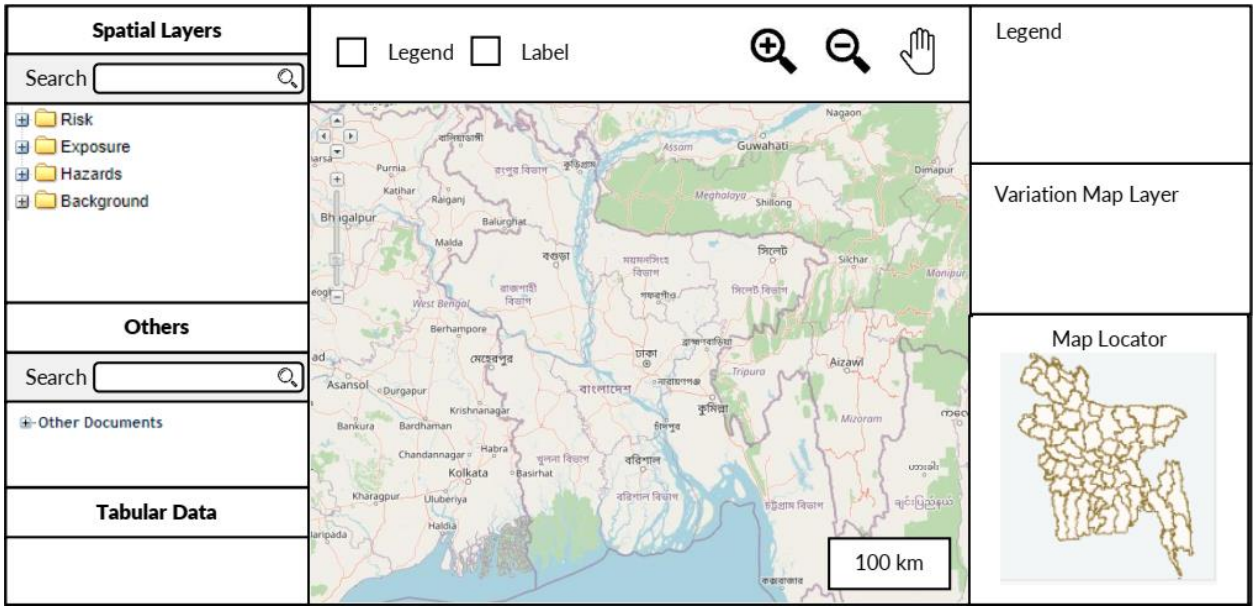
Data Requirements

Entity	Field Name	Data Type	Validation/Description
Lookup Data Group	DataGroupId DataGroup	INT NVARCHAR	Auto-generated + unique Mandatory
Lookup Data Source Type	DataSourceTypeId DataSourceType	INT NVARCHAR	Auto-generated + unique Mandatory
Lookup Data Source	DataSourceId DataGroupId	INT INT	Auto-generated + unique Auto-generated + unique

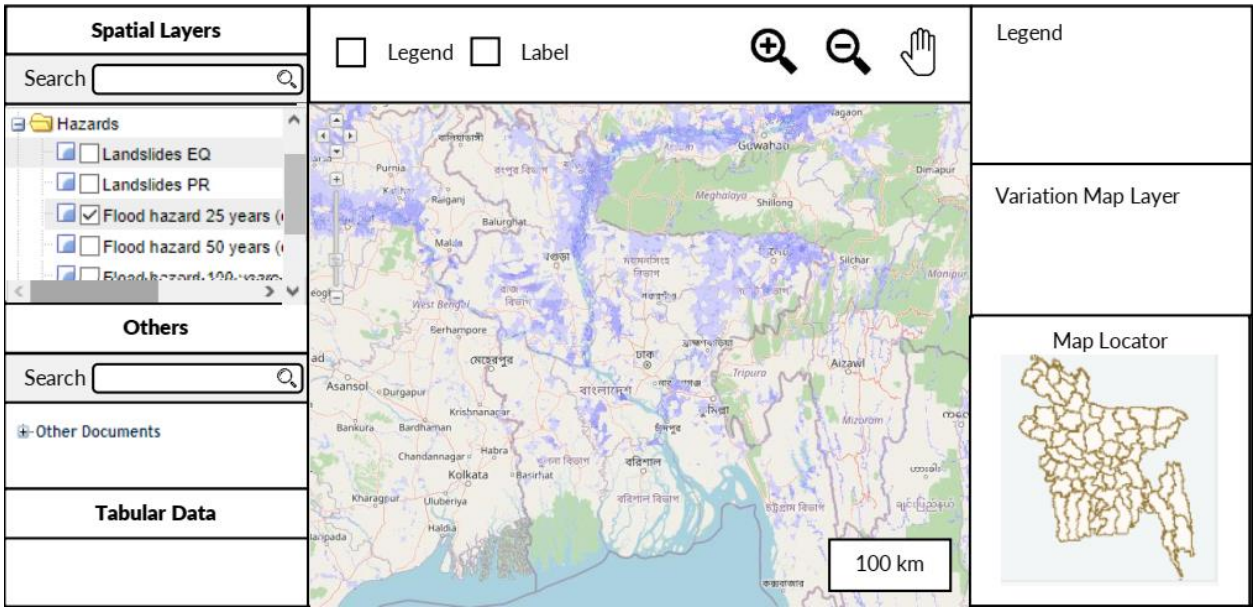
	DataSourceTypeId	INT	Auto-generated + unique
	DataSourcePath	NVARCHAR	
	LabelField	NVARCHAR	
	ClassField	NVARCHAR	
Legend Detail	LegendDetailId	INT	Auto-generated + unique
	DataSourceId	INT	Auto-generated + unique
	LabelField	NVARCHAR	
	ClassifyField	NVARCHAR	
	LegendSerialNumber	INT	Auto-generated + unique
	LegendName	NVARCHAR	
	FilterExpression	NVARCHAR	
	LRed	DOUBLE	
	LGreen	DOUBLE	
	LBlue	DOUBLE	
	FRed	DOUBLE	
	FGreen	DOUBLE	
	FBlue	DOUBLE	
	SymbolNumber	INT	
	SymbolSize	INT	

Prototype

Information Viewer (Main Page)



Information Viewer (Data Source Selected)



UC-005: Search

Use Case ID:	UC-005
BREQ ID:	FBR-05
User/Actors:	DPP Creator, DPP Approval Authority, Planner, System Admin
Detail Business Rule:	System should have facilities to allow users to search data and find what they are looking for.
Pre-Condition:	User must be logged in to gain the required authorization for access of data.
Main success scenario/steps	
View Information	
<<system>>	Displays a list of Data Groups with a search component on top.
<<user>>	Enters search term into the search component's text box and clicks on the search button.
<<system>>	Creates and expands a new list with all the data sources where the search term was found.

Post-Condition:	▪ System allows user to return to the original tree with click of another button. ▪ If no matches are found for the search term an empty list is displayed on screen.
Alternative Courses/Exceptions	If a user tries to access the page but is not logged in, the user is redirected to the log in page to log in before the user can continue to the page.

Data Requirements

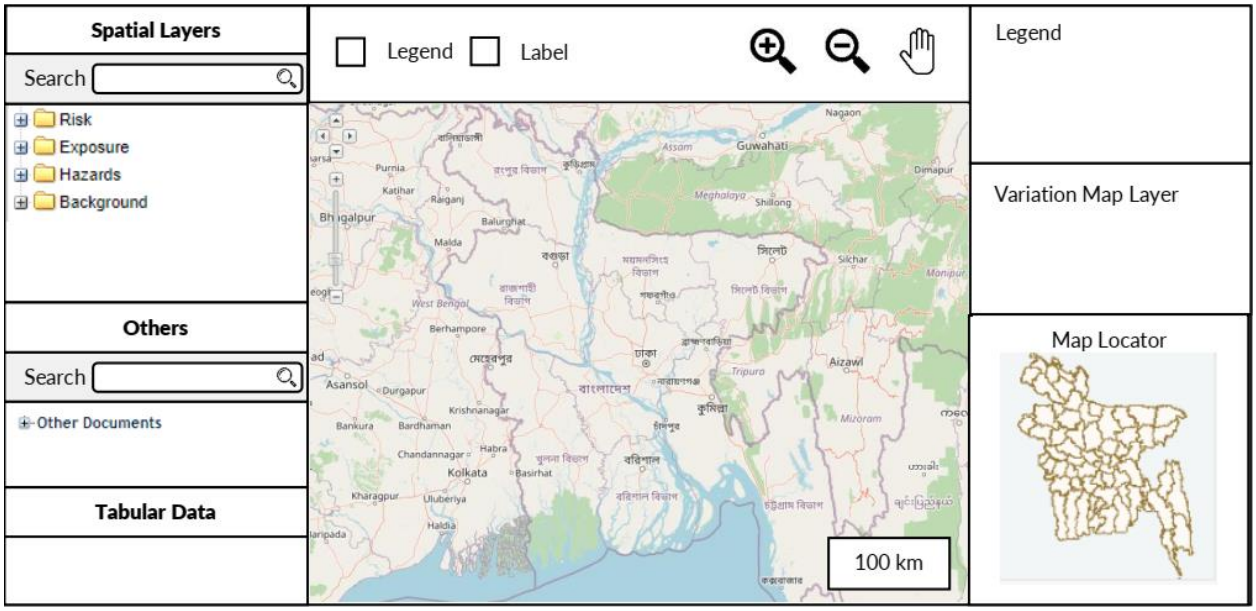
Entity	Field Name	Data Type	Validation/Description
Lookup Data Group	DataGroupId DataGroup	INT NVARCHAR	Auto-generated + unique Mandatory
Lookup Data Source Type	DataSourceTypeId DataSourceType	INT NVARCHAR	Auto-generated + unique Mandatory
Lookup Data Source	DataSourceId DataGroupId DataSourceTypeId DataSourcePath LabelField ClassField	INT INT INT NVARCHAR NVARCHAR NVARCHAR	Auto-generated + unique Auto-generated + unique Auto-generated + unique
Legend Detail	LegendDetailId DataSourceId LabelField ClassifyField LegendSerialNumber LegendName FilterExpression LRed LGreen LBlue FRed	INT INT NVARCHAR NVARCHAR INT NVARCHAR NVARCHAR DOUBLE DOUBLE DOUBLE DOUBLE	Auto-generated + unique Auto-generated + unique Auto-generated + unique

	FGreen	DOUBLE	
	FBlue	DOUBLE	
	SymbolNumber	INT	
	SymbolSize	INT	
Meta-Dataset Detail	MetadataId	INT	Auto-generated + unique
	DataSourceId	INT	Auto-generated + unique
	DatasetLanguage	NVARCHAR	Mandatory
	Title	NVARCHAR	Mandatory + unique
	Abstract	NVARCHAR	Mandatory
	Purpose	NVARCHAR	Mandatory
	ProgressCode	INT	Mandatory
	AccessConstraints	NVARCHAR	Mandatory
	UseConstraints	NVARCHAR	Mandatory
	LineageStatement	NVARCHAR	Mandatory
	ProcessDescription	NVARCHAR	Mandatory
	QualitativeReport	NVARCHAR	Mandatory
	Completeness	NVARCHAR	Mandatory
	DistributionIdentifier	NVARCHAR	Mandatory
	DistributionFormat	NVARCHAR	Mandatory
	DistributionMedia	NVARCHAR	Mandatory
	SizeOfDataset	NVARCHAR	Mandatory
	LevelOfConformance	NVARCHAR	Mandatory
	MetadataLanguage	NVARCHAR	Mandatory
	MetadataDate	TIME	Mandatory
	InitiativeIdentification	NVARCHAR	Mandatory
	InitiativeName	NVARCHAR	Mandatory
	ReferenceDate	TIME	Mandatory
	ResponsiblePartyInfo	NVARCHAR	Mandatory
	ResponsibleParty Name	NVARCHAR	Mandatory
	PostalAddress	NVARCHAR	
	City	NVARCHAR	
	Country	NVARCHAR	
	ElectronicMail	NVARCHAR	Mandatory

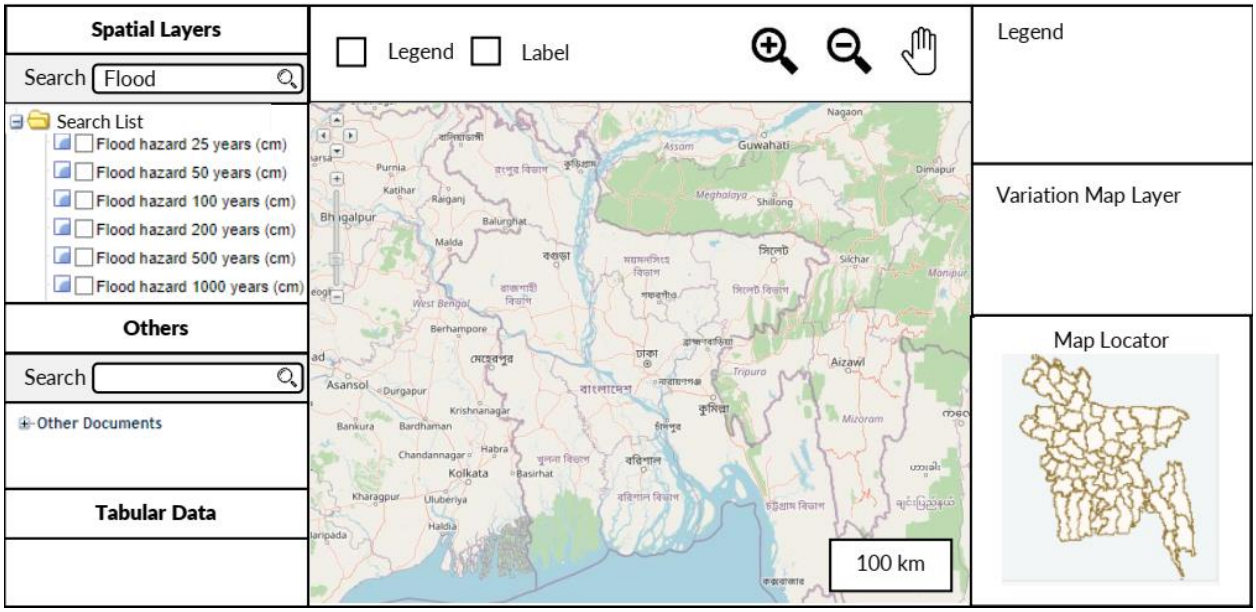
	DataSourceName	NVARCHAR	Mandatory
	DataSourceLocation	NVARCHAR	Mandatory
	BrowseGraphicFilename	NVARCHAR	Mandatory
	Type	NVARCHAR	Mandatory
	ResponsiblePartyOrg	NVARCHAR	Mandatory
	NwrdCategory	NVARCHAR	Mandatory
	MetadataSupplementalInfo	NVARCHAR	Mandatory
	OtherTable	NVARCHAR	

Prototype

Information Viewer (Main Page)



Information Viewer (Search List)



UC-006: Upload Data

Use Case ID:	UC-006
BREQ ID:	FBR-06
User/Actors:	System Admin
Detail Business Rule:	System should allow admins to upload new data to the database.
Pre-Condition:	User must be logged in to gain the required authorization for upload of data. User must fill up all the fields of the form before submitting the form.
Main success scenario/steps	
Upload Data	
<<system>>	Displays a list of Data Groups.
<<user>>	Clicks on “Add New Data”.
<<system>>	Displays a form for the user to fill up to upload new data into the database.
<<user>>	Fills up the form and then submits it.

<<system>>	Updates the database by adding the new data into it. Creates a log of this event.
Post-Condition:	Data will be added to the database. User will be notified upon completion of a successful upload of data.
Alternative Courses/Exceptions	▪ If a user tries to access the page but is not logged in, the user is redirected to the log in page to log in before the user can continue. ▪ If data entered is duplicate of existing data, the form will not be accepted and the user will be requested to enter new data if any. ▪ If data group entered exists, the data is added to the existing data group. Otherwise a new Data Group of the name provided is created and added to the database.

Data Requirements

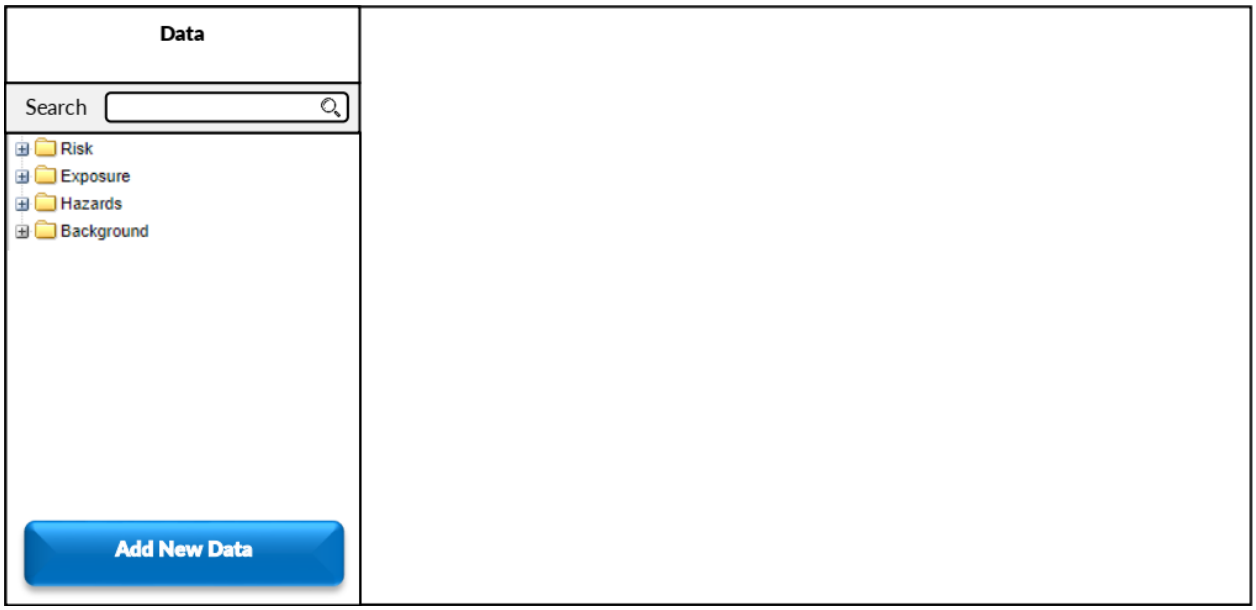
Entity	Field Name	Data Type	Validation/Description
Lookup Data Group	DataGroupId DataGroup	INT NVARCHAR	Auto-generated + unique Mandatory
Lookup Data Source Type	DataSourceTypeId DataSourceType	INT NVARCHAR	Auto-generated + unique Mandatory
Lookup Data Source	DataSourceId DataGroupId DataSourceTypeId DataSourcePath LabelField ClassField	INT INT INT NVARCHAR NVARCHAR NVARCHAR	Auto-generated + unique Auto-generated + unique Auto-generated + unique
Legend Detail	LegendDetailId DataSourceId LabelField ClassifyField LegendSerialNumber LegendName FilterExpression LRed LGreen LBlue FRed FGreen FBlue SymbolNumber SymbolSize	INT INT NVARCHAR NVARCHAR INT NVARCHAR NVARCHAR DOUBLE DOUBLE DOUBLE DOUBLE DOUBLE DOUBLE INT INT	Auto-generated + unique Auto-generated + unique Auto-generated + unique
Meta-Dataset Detail	MetadataId DataSourceId DatasetLanguage	INT INT NVARCHAR	Auto-generated + unique Auto-generated + unique Mandatory

	Title	NVARCHAR	Mandatory + unique
	Abstract	NVARCHAR	Mandatory
	Purpose	NVARCHAR	Mandatory
	ProgressCode	INT	Mandatory
	AccessConstraints	NVARCHAR	Mandatory
	UseConstraints	NVARCHAR	Mandatory
	LineageStatement	NVARCHAR	Mandatory
	ProcessDescription	NVARCHAR	Mandatory
	QualitativeReport	NVARCHAR	Mandatory
	Completeness	NVARCHAR	Mandatory
	DistributionIdentifier	NVARCHAR	Mandatory
	DistributionFormat	NVARCHAR	Mandatory
	DistributionMedia	NVARCHAR	Mandatory
	SizeOfDataset	NVARCHAR	Mandatory
	LevelOfConformance	NVARCHAR	Mandatory
	MetadataLanguage	NVARCHAR	Mandatory
	MetadataDate	TIME	Mandatory
	InitiativeIdentification	NVARCHAR	Mandatory
	InitiativeName	NVARCHAR	Mandatory
	ReferenceDate	TIME	Mandatory
	ResponsiblePartyInfo	NVARCHAR	Mandatory
	ResponsibleParty Name	NVARCHAR	Mandatory
	PostalAddress	NVARCHAR	
	City	NVARCHAR	
	Country	NVARCHAR	
	ElectronicMail	NVARCHAR	Mandatory
	DataSourceName	NVARCHAR	Mandatory
	DataSourceLocation	NVARCHAR	Mandatory
	BrowseGraphicFilename	NVARCHAR	Mandatory
	Type	NVARCHAR	Mandatory
	ResponsiblePartyOrg	NVARCHAR	Mandatory
	NwrdCategory	NVARCHAR	Mandatory
	MetadataSupplementalInfo	NVARCHAR	Mandatory

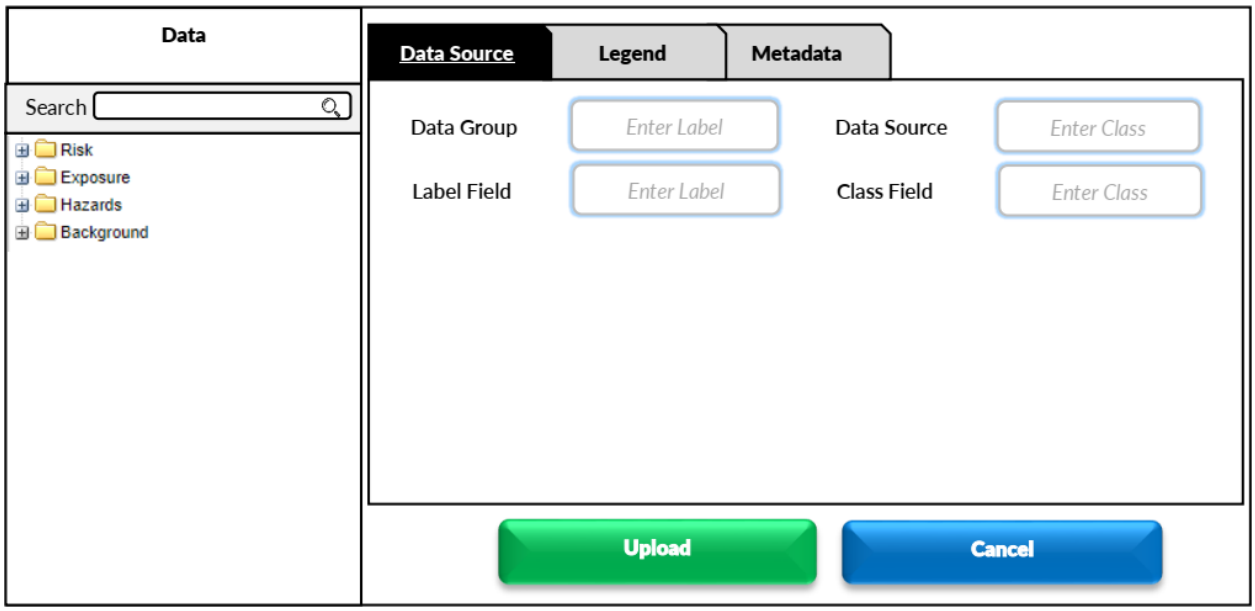
	OtherTable	NVARCHAR	

Prototype

Upload Data (Main Page)



Upload Data (Form)



UC-007: Modify Data

Use Case ID:	UC-007
BREQ ID:	FBR-07
User/Actors:	System Admin
Detail Business Rule:	System should allow admins to modify currently existing data within the database.
Pre-Condition:	User must be logged in to gain the required authorization for modification of data. User must fill up all the fields of the form before submitting the form.
Main success scenario/steps	
Edit Data	
<<system>>	Displays a list of Data Groups.
<<user>>	Selects Data Group from the list presented on the interface.
<<system>>	Expands a list of Data Sources from the selected Data Group.
<<user>>	Selects a Data Source from the provided list on screen.
<<system>>	Displays a form for the user to fill up to edit current data into the database.
<<user>>	Fills up the form and then submits it.
<<system>>	Updates the database by adding the changes into the data. Creates a log of this event.
Delete Data	
<<system>>	Displays a list of Data Groups.
<<user>>	Selects Data Group from the list presented on the interface.
<<system>>	Expands a list of Data Sources from the selected Data Group.
<<user>>	Selects a Data Source from the provided list on screen.
<<system>>	Displays a form to edit the data and also a button to delete the data.
<<user>>	Selects the delete option to delete the data from the database.

<<system>>	Updates the database by deleting the data source. Creates a log of this event.
Post-Condition:	Data will be updated on the database. User will be notified upon completion of a successful modification of data.
Alternative Courses/Exceptions	If a user tries to access the page but is not logged in, the user is redirected to the log in page to log in before the user can continue. If data entered is duplicate of another existing data the form will not be accepted and the user will be requested to enter new data if any.

Data Requirements

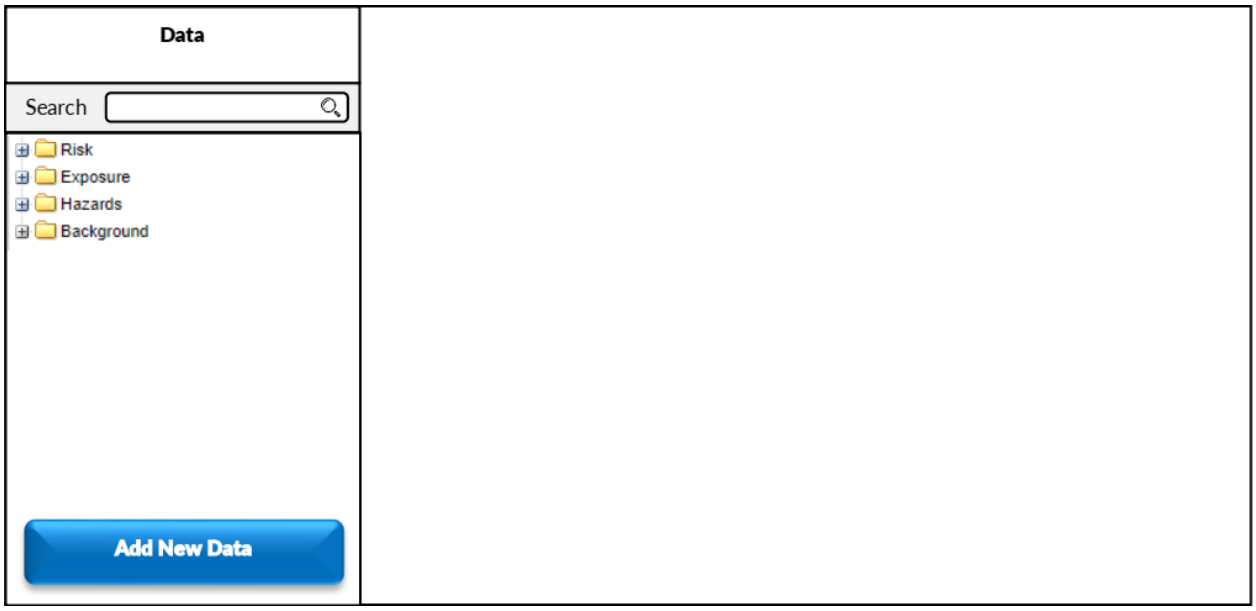
Entity	Field Name	Data Type	Validation/Description
Lookup Data Group	DataGroupId DataGroup	INT NVARCHAR	Auto-generated + unique Mandatory
Lookup Data Source Type	DataSourceTypeId DataSourceType	INT NVARCHAR	Auto-generated + unique Mandatory
Lookup Data Source	DataSourceId DataGroupId DataSourceTypeId DataSourcePath LabelField ClassField	INT INT INT NVARCHAR NVARCHAR NVARCHAR	Auto-generated + unique Auto-generated + unique Auto-generated + unique
Legend Detail	LegendDetailId DataSourceId LabelField ClassifyField LegendSerialNumber LegendName FilterExpression	INT INT NVARCHAR NVARCHAR INT NVARCHAR NVARCHAR	Auto-generated + unique Auto-generated + unique Auto-generated + unique

	LRed	DOUBLE	
	LGreen	DOUBLE	
	LBlue	DOUBLE	
	FRed	DOUBLE	
	FGreen	DOUBLE	
	FBlue	DOUBLE	
	SymbolNumber	INT	
	SymbolSize	INT	
Meta-Dataset Detail	MetadataId	INT	Auto-generated + unique
	DataSourceId	INT	Auto-generated + unique
	DatasetLanguage	NVARCHAR	Mandatory
	Title	NVARCHAR	Mandatory + unique
	Abstract	NVARCHAR	Mandatory
	Purpose	NVARCHAR	Mandatory
	ProgressCode	INT	Mandatory
	AccessConstraints	NVARCHAR	Mandatory
	UseConstraints	NVARCHAR	Mandatory
	LineageStatement	NVARCHAR	Mandatory
	ProcessDescription	NVARCHAR	Mandatory
	QualitativeReport	NVARCHAR	Mandatory
	Completeness	NVARCHAR	Mandatory
	DistributionIdentifier	NVARCHAR	Mandatory
	DistributionFormat	NVARCHAR	Mandatory
	DistributionMedia	NVARCHAR	Mandatory
	SizeOfDataset	NVARCHAR	Mandatory
	LevelOfConformance	NVARCHAR	Mandatory
	MetadataLanguage	NVARCHAR	Mandatory
	MetadataDate	TIME	Mandatory
	InitiativeIdentification	NVARCHAR	Mandatory
	InitiativeName	NVARCHAR	Mandatory
	ReferenceDate	TIME	Mandatory
	ResponsiblePartyInfo	NVARCHAR	Mandatory
	ResponsibleParty Name	NVARCHAR	Mandatory

	PostalAddress	NVARCHAR	
	City	NVARCHAR	
	Country	NVARCHAR	
	ElectronicMail	NVARCHAR	Mandatory
	DataSourceName	NVARCHAR	Mandatory
	DataSourceLocation	NVARCHAR	Mandatory
	BrowseGraphicFilename	NVARCHAR	Mandatory
	Type	NVARCHAR	Mandatory
	ResponsiblePartyOrg	NVARCHAR	Mandatory
	NwrdCategory	NVARCHAR	Mandatory
	MetadataSupplementalInfo	NVARCHAR	Mandatory
	OtherTable	NVARCHAR	

Prototype

Data Configuration (Main Page)



Data Configuration (Form)

UC-008: View Metadata

Use Case ID:	UC-008
BREQ ID:	FBR-08
User/Actors:	DPP Creator, DPP Approval Authority, Planner, System Admin
Detail Business Rule:	System should have facilities to allow users to view metadata associated with data presented in the Information Viewer.
Pre-Condition:	User must be logged in to gain the required authorization for access of metadata.
Main success scenario/steps	
View Metadata	
<<system>>	Displays a list of Data Groups.
<<user>>	Selects Data Group from the list presented on the interface.
<<system>>	Expands a list of Data Sources from the selected Data Group.
<<user>>	Selects a Data Source from the provided list on screen.
<<system>>	Displays all metadata related to the selected data source and creates a log of this event.

Post-Condition:	System displays metadata on screen.
Alternative Courses/Exceptions	If a user tries to access the page but is not logged in, the user is redirected to the log in page to log in before the user can continue.

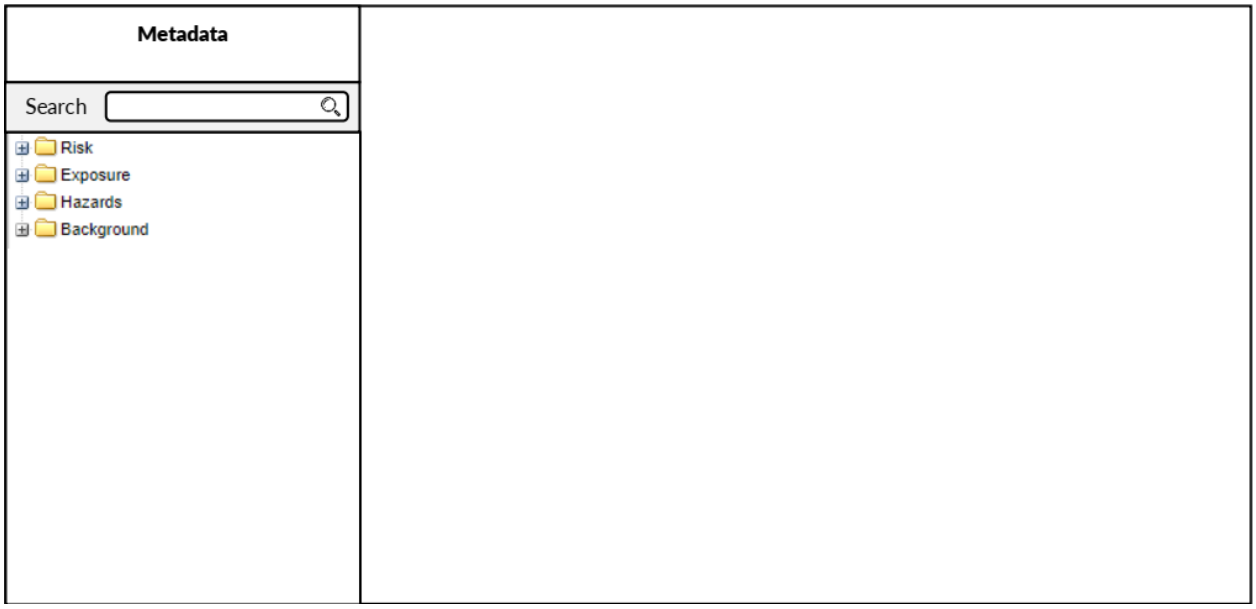
Data Requirements

Entity	Field Name	Data Type	Validation/Description
Lookup Data Source	DataSourceId	INT	Auto-generated + unique
	DataGroupId	INT	Auto-generated + unique
	DataSourceTypeId	INT	Auto-generated + unique
	DataSourcePath	NVARCHAR	
	LabelField	NVARCHAR	
	ClassField	NVARCHAR	
Meta-Dataset Detail	MetadataId	INT	Auto-generated + unique
	DataSourceId	INT	Auto-generated + unique
	DatasetLanguage	NVARCHAR	Mandatory
	Title	NVARCHAR	Mandatory + unique
	Abstract	NVARCHAR	Mandatory
	Purpose	NVARCHAR	Mandatory
	ProgressCode	INT	Mandatory
	AccessConstraints	NVARCHAR	Mandatory
	UseConstraints	NVARCHAR	Mandatory
	LineageStatement	NVARCHAR	Mandatory
	ProcessDescription	NVARCHAR	Mandatory
	QualitativeReport	NVARCHAR	Mandatory
	Completeness	NVARCHAR	Mandatory
	DistributionIdentifier	NVARCHAR	Mandatory
	DistributionFormat	NVARCHAR	Mandatory
	DistributionMedia	NVARCHAR	Mandatory
	SizeOfDataset	NVARCHAR	Mandatory
	LevelOfConformance	NVARCHAR	Mandatory
	MetadataLanguage	NVARCHAR	Mandatory

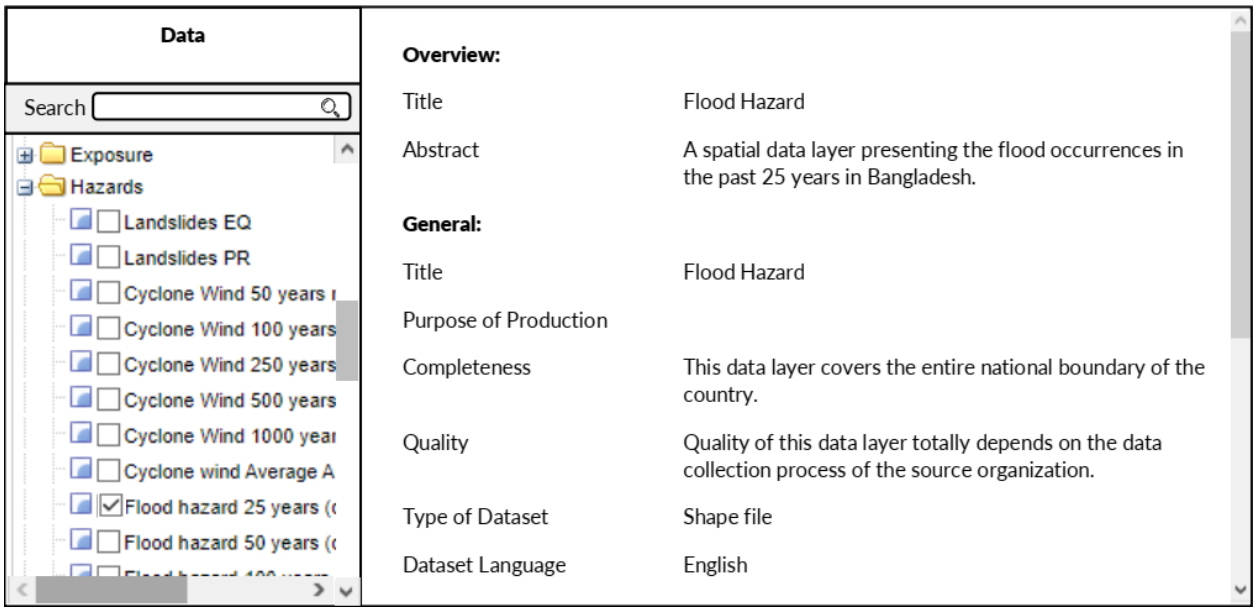
	MetadataDate	TIME	Mandatory
	InitiativeIdentification	NVARCHAR	Mandatory
	InitiativeName	NVARCHAR	Mandatory
	ReferenceDate	TIME	Mandatory
	ResponsiblePartyInfo	NVARCHAR	Mandatory
	ResponsibleParty Name	NVARCHAR	Mandatory
	PostalAddress	NVARCHAR	
	City	NVARCHAR	
	Country	NVARCHAR	
	ElectronicMail	NVARCHAR	Mandatory
	DataSourceName	NVARCHAR	Mandatory
	DataSourceLocation	NVARCHAR	Mandatory
	BrowseGraphicFilename	NVARCHAR	Mandatory
	Type	NVARCHAR	Mandatory
	ResponsiblePartyOrg	NVARCHAR	Mandatory
	NwrdCategory	NVARCHAR	Mandatory
	MetadataSupplementalInfo	NVARCHAR	Mandatory
	OtherTable	NVARCHAR	

Prototype

Metadata Viewer (Main Page)



Metadata Viewer Details



UC-009: Perform Analysis

Use Case ID:	UC-009
BREQ ID:	FBR-09
User/Actors:	DPP Creator, DPP Approval Authority, System Admin
Detail Business Rule:	System should have facilities to allow users to perform analysis on data.
Pre-Condition:	User must be logged in to gain the required authorization for analysis of data.
Main success scenario/steps	
Perform Economic/Statistical Analysis	
<<system>>	Displays a list of Data Groups.
<<user>>	Selects Data Group from the list presented on the interface.
<<system>>	Expands a list of Data Sources from the selected Data Group.
<<user>>	Selects a Data Source from the provided list on screen.
<<system>>	Displays options for economic or statistical analysis on the selected data.
<<user>>	Selects which kind of analysis the user prefers.

<<system>>	Performs selected analysis and presents the result on screen. Creates log of this event.
Post-Condition:	System displays analysis on screen
Alternative Courses/Exceptions	If a user tries to access the page but is not logged in, the user is redirected to the log in page to log in before the user can continue.

Data Requirements

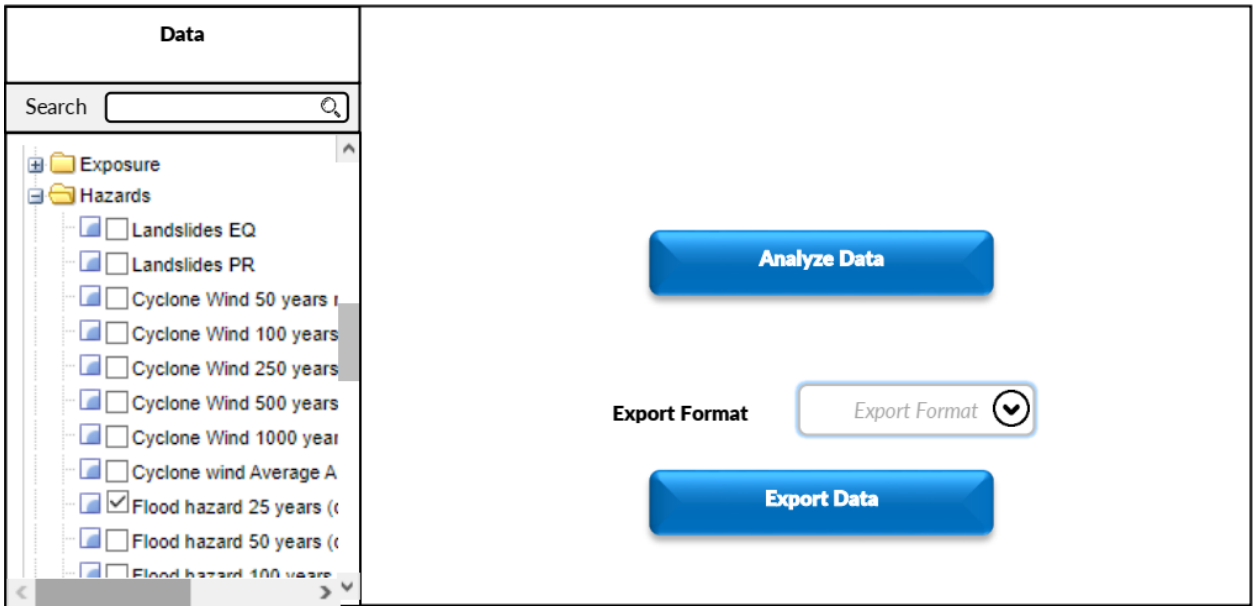
Entity	Field Name	Data Type	Validation/Description
Lookup Data Group	DataGroupId DataGroup	INT NVARCHAR	Auto-generated + unique Mandatory
Lookup Data Source Type	DataSourceTypeId DataSourceType	INT NVARCHAR	Auto-generated + unique Mandatory
Lookup Data Source	DataSourceId DataGroupId DataSourceTypeId DataSourcePath LabelField ClassField	INT INT INT NVARCHAR NVARCHAR NVARCHAR	Auto-generated + unique Auto-generated + unique Auto-generated + unique
Legend Detail	LegendDetailId DataSourceId LabelField ClassifyField LegendSerialNumber LegendName FilterExpression LRed LGreen LBlue FRed	INT INT NVARCHAR NVARCHAR INT NVARCHAR NVARCHAR DOUBLE DOUBLE DOUBLE DOUBLE	Auto-generated + unique Auto-generated + unique Auto-generated + unique

	FGreen	DOUBLE	
	FBlue	DOUBLE	
	SymbolNumber	INT	
	SymbolSize	INT	
Meta-Dataset Detail	MetadataId	INT	Auto-generated + unique
	DataSourceId	INT	Auto-generated + unique
	DatasetLanguage	NVARCHAR	Mandatory
	Title	NVARCHAR	Mandatory + unique
	Abstract	NVARCHAR	Mandatory
	Purpose	NVARCHAR	Mandatory
	ProgressCode	INT	Mandatory
	AccessConstraints	NVARCHAR	Mandatory
	UseConstraints	NVARCHAR	Mandatory
	LineageStatement	NVARCHAR	Mandatory
	ProcessDescription	NVARCHAR	Mandatory
	QualitativeReport	NVARCHAR	Mandatory
	Completeness	NVARCHAR	Mandatory
	DistributionIdentifier	NVARCHAR	Mandatory
	DistributionFormat	NVARCHAR	Mandatory
	DistributionMedia	NVARCHAR	Mandatory
	SizeOfDataset	NVARCHAR	Mandatory
	LevelOfConformance	NVARCHAR	Mandatory
	MetadataLanguage	NVARCHAR	Mandatory
	MetadataDate	TIME	Mandatory
	InitiativeIdentification	NVARCHAR	Mandatory
	InitiativeName	NVARCHAR	Mandatory
	ReferenceDate	TIME	Mandatory
	ResponsiblePartyInfo	NVARCHAR	Mandatory
	ResponsibleParty Name	NVARCHAR	Mandatory
	PostalAddress	NVARCHAR	
	City	NVARCHAR	
	Country	NVARCHAR	
	ElectronicMail	NVARCHAR	Mandatory

	DataSourceName	NVARCHAR	Mandatory
	DataSourceLocation	NVARCHAR	Mandatory
	BrowseGraphicFilename	NVARCHAR	Mandatory
	Type	NVARCHAR	Mandatory
	ResponsiblePartyOrg	NVARCHAR	Mandatory
	NwrdCategory	NVARCHAR	Mandatory
	MetadataSupplementalInfo	NVARCHAR	Mandatory
	OtherTable	NVARCHAR	

Prototype

Analysis Page



UC-010: Export Data

Use Case ID:	UC-010
BREQ ID:	FBR-10
User/Actors:	DPP Creator, DPP Approval Authority, System Admin
Detail Business Rule:	System should have facilities to allow users to export data in available formats.
Pre-Condition:	User must be logged in to gain the required authorization for exporting data.

Main success scenario/steps	
Export Data	
<<system>>	Displays a list of Data Groups.
<<user>>	Selects Data Group from the list presented on the interface.
<<system>>	Expands a list of Data Sources from the selected Data Group.
<<user>>	Selects a Data Source from the provided list on screen.
<<system>>	Displays format options for exporting data.
<<user>>	Selects which format the user prefers.
<<system>>	Exports the data into the user's local storage. Creates log of this event.
Post-Condition:	System downloads file into local storage.
Alternative Courses/Exceptions	If a user tries to access the page but is not logged in, the user is redirected to the log in page to log in before the user can continue.

Data Requirements

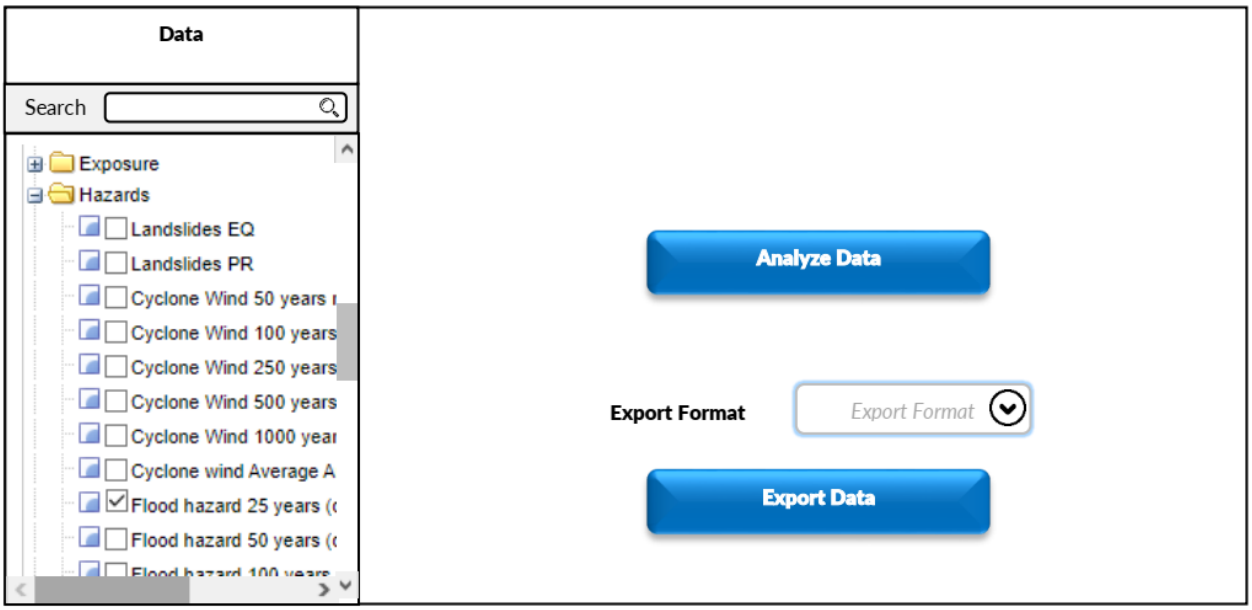
Entity	Field Name	Data Type	Validation/Description
Lookup Data Group	DataGroupId DataGroup	INT NVARCHAR	Auto-generated + unique Mandatory
Lookup Data Source Type	DataSourceTypeId DataSourceType	INT NVARCHAR	Auto-generated + unique Mandatory
Lookup Data Source	DataSourceId DataGroupId DataSourceTypeId DataSourcePath LabelField ClassField	INT INT INT NVARCHAR NVARCHAR NVARCHAR	Auto-generated + unique Auto-generated + unique Auto-generated + unique

Legend Detail	LegendDetailId	INT	Auto-generated + unique
	DataSourceId	INT	Auto-generated + unique
	LabelField	NVARCHAR	
	ClassifyField	NVARCHAR	
	LegendSerialNumber	INT	Auto-generated + unique
	LegendName	NVARCHAR	
	FilterExpression	NVARCHAR	
	LRed	DOUBLE	
	LGreen	DOUBLE	
	LBlue	DOUBLE	
	FRed	DOUBLE	
	FGreen	DOUBLE	
	FBlue	DOUBLE	
	SymbolNumber	INT	
	SymbolSize	INT	
Meta-Dataset Detail	MetadataId	INT	Auto-generated + unique
	DataSourceId	INT	Auto-generated + unique
	DatasetLanguage	NVARCHAR	Mandatory
	Title	NVARCHAR	Mandatory + unique
	Abstract	NVARCHAR	Mandatory
	Purpose	NVARCHAR	Mandatory
	ProgressCode	INT	Mandatory
	AccessConstraints	NVARCHAR	Mandatory
	UseConstraints	NVARCHAR	Mandatory
	LineageStatement	NVARCHAR	Mandatory
	ProcessDescription	NVARCHAR	Mandatory
	QualitativeReport	NVARCHAR	Mandatory
	Completeness	NVARCHAR	Mandatory
	DistributionIdentifier	NVARCHAR	Mandatory
	DistributionFormat	NVARCHAR	Mandatory
	DistributionMedia	NVARCHAR	Mandatory
	SizeOfDataset	NVARCHAR	Mandatory
	LevelOfConformance	NVARCHAR	Mandatory

	MetadataLanguage	NVARCHAR	Mandatory
	MetadataDate	TIME	Mandatory
	InitiativeIdentification	NVARCHAR	Mandatory
	InitiativeName	NVARCHAR	Mandatory
	ReferenceDate	TIME	Mandatory
	ResponsiblePartyInfo	NVARCHAR	Mandatory
	ResponsibleParty Name	NVARCHAR	Mandatory
	PostalAddress	NVARCHAR	
	City	NVARCHAR	
	Country	NVARCHAR	
	ElectronicMail	NVARCHAR	Mandatory
	DataSourceName	NVARCHAR	Mandatory
	DataSourceLocation	NVARCHAR	Mandatory
	BrowseGraphicFilename	NVARCHAR	Mandatory
	Type	NVARCHAR	Mandatory
	ResponsiblePartyOrg	NVARCHAR	Mandatory
	NwrdCategory	NVARCHAR	Mandatory
	MetadataSupplementalInfo	NVARCHAR	Mandatory
	OtherTable	NVARCHAR	
Export Log Detail	ExportLogDetailId	INT	Auto-generated + unique
	UserId	INT	Auto-generated + unique
	DataSourceId	INT	Auto-generated + unique
	ExportDate	DATE	Mandatory
	ExportFormat	NVARCHAR	Mandatory
	ExportPurpose	NVARCHAR	Mandatory
	HostName	NVARCHAR	Mandatory
	ExportLocation	NVARCHAR	Mandatory

Prototype

Export Page



UC-011: Monitor Logs

Use Case ID:	UC-011
BREQ ID:	FBR-11
User/Actors:	DPP Approval Authority, System Admin
Detail Business Rule:	System should allow certain users to monitor logs related to other user's data exporting activities based on permissions associated with the account.
Pre-Condition:	User must be logged in to gain the required authorization for monitoring logs.
Main success scenario/steps	
Delete Account	
<<user>>	Enters username in the a text box displayed on screen.
<<system>>	After verifying that the user has necessary permissions, the system displays a list of logs associated with the provided username's export history details. Also creates logs to keep track of this event.
<<user>>	Clicks on the name of a Data Source mentioned in the log.

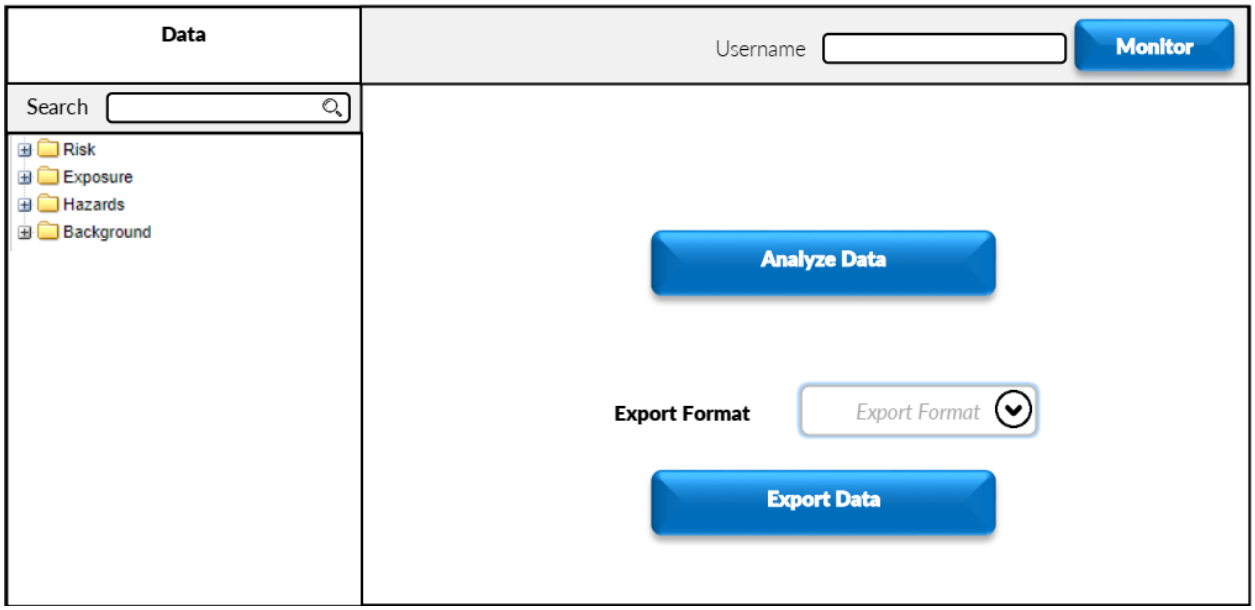
<<system>>	Redirects user to the information viewer page for the specified data source.
Post-Condition:	System would display an appropriate message to indicate any failed display attempt for logs that may be due to lack of permissions associated with the logged in account.
Alternative Courses/Exceptions	None.

Data Requirements

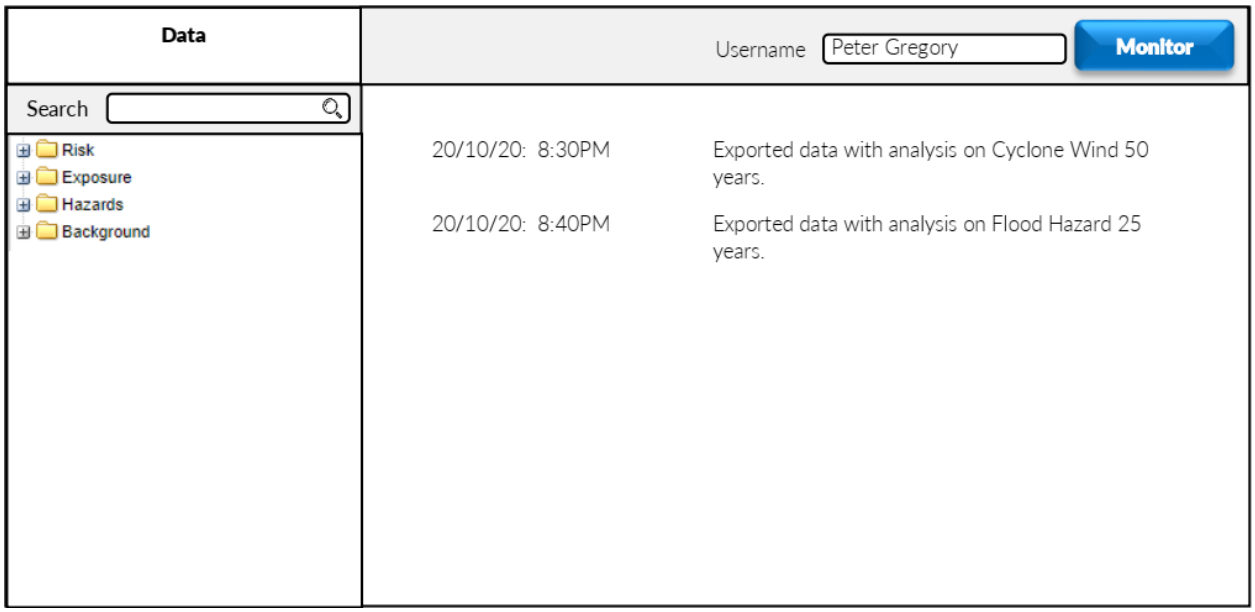
Entity	Field Name	Data Type	Validation/Description
User Detail	UserId	INT	Auto-generated + unique
	UserRegistrationId	INT	Auto-generated + unique
	UserFullName	NVARCHAR	Mandatory
	UserFullNameBn	NVARCHAR	
	UserDesignation	NVARCHAR	Mandatory
	UserAddress	NVARCHAR	Mandatory
	UserAddressBn	NVARCHAR	
	SecurityQuestion Id	INT	Mandatory, Id of Question selected
	SecurityQuestionAnswer	NVARCHAR	Mandatory
	IsProfileSubmitted	BOOL	True Or False
Export Log Detail	ExportLogDetailId	INT	Auto-generated + unique
	UserId	INT	Auto-generated + unique
	DataSourceId	INT	Auto-generated + unique
	ExportDate	DATE	Mandatory
	ExportFormat	NVARCHAR	Mandatory
	ExportPurpose	NVARCHAR	Mandatory
	HostName	NVARCHAR	Mandatory
	ExportLocation	NVARCHAR	Mandatory

Prototype

Export Page



User Logs Page



UC-012: Delete Account

Use Case ID:	UC-012
BREQ ID:	FBR-12
User/Actors:	DPP Creator, DPP Approval Authority, Planner
Detail Business Rule:	System should have facilities to allow someone to delete an account from the system.

Pre-Condition:	User must be logged in to gain the required authorization for deleting an account.
Main success scenario/steps	
Delete Account	
<<user>>	Clicks on “Edit Profile”.
<<system>>	Displays a form where the user is asked to provide detailed information for the account.
<<user>>	Clicks on the “Delete” button.
<<system>>	Deletes the account from the database and creates a log of this event.
Post-Condition:	System would log the user out of the account once deletion is successful. System would display an appropriate message to indicate any failed delete attempt and provide suggestions to the user.
Alternative Courses/Exceptions	None.

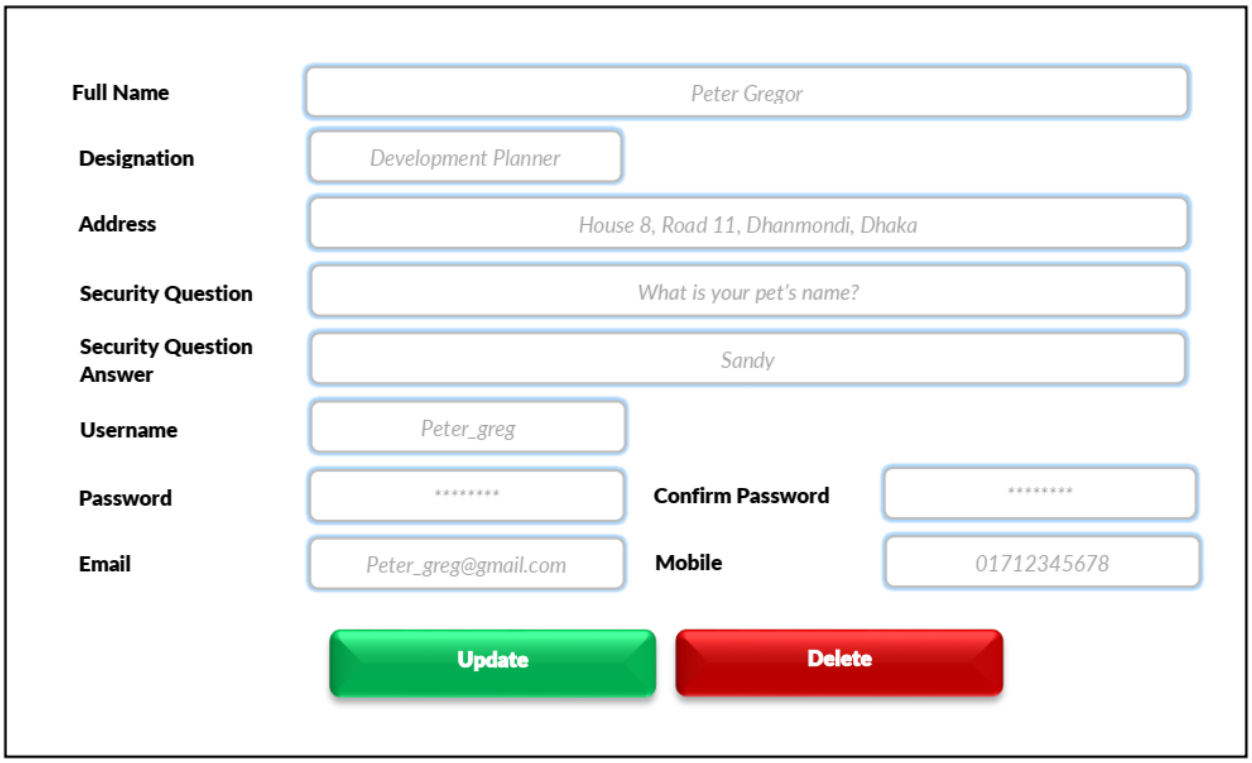
Data Requirements

Entity	Field Name	Data Type	Validation/Description
User Detail	UserId	INT	Auto-generated + unique
	UserRegistrationId	INT	Auto-generated + unique
	UserFullName	NVARCHAR	Mandatory
	UserFullNameBn	NVARCHAR	
	UserDesignation	NVARCHAR	Mandatory
	UserAddress	NVARCHAR	Mandatory
	UserAddressBn	NVARCHAR	
	SecurityQuestion Id	INT	Mandatory, Id of Question selected
	SecurityQuestionAnswer	NVARCHAR	Mandatory
	IsProfileSubmitted	BOOL	True Or False

User Registration Detail	UserRegistrationId UserName UserPassword IsActive UserEmail UserMobile DateOfCreation LastModifiedDate IsVerified	INT NVARCHAR NVARCHAR BOOL NVARCHAR NVARCHAR DATE DATE BOOL	Auto-generated + unique Mandatory + unique Mandatory + unique True or False Mandatory + unique Mandatory + unique Auto-generated Auto-generated True Or False
User Hit Counter Detail	CountOfHit	INT	

Prototype

Delete Account



UC-013: Edit Profile

Use Case ID:	UC-013

BREQ ID:	FBR-13
User/Actors:	DPP Creator, DPP Approval Authority, Planner
Detail Business Rule:	System should have facilities to allow someone to update an account's information on the system.
Pre-Condition:	User must be logged in to gain the required authorization for updating an account data.
Main success scenario/steps	
Edit Account	
<<user>>	Clicks on "Edit Profile".
<<system>>	Displays a form where the user is asked to provide detailed information for the account.
<<user>>	Enters all the information required in the form and then submits the form.
<<system>>	Verifies the information, updates the account and creates a log of this event.
Post-Condition:	Dashboard will display updated user's information in the interface indicating a successful modification attempt. System would display an appropriate message to indicate any failed update attempt and provide suggestions to the user.
Alternative Courses/Exceptions	When the user tries to submit an empty form the system would not perform an update and keep the current data intact. When the user inputs invalid information, the form would indicate why the input is invalid.

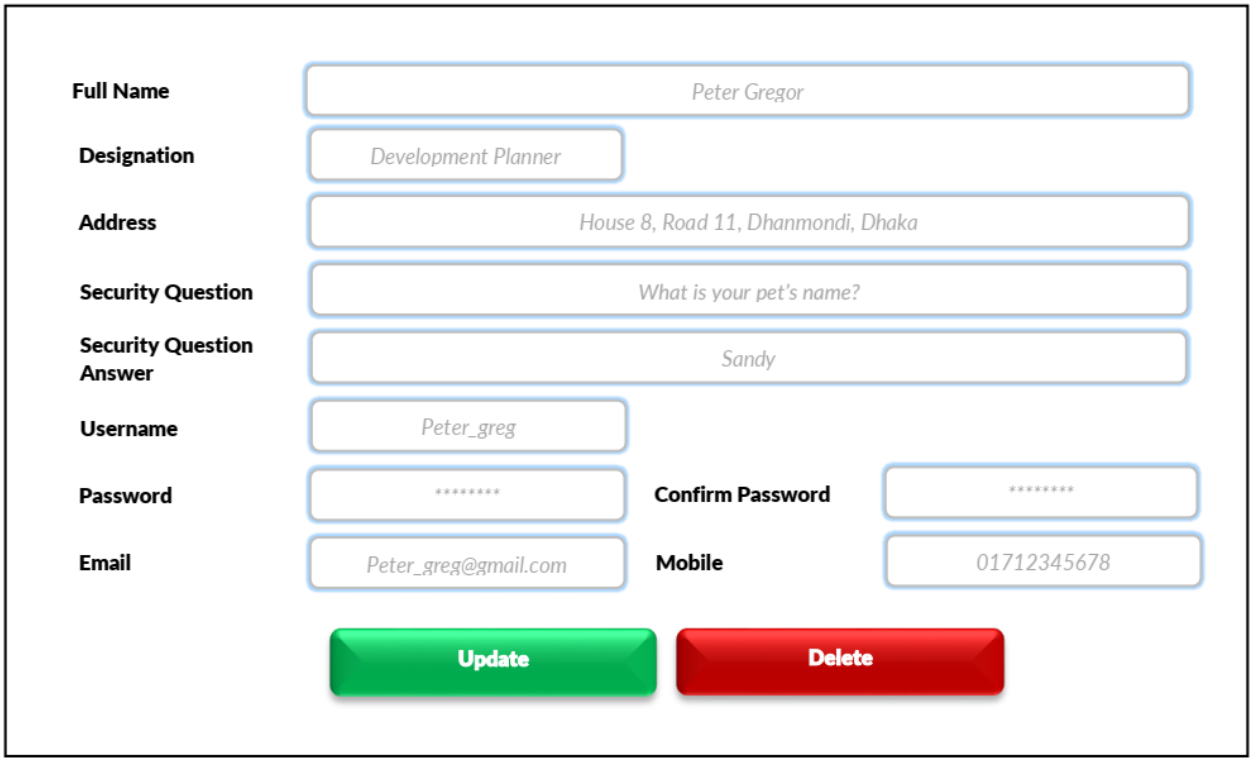
Data Requirements

Entity	Field Name	Data Type	Validation/Description
User Detail	UserId	INT	Auto-generated + unique
	UserRegistrationId	INT	Auto-generated + unique
	UserFullName	NVARCHAR	Mandatory
	UserFullNameBn	NVARCHAR	
	UserDesignation	NVARCHAR	Mandatory

	UserAddress UserAddressBn SecurityQuestion Id SecurityQuestionAnswer IsProfileSubmitted	NVARCHAR NVARCHAR INT NVARCHAR BOOL	Mandatory Mandatory, Id of Question selected Mandatory True Or False
User Registration Detail	UserRegistrationId UserName UserPassword IsActive UserEmail UserMobile DateOfCreation LastModifiedDate IsVerified	INT NVARCHAR NVARCHAR BOOL NVARCHAR NVARCHAR DATE DATE BOOL	Auto-generated + unique Mandatory + unique Mandatory + unique True or False Mandatory + unique Mandatory + unique Auto-generated Auto-generated True Or False

Prototype

Edit Profile



UC-014: Activate/Deactivate Account

Use Case ID:	UC-014
BREQ ID:	FBR-14
User/Actors:	System Admin
Detail Business Rule:	System should have facilities to allow admins to activate or deactivate an account on the system.
Pre-Condition:	User must be logged in to gain the required authorization for modifying the activation status of an account.
Main success scenario/steps	
Activate Account	
<<user>>	Clicks on "User List".
<<system>>	Displays a list of current users of the system.
<<user>>	Performs a search for the user to activate or deactivate or some other information related to the user.

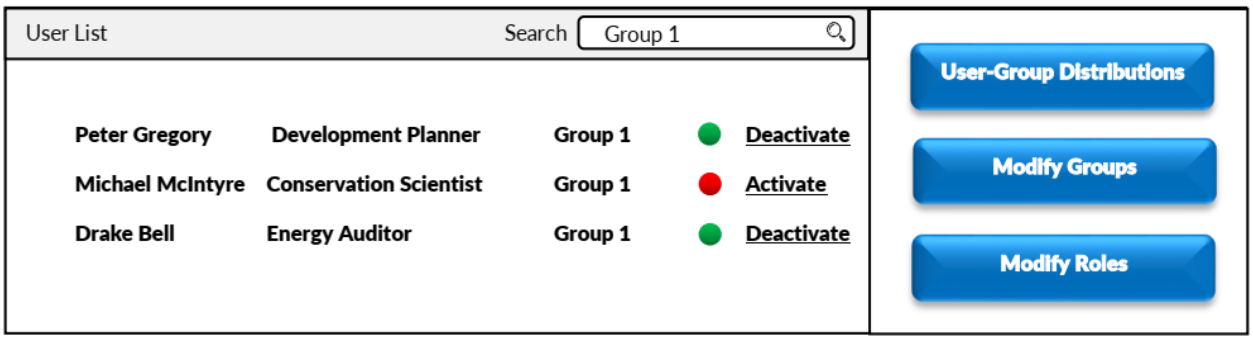
<<system>>	Displays the user account being searched for or accounts with similar names.
<<user>>	Clicks on “Activate/Deactivate”.
<<system>>	Deactivates the account if it is activated, or activates it if it is deactivated. Creates a log of this event.
Post-Condition:	System would prevent deactivated user from logging in if the account is deactivated. If the account is already logged in from one or more devices, the accounts would be logged out automatically.
Alternative Courses/Exceptions	Same procedure can be followed to deactivate an already activated account.

Data Requirements

Entity	Field Name	Data Type	Validation/Description
User Registration Detail	UserRegistrationId	INT	Auto-generated + unique
	UserName	NVARCHAR	Mandatory + unique
	UserPassword	NVARCHAR	Mandatory + unique
	IsActive	BOOL	True or False
	UserEmail	NVARCHAR	Mandatory + unique
	UserMobile	NVARCHAR	Mandatory + unique
	DateOfCreation	DATE	Auto-generated
	LastModifiedDate	DATE	Auto-generated
	IsVerified	BOOL	True Or False

Prototype

User List



UC-015: Create Group

Use Case ID:	UC-015
BREQ ID:	FBR-15
User/Actors:	System Admin
Detail Business Rule:	System should allow admins to add new user groups to the database.
Pre-Condition:	User must be logged in to gain the required authorization for creating a new user group. User must fill up all the fields of the form before submitting the form.
Main success scenario/steps	
Create Group	
<<user>>	Clicks on “Modify Groups”.
<<system>>	Displays a list of Users Groups.
<<user>>	Clicks on the plus sign.
<<system>>	Displays a form for the user to fill up information regarding the new group.
<<user>>	Fills up the form and then submits it.
<<system>>	Updates the database by adding the new User Group into it. Creates a log of this event.
Post-Condition:	New group data will be added to the database. User will be notified upon completion of a successful upload of the group’s data.
Alternative Courses/Exceptions	If a user is being assigned to a group that has not yet been created, the form will be displayed and a group can be created from there. If a user tries to access the page but is not logged in, the user is redirected to the log in page to log in before the user can continue.

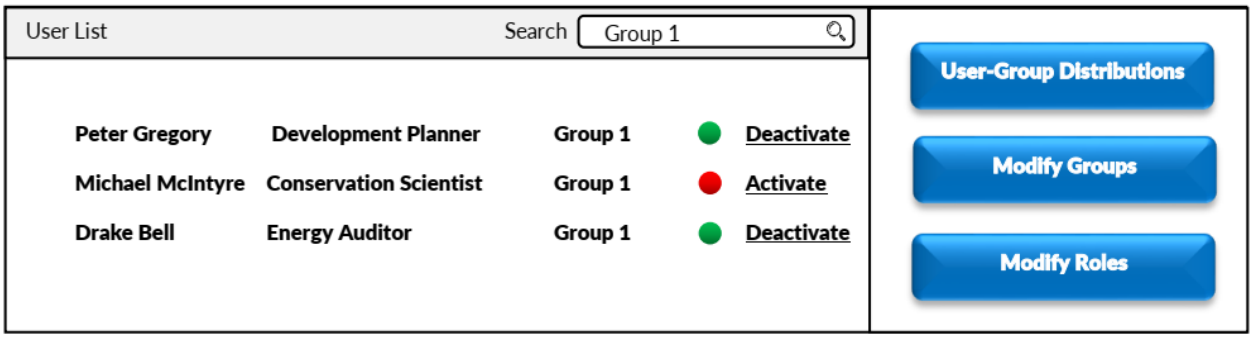
	If data entered is duplicate of existing data the form will not be accepted and the user will be requested to enter new data if any.

Data Requirements

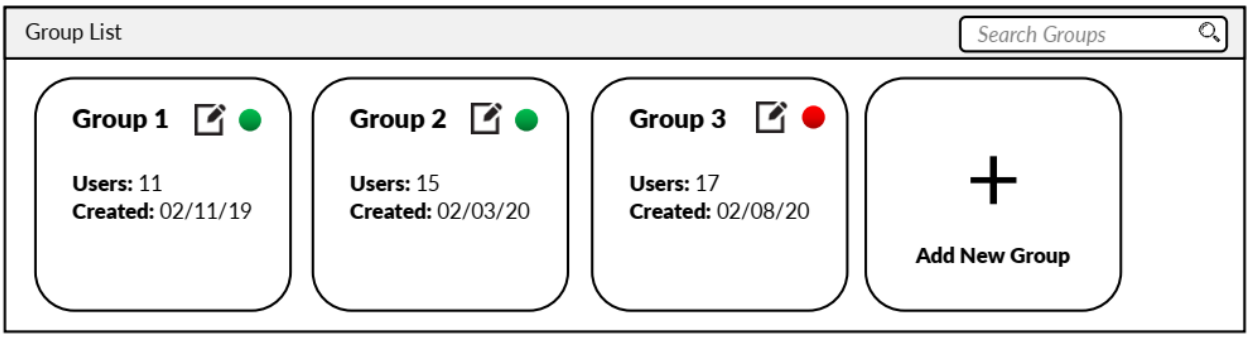
Entity	Field Name	Data Type	Validation/Description
Lookup User Group	UserGroupId	INT	Auto-generated + unique
	UserGroupName	NVARCHAR	Mandatory + unique
	UserGroupActivationStatus	BOOL	True Or False
	CanViewOneAsList	BOOL	True Or False
	CanViewMultipleAsList	BOOL	True Or False
	CanViewAsDetails	BOOL	True Or False
	CanInsertOne	BOOL	True Or False
	CanInsertMultiple	BOOL	True Or False
	CanUpdateOne	BOOL	True Or False
	CanUpdateMultiple	BOOL	True Or False
	CanDeleteOne	BOOL	True Or False
	CanDeleteMultiple	BOOL	True Or False
User Group Wise Menu Details	GrpWiseMenuDistrbId	INT	Auto-generated + unique
	MenuId	INT	Auto-generated + unique
	SubMenuId	INT	Auto-generated + unique
	UserGroupId	INT	Auto-generated + unique
	IsActive	BOOL	True Or False
Lookup Menu	MenuId	INT	Auto-generated + unique
	MenuTitle	NVARCHAR	Mandatory
	MenuTitleBn	NVARCHAR	Mandatory
Lookup Sub Menu	SubMenuId	INT	Auto-generated + unique
	MenuId	INT	Auto-generated + unique
	SubMenuTitle	NVARCHAR	Mandatory
	SubMenuTitleBn	NVARCHAR	Mandatory
	Controller	NVARCHAR	Mandatory
	Action	NVARCHAR	Mandatory

Prototype

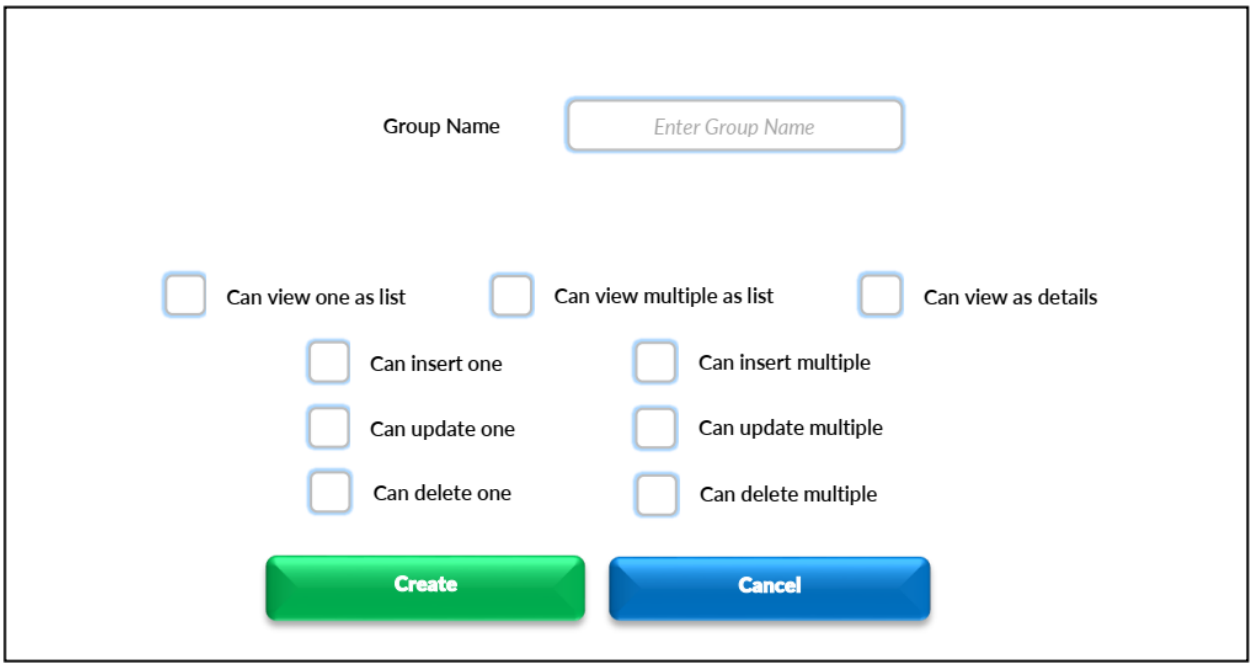
User List



Modify Groups



Create Group



UC-016: Edit Group

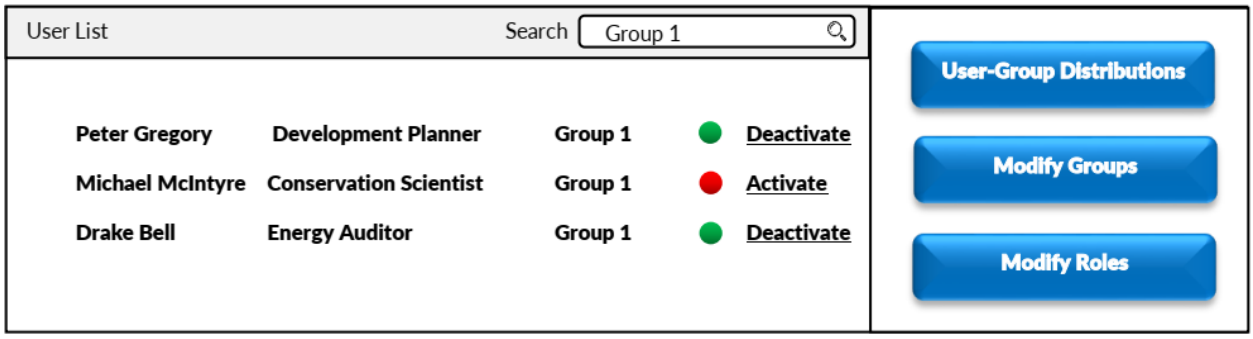
Use Case ID:	UC-016
BREQ ID:	FBR-16
User/Actors:	System Admin
Detail Business Rule:	System should allow admins to edit existing user groups on the database.
Pre-Condition:	User must be logged in to gain the required authorization for editing an existing user group.
Main success scenario/steps	
Edit Group	
<<user>>	Clicks on “Modify Groups”.
<<system>>	Displays a list of Users Groups.
<<user>>	Clicks on the edit icon.
<<system>>	Displays a form for the user to fill up information regarding the updates for the group.
<<user>>	Fills up the form and then submits it.
<<system>>	Updates the database by updating the information of the User Group in it. Creates a log of this event.
Post-Condition:	Updated group data will be added to the database. User will be notified upon completion of a successful upload of the group’s data.
Alternative Courses/Exceptions	If a user tries to access the page but is not logged in, the user is redirected to the log in page to log in before the user can continue. If data entered is duplicate of existing data the form will not be accepted and the user will be requested to enter new data if any.

Data Requirements

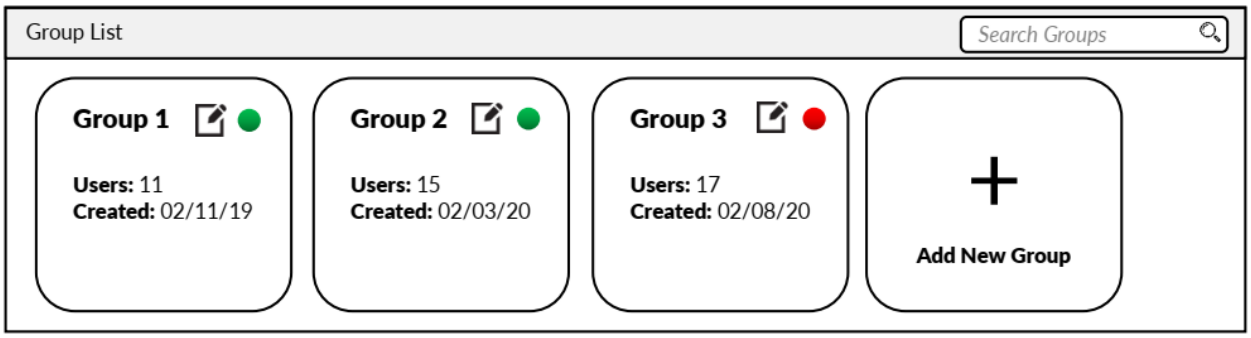
Entity	Field Name	Data Type	Validation/Description
Lookup User Group	UserGroupId	INT	Auto-generated + unique
	UserGroupName	NVARCHAR	Mandatory + unique
	UserGroupActivationStatus	BOOL	True Or False
	CanViewOneAsList	BOOL	True Or False
	CanViewMultipleAsList	BOOL	True Or False
	CanViewAsDetails	BOOL	True Or False
	CanInsertOne	BOOL	True Or False
	CanInsertMultiple	BOOL	True Or False
	CanUpdateOne	BOOL	True Or False
	CanUpdateMultiple	BOOL	True Or False
	CanDeleteOne	BOOL	True Or False
	CanDeleteMultiple	BOOL	True Or False
User Group Wise Menu Details	GrpWiseMenuDistrbId	INT	Auto-generated + unique
	MenuId	INT	Auto-generated + unique
	SubMenuId	INT	Auto-generated + unique
	UserGroupId	INT	Auto-generated + unique
	IsActive	BOOL	True Or False
Lookup Menu	MenuId	INT	Auto-generated + unique
	MenuTitle	NVARCHAR	Mandatory
	MenuTitleBn	NVARCHAR	Mandatory
Lookup Sub Menu	SubMenuId	INT	Auto-generated + unique
	MenuId	INT	Auto-generated + unique
	SubMenuTitle	NVARCHAR	Mandatory
	SubMenuTitleBn	NVARCHAR	Mandatory
	Controller	NVARCHAR	Mandatory
	Action	NVARCHAR	Mandatory

Prototype

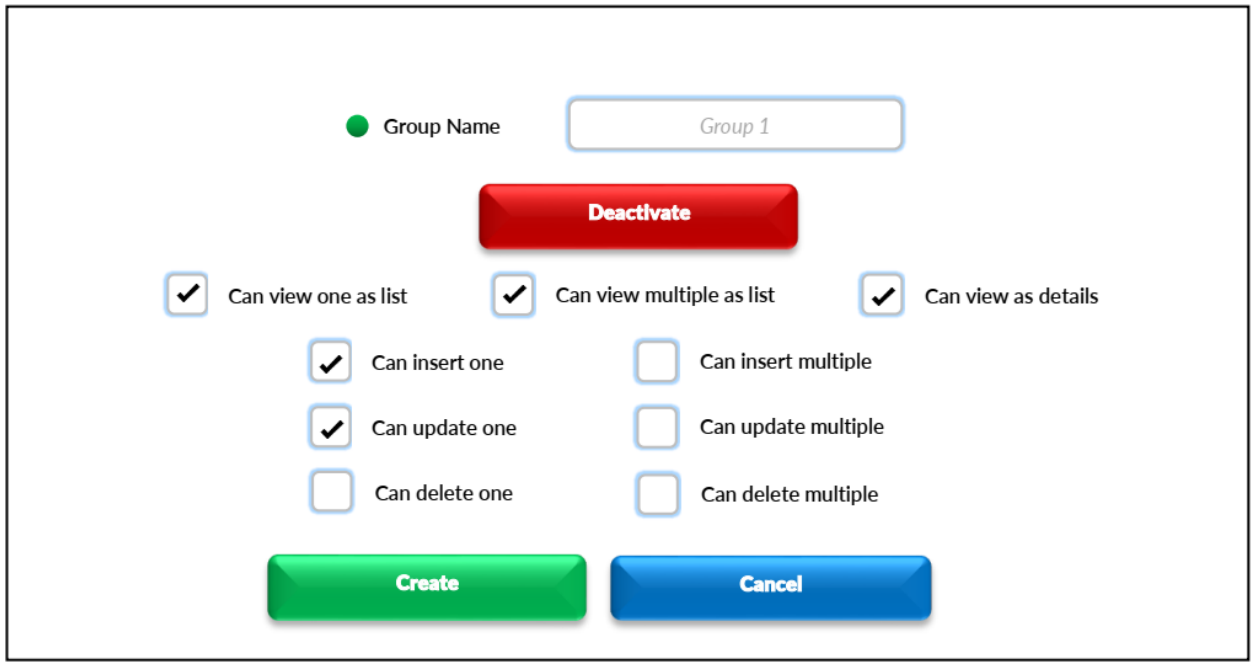
User List



Modify Groups



Edit Group



UC-017: Assign Role To Group

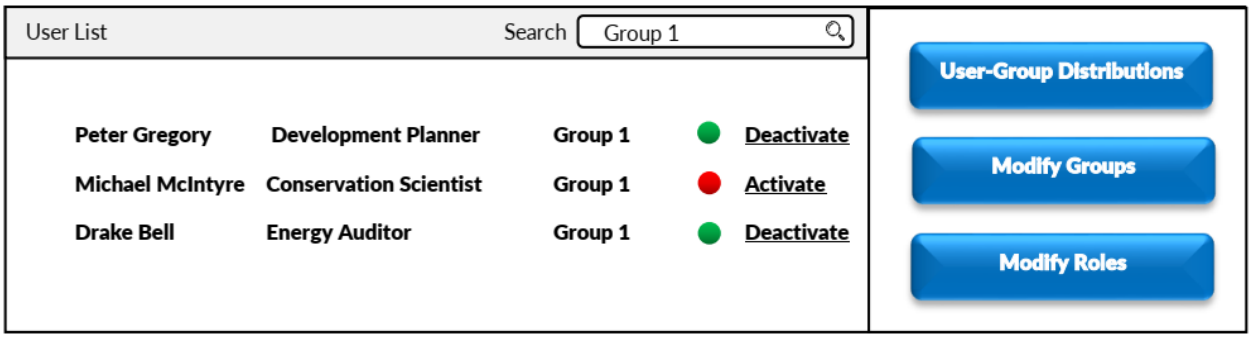
Use Case ID:	UC-017
BREQ ID:	FBR-17
User/Actors:	System Admin
Detail Business Rule:	System should allow admins to assign roles to existing user groups on the database.
Pre-Condition:	User must be logged in to gain the required authorization for assigning a role to an existing user group.
Main success scenario/steps	
Edit Group	
<<user>>	Clicks on “Modify Groups”.
<<system>>	Displays a list of Users Groups.
<<user>>	Clicks on the edit icon.
<<system>>	Displays a form for the user to fill up information regarding the updates for the group.
<<user>>	Modifies the permissions on the form and then submits it.
<<system>>	Updates the database by updating the information of the User Group in it. Creates a log of this event.
Post-Condition:	Updated group data will be added to the database. User will be notified upon completion of a successful upload of the group’s data.
Alternative Courses/Exceptions	If a user tries to access the page but is not logged in, the user is redirected to the log in page to log in before the user can continue.

Data Requirements

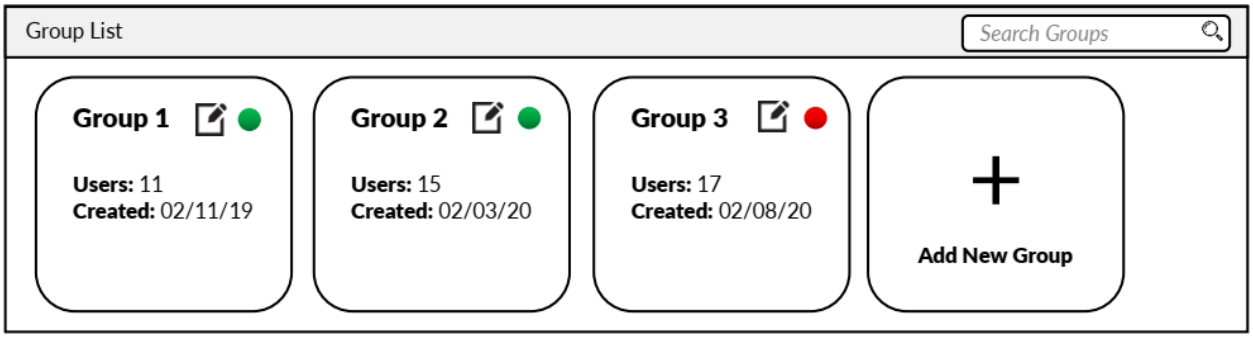
Entity	Field Name	Data Type	Validation/Description
Lookup User Group	UserGroupId	INT	Auto-generated + unique
	UserGroupName	NVARCHAR	Mandatory + unique
	UserGroupActivationStatus	BOOL	True Or False
	CanViewOneAsList	BOOL	True Or False
	CanViewMultipleAsList	BOOL	True Or False
	CanViewAsDetails	BOOL	True Or False
	CanInsertOne	BOOL	True Or False
	CanInsertMultiple	BOOL	True Or False
	CanUpdateOne	BOOL	True Or False
	CanUpdateMultiple	BOOL	True Or False
	CanDeleteOne	BOOL	True Or False
	CanDeleteMultiple	BOOL	True Or False
User Group Wise Menu Details	GrpWiseMenuDistrbId	INT	Auto-generated + unique
	MenuId	INT	Auto-generated + unique
	SubMenuId	INT	Auto-generated + unique
	UserGroupId	INT	Auto-generated + unique
	IsActive	BOOL	True Or False
Lookup Menu	MenuId	INT	Auto-generated + unique
	MenuTitle	NVARCHAR	Mandatory
	MenuTitleBn	NVARCHAR	Mandatory
Lookup Sub Menu	SubMenuId	INT	Auto-generated + unique
	MenuId	INT	Auto-generated + unique
	SubMenuTitle	NVARCHAR	Mandatory
	SubMenuTitleBn	NVARCHAR	Mandatory
	Controller	NVARCHAR	Mandatory
	Action	NVARCHAR	Mandatory

Prototype

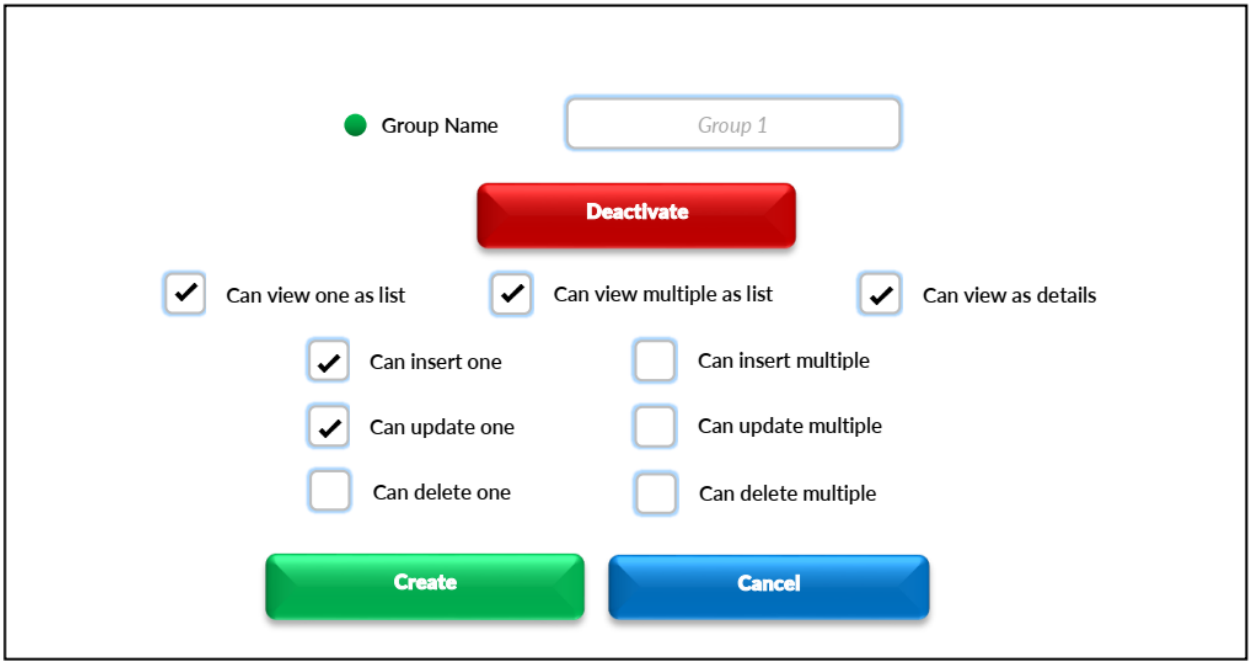
User List



Modify Groups



Edit Group



UC-018: Activate/Deactivate Group

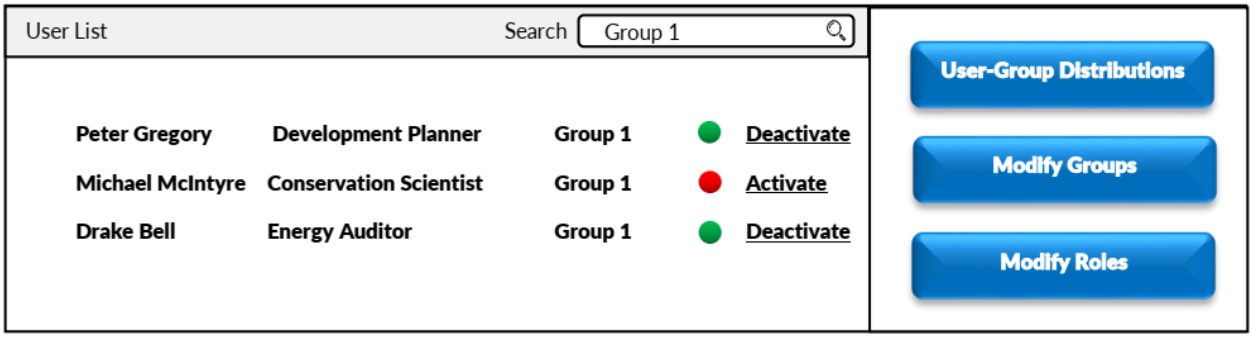
Use Case ID:	UC-018
BREQ ID:	FBR-18
User/Actors:	System Admin
Detail Business Rule:	System should allow admins to activate or deactivate existing user groups from the database.
Pre-Condition:	User must be logged in to gain the required authorization for activating or deactivating an existing user group.
Main success scenario/steps	
Delete Group	
<<user>>	Clicks on “Modify Groups”.
<<system>>	Displays a list of Users Groups.
<<user>>	Clicks on the edit icon.
<<system>>	Displays a form for the user to fill up with a “Activate” or “Deactivate” button on it.
<<user>>	Clicks on the “Activate” or “Deactivate” button.
<<system>>	Updates the database by updating the information of the User Group in it. Creates a log of this event.
Post-Condition:	Group data will be updated in the database. User will be notified upon completion of a successful activation or deactivation of the group.
Alternative Courses/Exceptions	If a user tries to access the page but is not logged in, the user is redirected to the log in page to log in before the user can continue.

Data Requirements

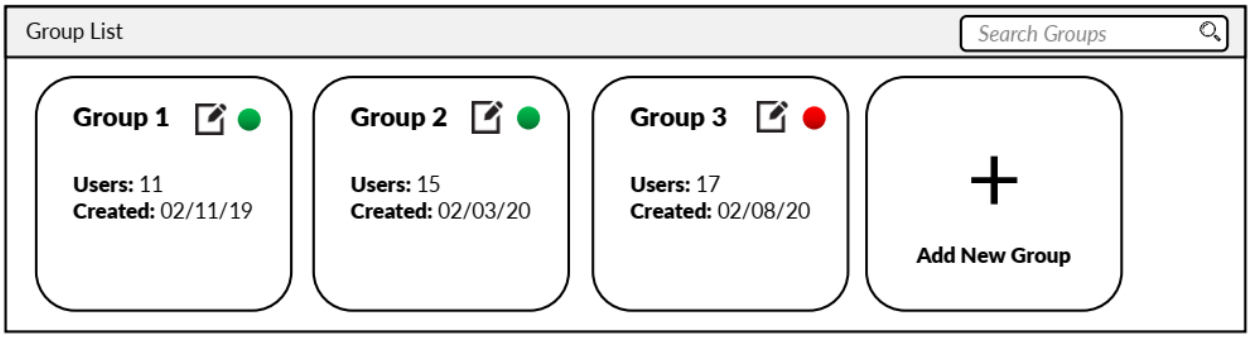
Entity	Field Name	Data Type	Validation/Description
Lookup User Group	UserGroupId	INT	Auto-generated + unique
	UserGroupName	NVARCHAR	Mandatory + unique
	UserGroupActivationStatus	BOOL	True Or False
	CanViewOneAsList	BOOL	True Or False
	CanViewMultipleAsList	BOOL	True Or False
	CanViewAsDetails	BOOL	True Or False
	CanInsertOne	BOOL	True Or False
	CanInsertMultiple	BOOL	True Or False
	CanUpdateOne	BOOL	True Or False
	CanUpdateMultiple	BOOL	True Or False
	CanDeleteOne	BOOL	True Or False
	CanDeleteMultiple	BOOL	True Or False

Prototype

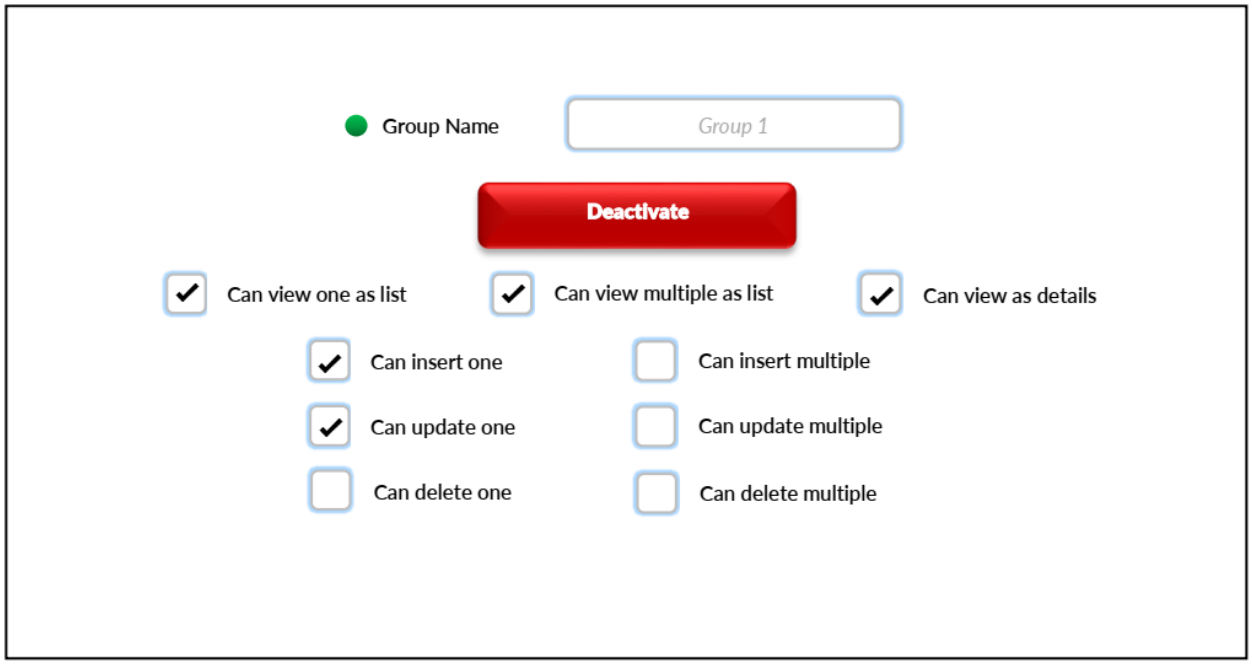
User List



Modify Groups



Edit Group



UC-019: Manage User-Group Distribution

Use Case ID:	UC-019
BREQ ID:	FBR-19
User/Actors:	System Admin
Detail Business Rule:	System should allow admins to manage user-group distributions within the database.
Pre-Condition:	User must be logged in to gain the required authorization for assigning user and groups associations.
Main success scenario/steps	
Add Users to Groups	
<<user>>	Clicks on “User-Group Distributions”.
<<system>>	Displays a list of Users Groups.
<<user>>	Types the name of the user and clicks on the plus icon.

<<system>>	Updates the database by adding the user to the User Group selected and removes all existing user associations with any other group. Creates a log of this event.
Remove Users from Groups	
<<user>>	Clicks on “User-Group Distributions”.
<<system>>	Displays a list of Users Groups.
<<user>>	Types the name of the user and clicks on the minus icon.
<<system>>	Updates the database by removing the user from the User Group selected. Creates a log of this event.
Post-Condition:	User will be added to or removed from the selected group. User will be notified upon completion of a successful addition or removal of a user from a group.
Alternative Courses/Exceptions	If a user tries to access the page but is not logged in, the user is redirected to the log in page to log in before the user can continue.

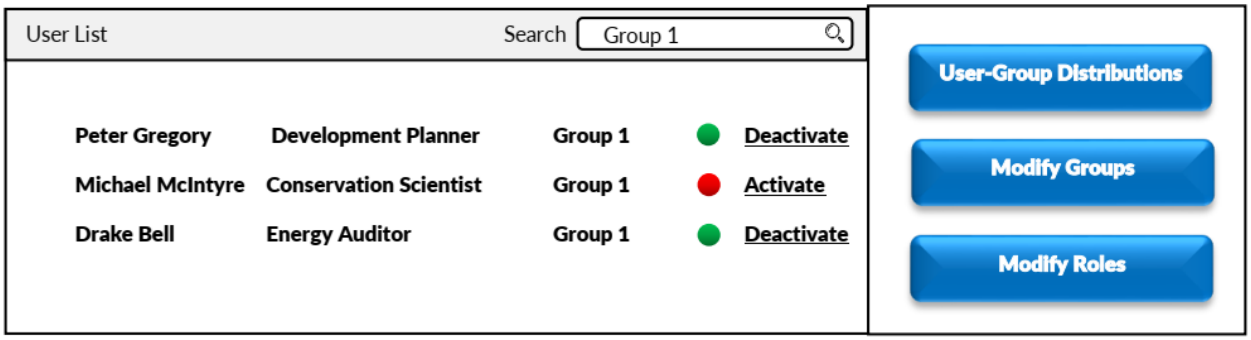
Data Requirements

Entity	Field Name	Data Type	Validation/Description
Lookup User Group	UserGroupId	INT	Auto-generated + unique
	UserGroupName	NVARCHAR	Mandatory + unique
	UserGroupActivationStatus	BOOL	True Or False
	CanViewOneAsList	BOOL	True Or False
	CanViewMultipleAsList	BOOL	True Or False
	CanViewAsDetails	BOOL	True Or False
	CanInsertOne	BOOL	True Or False
	CanInsertMultiple	BOOL	True Or False
	CanUpdateOne	BOOL	True Or False
	CanUpdateMultiple	BOOL	True Or False
	CanDeleteOne	BOOL	True Or False
	CanDeleteMultiple	BOOL	True Or False

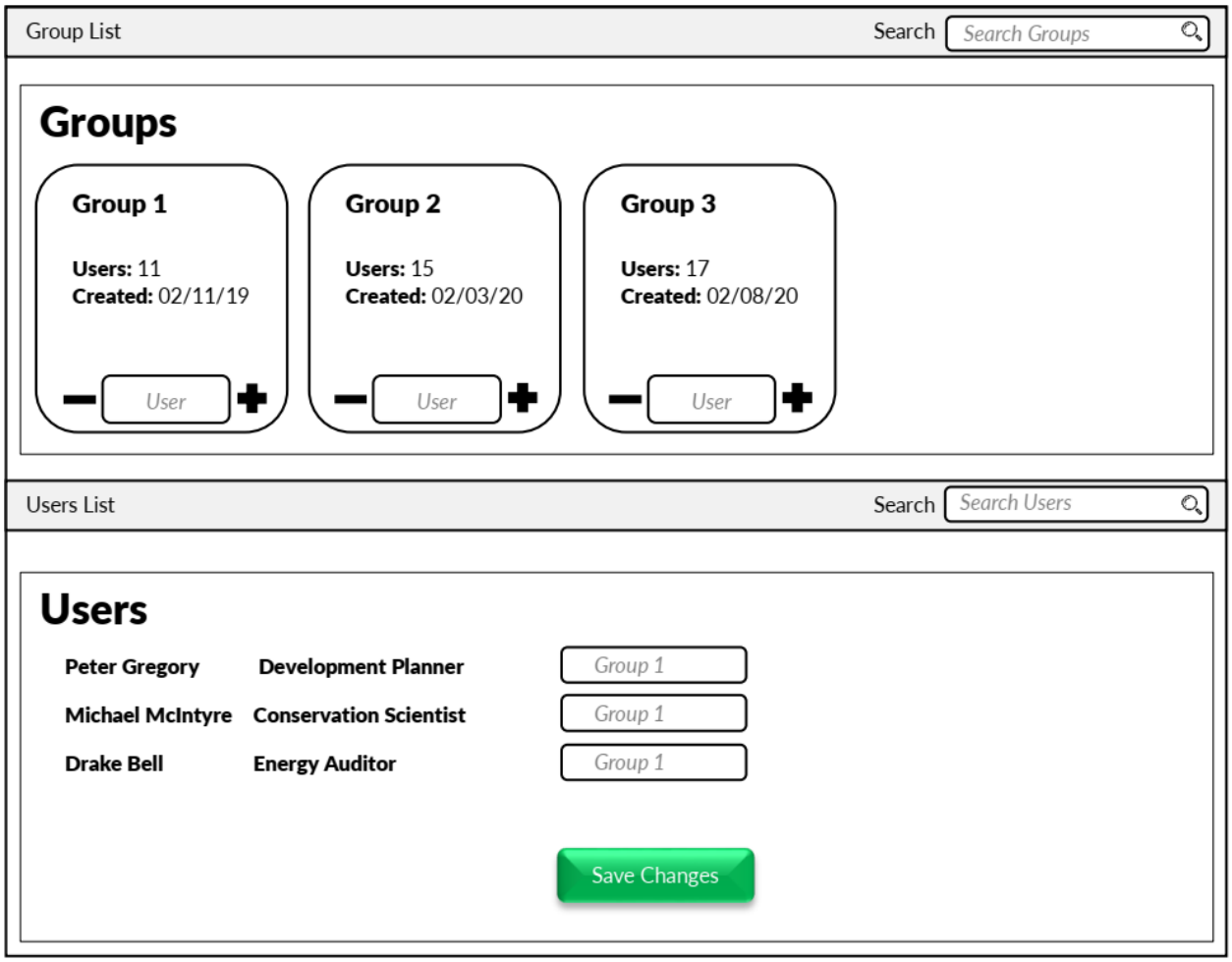
User Group Distribution Detail	UserDistributionDetailId	INT	Auto-generated + unique
	UserId	INT	Auto-generated + unique
	UserGroupId	INT	Auto-generated + unique

Prototype

User List



User-Group Distributions



UC-020: Monitor User Log History

Use Case ID:	UC-020
BREQ ID:	FBR-20
User/Actors:	System Admin
Detail Business Rule:	System should allow admin to monitor user log history.
Pre-Condition:	User must be logged in to gain the required authorization for monitoring logs.
Main success scenario/steps	
Delete Account	
<<user>>	Clicks on “Monitor User Log History”,

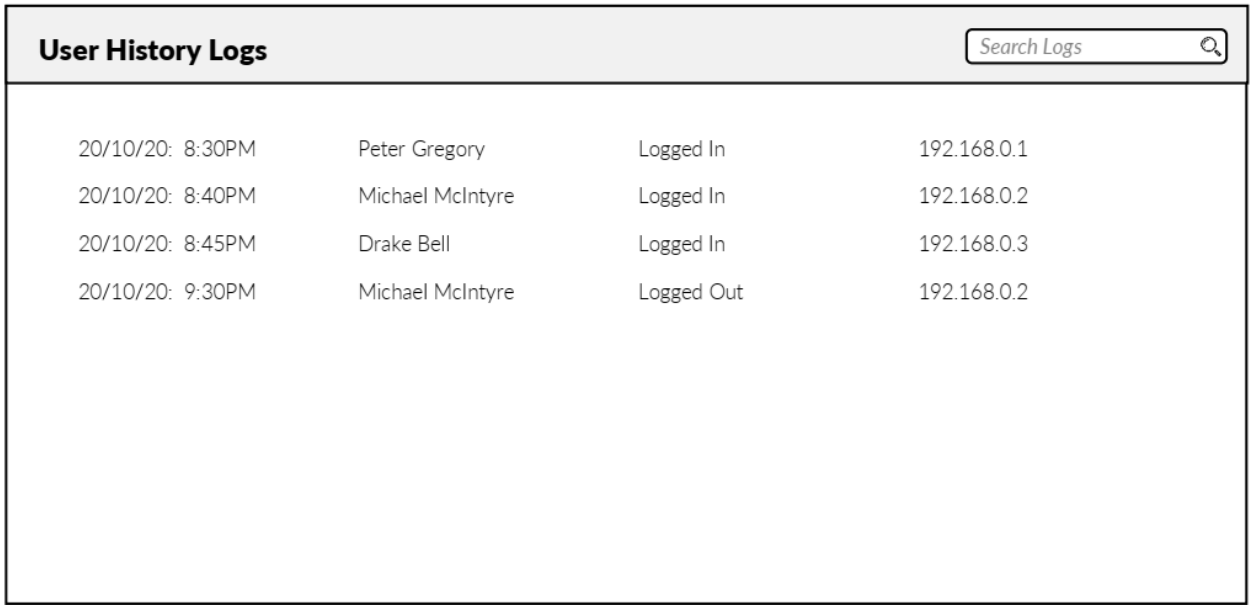
<<system>>	Displays a list of logs of all System events and a summary of the events.
<<user>>	Reports logs of events that require certain actions to be taken.
<<system>>	Creates a log to record this event.
Post-Condition:	System would display an appropriate message to indicate any failed display attempt for logs.
Alternative Courses/Exceptions	None.

Data Requirements

Entity	Field Name	Data Type	Validation/Description
User Detail	UserId	INT	Auto-generated + unique
	UserRegistrationId	INT	Auto-generated + unique
	UserFullName	NVARCHAR	Mandatory
	UserFullNameBn	NVARCHAR	
	UserDesignation	NVARCHAR	Mandatory
	UserAddress	NVARCHAR	Mandatory
	UserAddressBn	NVARCHAR	
	SecurityQuestion Id	INT	Mandatory, Id of Question selected
	SecurityQuestionAnswer	NVARCHAR	Mandatory
	IsProfileSubmitted	BOOL	True Or False
User Log History Detail	UserLogHistoryId	INT	Auto-generated + unique
	UserId	INT	Auto-generated + unique
	LoginDateTime	DATE	Auto-generated
	MachineIPOrURL	NVARCHAR	

Prototype

User Log History Page



5.3.2 External Interface Requirements(ARH)

- **Hardware Interface**

  No hardware interfacing is required except standard printing devices for printing the reports.

- **Software Interface**

  No software interfacing is required. It is an independent module.

- **Communications Interface**

  Communications protocols: TCP/IP Database (MySQL) access port number: 3306

5.3.3 Nonfunctional Requirements(ARH)

The consultant team identified the following non-functional requirement:

- Usability Requirement

  To make the system easily navigated there should be dropdown menu facility. The following will meet the usability requirement:

  → Background color should be comfortable
  → Font of the software should be large enough so that user can read easily
  → Dropdown menu needs to be used to ease the navigation.
  → DRIP user manual will help the users to operate the system easily.
  → Training must be given to the System User to use the system perfectly.
  → Training document should be given to the system user.

- Reliability

  System need to be available 24/7.

- Performance

  System should response with in 8 seconds after submitting the request.

- Supportability
  - → Coding will have in line documentation and proper indenting between functions, variables, etc.
  - → There will be naming convention for coding.
- Security Requirement
  - → User authentication is required.
  - → Users need to be logged in to the system for any type of processing.
  - → User will give proper user id and password to authenticate.
  - → Role based security is required.
  - → Privileges will be given to roles (user groups).
  - → User will be assigned with particular roles.
- Operational Requirements

  N/A

- Design Constrains

The system needs to be designed to work with MySQL database

5.4 Development of DRIP System

Based on the above mentioned literature review, inception workshop and stakeholder analysis, the DRIP will be developed. The system will be developed in a gis based architecture. The web application will also be developed considering the role-based architecture. Thus most of the features of this application will be accessible by the authenticated users.

5.5 System Architecture

A system architecture of DRIP system has been finalized. According to the requirement, the system will be designed and developed using the standard four-tier architecture of software development. Hence, It will consist of the following layers: 1) Presentation (user-interface), 2) Web server, 3) Application server, 4) Data server

5.5.1 Presentation Layer

The presentation layer is a user-interface that a user uses to interact with the application. This layer will be developed using ASP.Net Core. The development of the system can be performed by the PHP programming language as well. However, it is too much time consuming in the php environment to implement some simple functionality than in ASP.Net Core. In addition, the features of the ASP.Net Core is very flexible, robust and time-efficient with respect to an application development like DRIP. The design and look of interfaces will be made simple and user-friendly in consultation with the officials of Programming Division and UNDP.

5.5.2 Web Server

The main component for a web-enabled application is the web server. A program manages and delivers web pages and allows users to communicate with the server for data service Approach and Methodology 11 through the Internet or the intranet. The web server will be configured using Internet Information Services.

5.5.3 Application Server

The application layer will consist of business and data components. The business component is used to impose different business rules and logic. The data component is responsible for retrieving data from the server. The application layer will be developed using ASP .Net.

5.5.4 Data Server

The data server contains data, views, triggers and stored-procedure. It executes SQL statements, views, triggers and stored-procedure for data manipulation. A geo-spatial database will be used for storing spatial data. MySQL Database Management System will be used for managing this database.

5.6 Development of Geo-Spatial Database

A Geo-spatial database has been be designed for the DRIP system which will be used to store data in a relational dbms environment. In order to develop this database, the requirements identified has been converted into a Data Flow Diagram (DFD). Depending on the DFD, a logical model has been developed to produce an ER diagram. Depending on the logical model (ER Diagram), the physical database has been designed. According to the specifications, system analysis and considering the volume of data, MySQL DBMS has been chosen to develop the physical database. To avoid data redundancy and inconsistency, the database has been normalized and a number of tables have been used to store attribute data. Parent-child relationship has been implemented between tables to maintain data relationships and the referential integrity has been implemented for maintaining the data integrity. The referential integrity ensures that, no data can be entered in the child tables without entering corresponding data in the parent table. Each table maintains a primary key, which uniquely identifies each record in the table to reduce the chances of data duplication.

5.6.1 Data Flow Diagram

A data flow diagram (DFD) of DRIP system has been drawn to view the graphical representation of the flow of data through an information system, modelling its process aspects. The DFD of DRIP system shows what kinds of information will be input to and output from it, where the data will come from and go to, and where the data will be stored. A context-level data flow diagram shows the interaction between the system and external agents which act as data sources and data sinks.

A level-0 DFD of the DRIP system is given below.

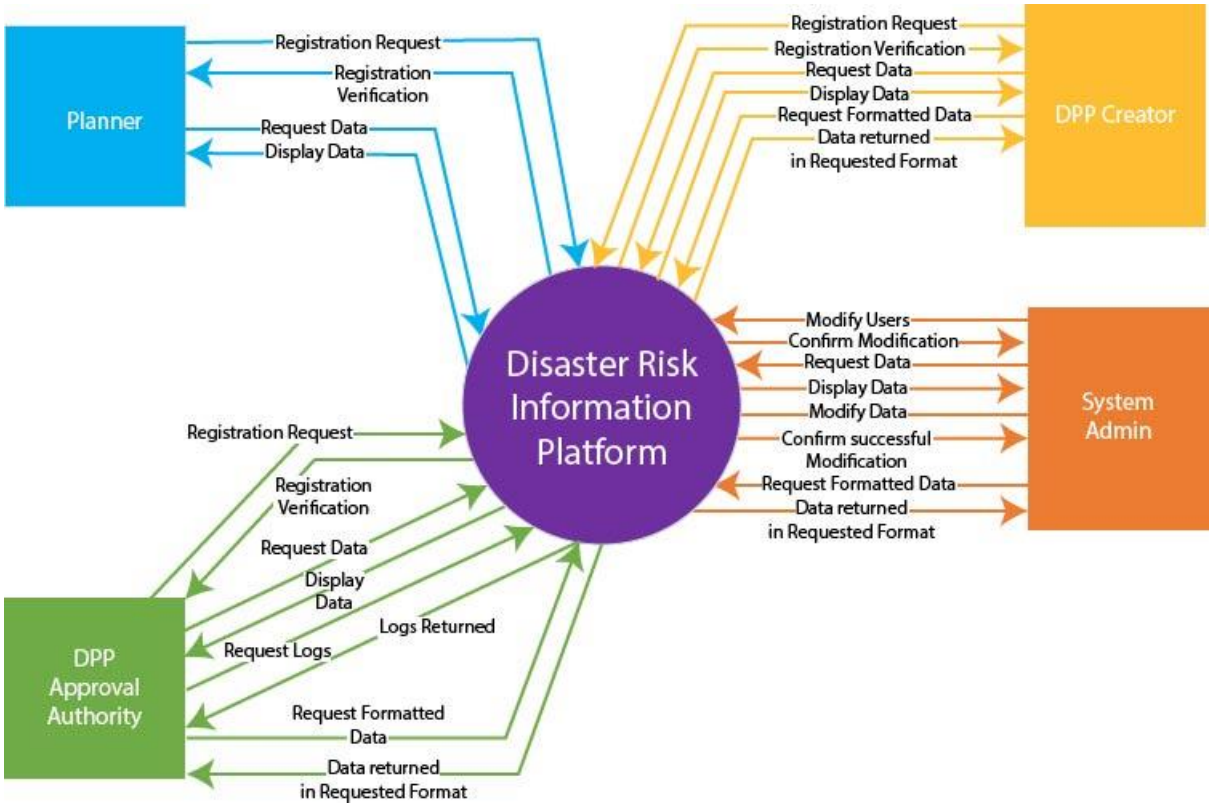


Figure 5.1: DFD-0/Context Diagram of DRIP

A level-1 DFD of the DRIP system is given below.

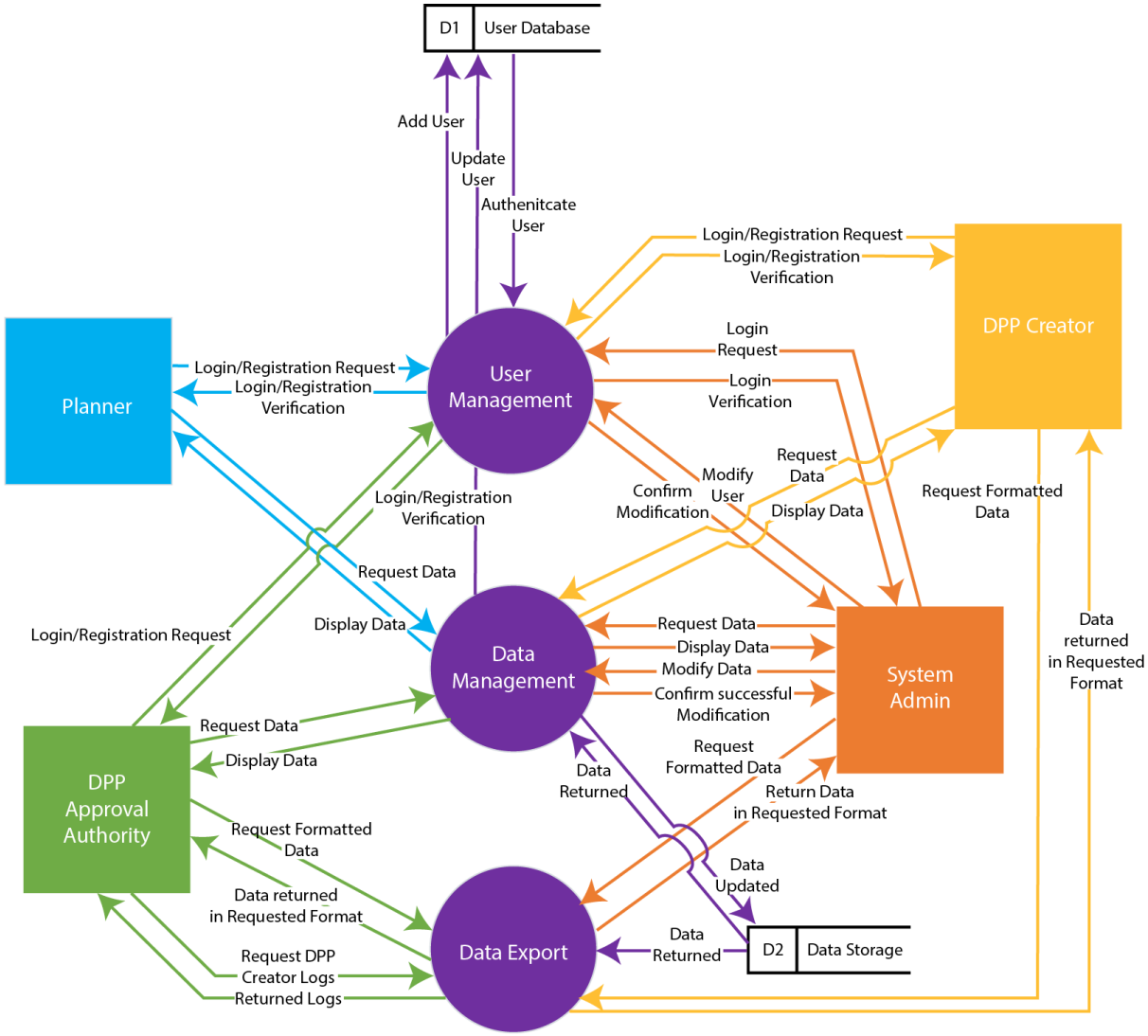


Figure 5.2: DFD-1 Diagram of DRIP

A level-2 DFD of the DRIP system is given below.

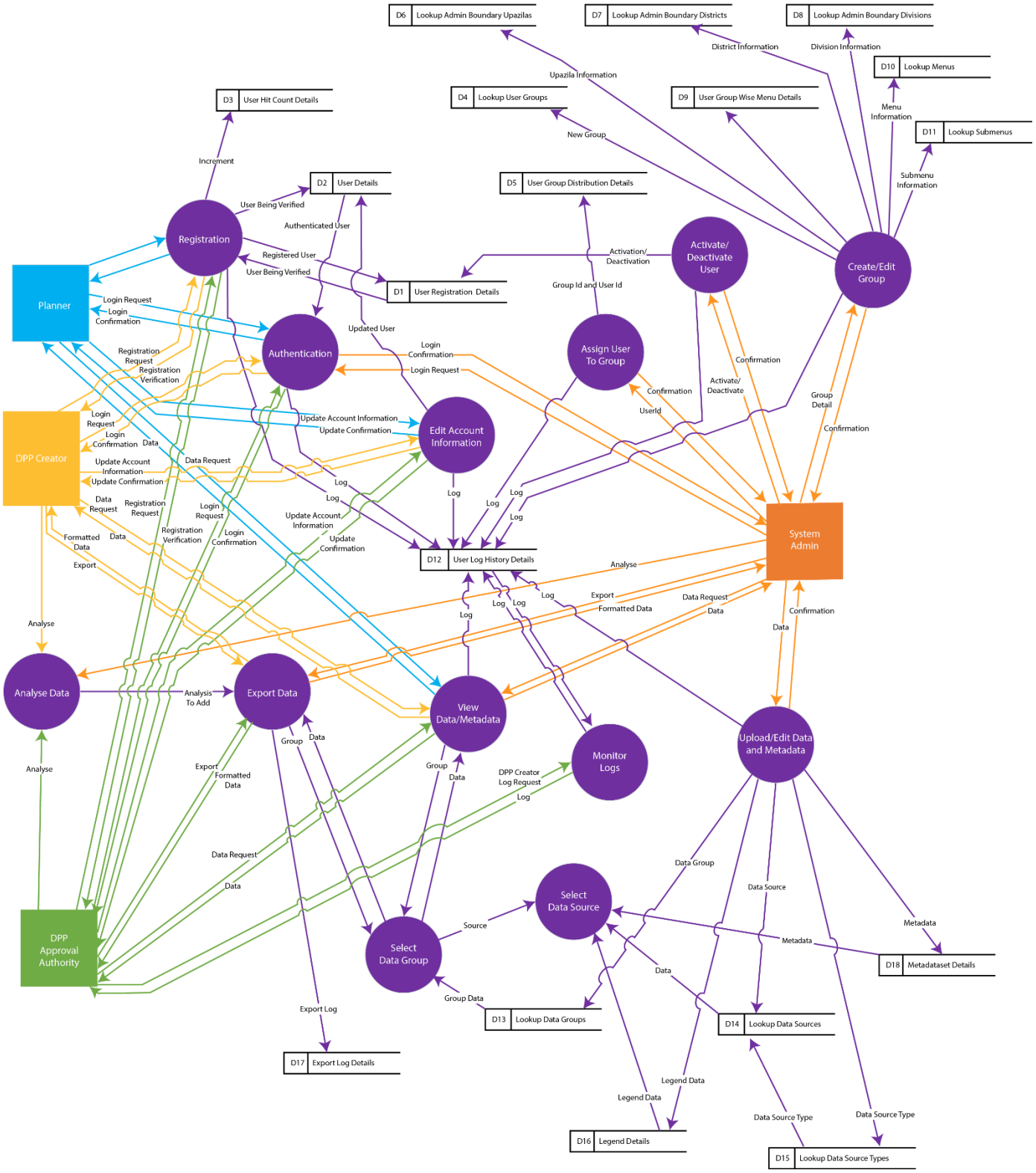


Figure 5.3: DFD-2 Diagram of DRIP

5.6.2 E-R Diagram

The ER diagrams have been prepared for the DRIP system which represents the Data Definition Tables, Lookup Tables and Data Tables that has been designed for this system. The ER diagrams of tables related to DRIP System is shown in the following figures:

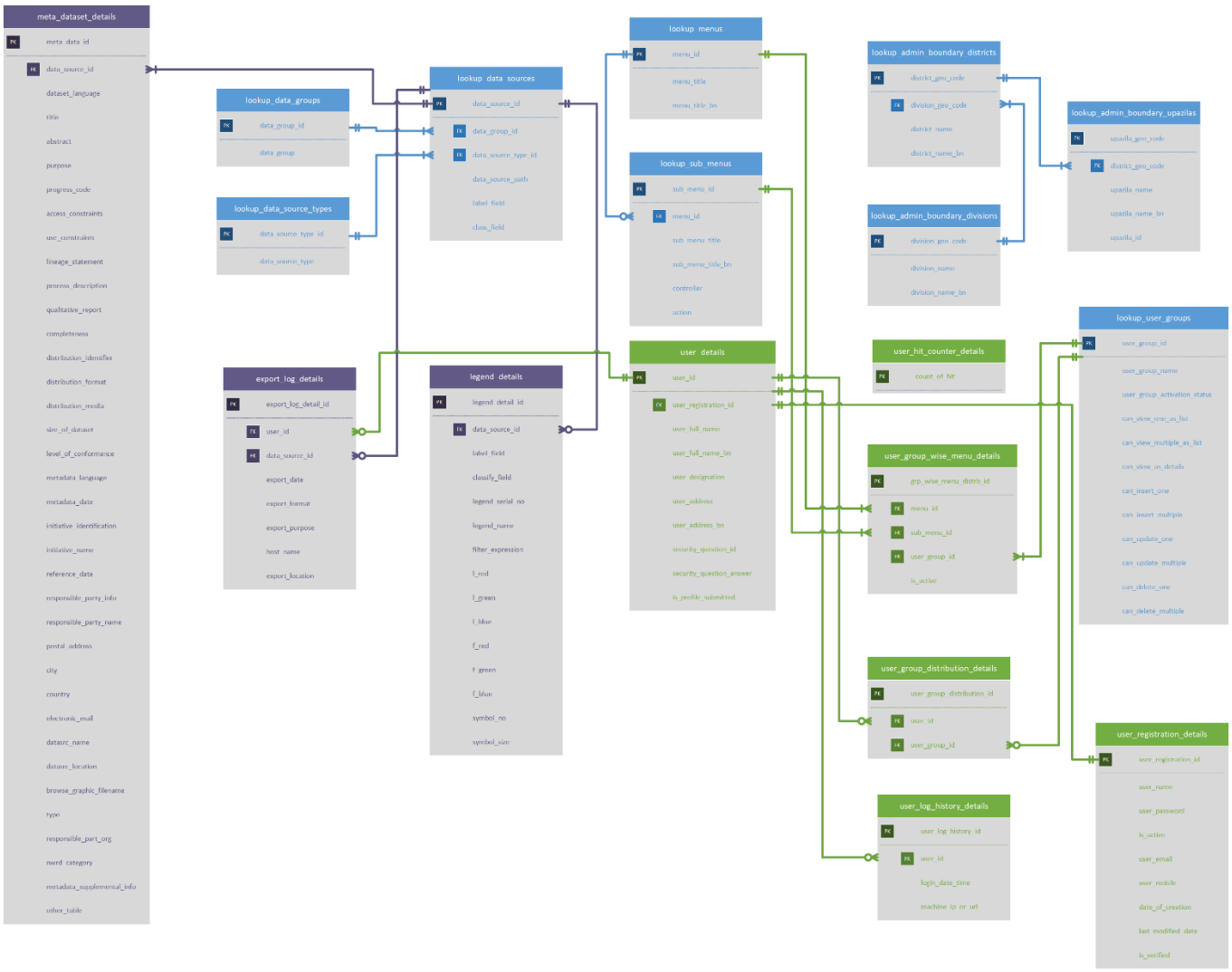


Figure 5.4: E-R Diagram of DRIP

5.6.3 Structure of DB Tables

After completing E-R diagram, description of structure of each table of DRIP has been prepared. The description contains Column Name, Data Type, Length, PK/FK, Ref. Table, Ref. Field. A list of similar kind of table structure is given below.

Table Name: meta_dataset_details

Description: This table stores meta dataset information. The key parameter fields of this table are **meta_data_id, data_source_id, dataset_language** etc. **meta_data_id** field is assigned as primary key (PK). **data_source_id** has been used as the foreign key where **lookup_data _sources** is treated as their reference table respectively.

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
meta_data_id	INT		PK		
data_source_id	INT		FK	lookup _data _sources	data_source_id
dataset_language	NVARCHAR	250			
title	NVARCHAR	100			
abstract	NVARCHAR	250			
purpose	NVARCHAR	250			
progress_code	INT				
access_constraints	NVARCHAR	100			
use_constraints	NVARCHAR	100			
lineage_statement	NVARCHAR	250			
process_description	NVARCHAR	250			
qualitative_report	NVARCHAR	250			
completeness	NVARCHAR	100			
distribution_identifier	NVARCHAR	100			
distribution_format	NVARCHAR	100			
distribution_media	NVARCHAR	250			
size_of_dataset	NVARCHAR	50			

level_of_conformance	NVARCHAR	100			
metadata_language	NVARCHAR	100			
metadata_date	DATE				
initiative_identification	NVARCHAR	100			
initiative_name	NVARCHAR	100			
reference_date	DATE				
responsible_party_info	NVARCHAR	250			
responsible_party_name	NVARCHAR	100			
postal_address	NVARCHAR	100			
city	NVARCHAR	50			
country	NVARCHAR	50			
electronic_mail	NVARCHAR	50			
datasrc_name	NVARCHAR	100			
datasrc_location	NVARCHAR	50			
browse_graphic_filename	NVARCHAR	100			
type	NVARCHAR	50			
responsible_part_org	NVARCHAR	100			
nwrd_category	NVARCHAR	100			

metadata_supplemental_info	NVARCHAR	100			
other_table	NVARCHAR	100			

Table Name: legend_details

Description: This table stores legend information. The key parameter fields of this table are **legend_detail_id, data_source_id, label_field** etc. **legend_detail_id** field is assigned as primary key (PK). **data_source_id** has been used as the foreign key where **lookup _data _sources** is treated as their reference table respectively.

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
legend_detail_id	INT		PK		
data_source_id	INT		FK	lookup _data _sources	data_source_id
label_field	NVARCHAR				
classify_field	NVARCHAR				
legend_serial_no	INT				
legend_name	NVARCHAR	100			
filter_expression	NVARCHAR	200			
l_red	DOUBLE				
l_green	DOUBLE				
l_blue	DOUBLE				
f_red	DOUBLE				
f_green	DOUBLE				

f_blue	DOUBLE				
symbol_no	INT				
symbol_size	INT				

Table Name: user_details

Description: This table stores user's information. The key parameter fields of this table are **user_id,user_registration_id,user_full_name** etc. **User_Id** field is assigned as primary key (PK). **user_registration_id** has been used as the foreign key where **user_registration _details** is treated as their reference table respectively.

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
user_id	INT		PK		
user_registration_id	INT		FK	user_registration _details	user_registration_ id
user_full_name	NVARCHAR	100			
user_designation	NVARCHAR	100			
user_address	NVARCHAR	250			
security_question_id	INT				
security_question_answer	NVARCHAR	250			
is_profile_submitted	BOOL				
user_full_name_bn	NVARCHAR	100			
user_address_bn	NVARCHAR	100			

Table Name: user_registration_details

Description: This table stores user's registration information. The key parameter fields of this table are **user_registration_id, user_name, user_password** etc. **user_registration_id** field is assigned as primary key (PK).

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
user_registration_id	INT		PK		
user_name	NVARCHAR	100			
user_password	NVARCHAR	50			
is_active	BOOL				
user_email	NVARCHAR	50			
user_mobile	NVARCHAR	50			
date_of_creation	DATE				
last_modified_date	DATE				
is_verified	BOOL				

Table Name: user_group_distribution _details

Description: This table stores user's group distribution information. The key parameter fields of this table are **user_group_distribution_id, user_id, user_group_id**. **user_group_distribution_id** field is assigned as primary key (PK). **user_id** and **user_group_id** have been used as the foreign key where **user_details** and **lookup_user_groups** are treated as their reference table respectively.

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
user_group_distribution_id	INT		PK		
user_id	INT		FK	user_details	user_id
user_group_id	INT		FK	lookup_user_groups	user_group_id

Table Name: user_log_history _details

Description: This table stores user's log history information. The key parameter fields of this table are **user_log_history_id, user_id, login_date_time** etc. **user_log_history_id** field is assigned as primary key (PK). **user_id** has been used as the foreign key where **user_details** is treated as their reference table respectively.

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
user_log_history_id	INT		PK		
user_id	INT		FK	user_details	user_id
login_date_time	DATE				
machine_ip_or_url	NVARCHAR	250			

Table Name: user_hit_counter_details

Description: This table stores hit counter information. The key parameter fields of this table are **user_counter**. **user_counter** field is assigned as primary key (PK).

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
count_of_hit	INT				

Table Name: export_log_details

Description: This table stores export log information. The key parameter fields of this table are **export_log_detail_id, export_format, export_date, export_purpose** etc. **export_log_detail_id** field is assigned as primary key (PK). **user_id** and **data_source_id** have been used as the foreign key where **user_details** and **lookup _data _sources** are treated as their reference table respectively.

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
export_log_detail_id	INT		PK		
user_id	INT		FK	user_details	user_id
export_date	DATE				
data_source_id	INT		FK	lookup _data _sources	data_source_id
export_format	NVARCHAR	20			
export_purpose	NVARCHAR	250			
host_name	NVARCHAR	100			
export_location	NVARCHAR	200			

Table Name: lookup_user_groups

Description: This table stores user's group information for lookup. The key parameter fields of this table are user_group_id, user_group_name etc. **user_group_id** field is assigned as primary key (PK).

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
user_group_id	INT		PK		
user_group_name	NVARCHAR	100			
can_view_one_as_list	BOOL				
can_view_multiple_as_list	BOOL				
can_view_as_details	BOOL				
can_insert_one	BOOL				
can_insert_multiple	BOOL				
can_update_one	BOOL				
can_update_multiple	BOOL				
can_delete_one	BOOL				
can_delete_multiple	BOOL				
user_group_activation_status	BOOL				

Table Name: lookup_data_sources

Description: This table stores data source information for lookup. The key parameter fields of this table are **data_source_id, data_group_id, data_source_type_id** etc. **data_source_id** field is assigned as primary key (PK). **data_group_id** and **data_source_type_id** have been used as the foreign key where **lookup _data _groups** and **lookup _data _source _types** are treated as their reference table respectively.

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
data_source_id	INT		PK		
data_group_id	INT		FK	lookup _data _groups	data_group_id
data_source_type_id	INT		FK	lookup _data _source _types	data_source_type_id
data_source_path	NVARCHAR	150			
label_field	NVARCHAR	100			
class_field	NVARCHAR	50			

Table Name: lookup_data_source_types

Description: This table stores data source types for lookup. The key parameter fields of this table are **data_source_type_id, data_source** etc. **data_source_type_id** field is assigned as primary key (PK).

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
data_source_type_id	INT		PK		
data_source_type	NVARCHAR	100			

Table Name: lookup_data_group

Description: This table stores data group information for lookup. The key parameter fields of this table are data_group_id, data_group etc. **data_group_id** field is assigned as primary key (PK).

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
data_group_id	INT		PK		

data_group	NVARCHAR	50			

Table Name: user_group _wise _menu _details

Description: This table stores user group wise menu information. The key parameter fields of this table are Grp_Wise_Menu_Distrb_Id, Menu_Id, Sub_Menu_Id etc. **grp_wise_menu_distrb_id** field is assigned as primary key (PK). **menu_id, sub_menu_id** and **user_group_id** have been used as the foreign key where **lookup_menus, lookup_submenus** and **lookup_user_groups** are treated as their reference table respectively.

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
grp_wise_menu_distrb_id	INT		PK		
menu_id	INT		FK	lookup_menus	menu_id
sub_menu_id	INT		FK	lookup_submenus	sub_menu_id
user_group_id	INT		FK	lookup _user_groups	user_group_id
is_active	bool				

Table Name: lookup_menus

Description: This table stores menu information for lookup. The key parameter fields of this table **menu_id, menu_titile** etc. **menu_id** field is assigned as primary key (PK).

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
menu_id	INT		PK		

menu_titile	NVARCHAR	100			
menu_titile_bn	NVARCHAR	50			

Table Name: lookup_submenus

Description: This table stores submenu information for lookup. The key parameter fields of this table are **sub_menu_id, menu_Id** etc. **sub_menu_id** field is assigned as primary key (PK). **menu_Id,** has been used as the foreign key where **lookup_menus** is treated as their reference table respectively.

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
sub_menu_id	INT		PK		
menu_id	INT		FK	lookup_menus	menu_id
sub_menu_title	NVARCHAR	50			
sub_menu_title_bn	NVARCHAR	50			
controller	NVARCHAR	50			
action	NVARCHAR	50			

Table Name: lookup_admin_boundary_division

Description: This table stores admin boundary division level information for lookup. The key parameter fields of this table are **division_geo_code, division _name, division _name_bn**. **division _geo_code** field is assigned as primary key (PK).

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
division_geo_code	INT		PK		

division_name	NVARCHAR	100			
division_name_bn	NVARCHAR	50			

Table Name: lookup_admin_boundary_districts

Description: This table stores admin boundary district level information for lookup. The key parameter fields of this table are **division _geo_code, division _name, division _name_bn**. **district_geo_code** field is assigned as primary key (PK).

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
district_geo_code	INT		PK		
division_geo_code	INT		FK	lookup_admin_boundary_divisions	division_geo_code
district_name	NVARCHAR	100			
district_name_bn	NVARCHAR	50			

Table Name: lookup_admin_boundary_upazilas

Description: This table stores admin upazilla level boundary information for lookup. The key parameter fields of this table are division **upazila_geo_code, upazila_name, upazila_name_bn**. **upazila_geo_code** field is assigned as primary key (PK). **district_geo_code** has been used as the foreign key where **lookup_admin_boundary_districts** is treated as their reference table respectively.

Attribute	Data Type	Length	PK/ FK	Ref. Table	Ref. Field
upazila_geo_code	INT		PK		
district_geo_code	INT		FK	lookup_admin_boundary_districts	division_geo_code

upazila_name	NVARCHAR	100			
upazila_name_bn	NVARCHAR	50			
Upazila_id	INT				

5.7 Design and Development of Web Application

5.7.1 Use Case Diagram

The Use case diagrams of DRIP have been prepared used to gather the requirements of a system including internal and external influences. These requirements are mostly design requirements which has been modelled to present the outside view. Some of the use case diagrams of DRIP System are given below.

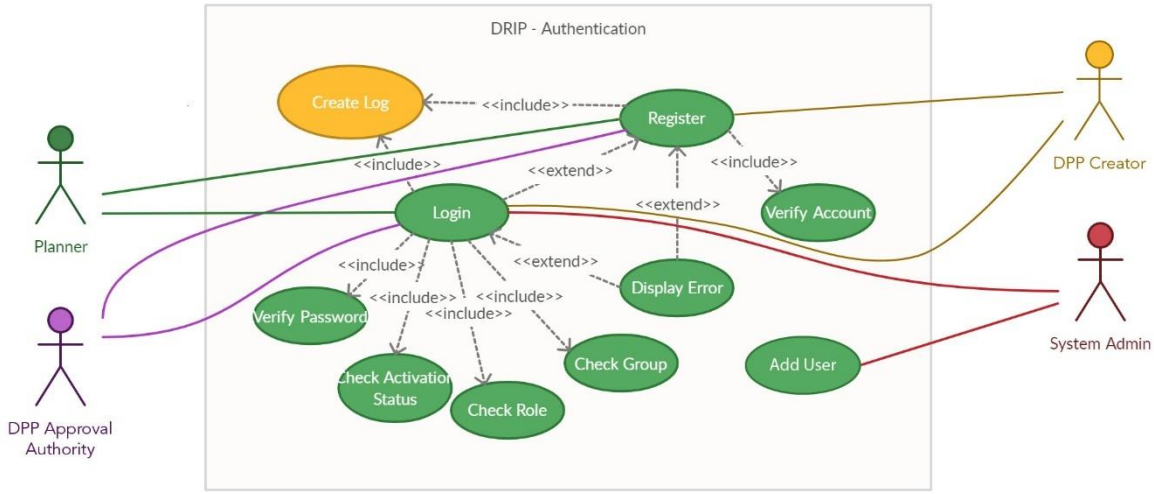


Figure 5.5: Use Case Diagram of DRIP Authentication

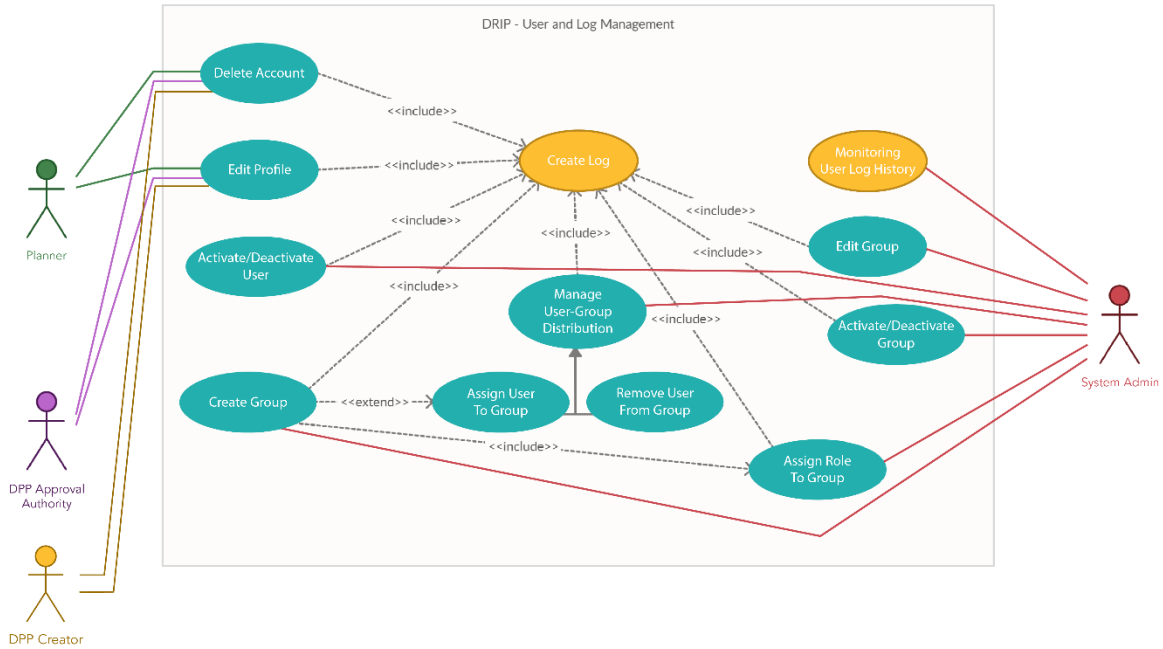


Figure 5.6: Use Case Diagram of DRIP – User and Log Management

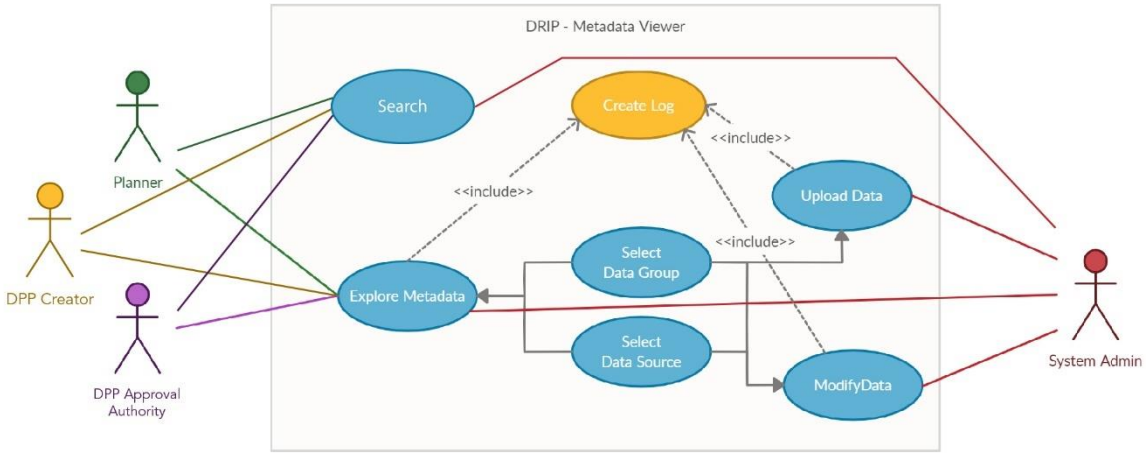


Figure 5.7: Use Case Diagram of DRIP – Metadata Viewer

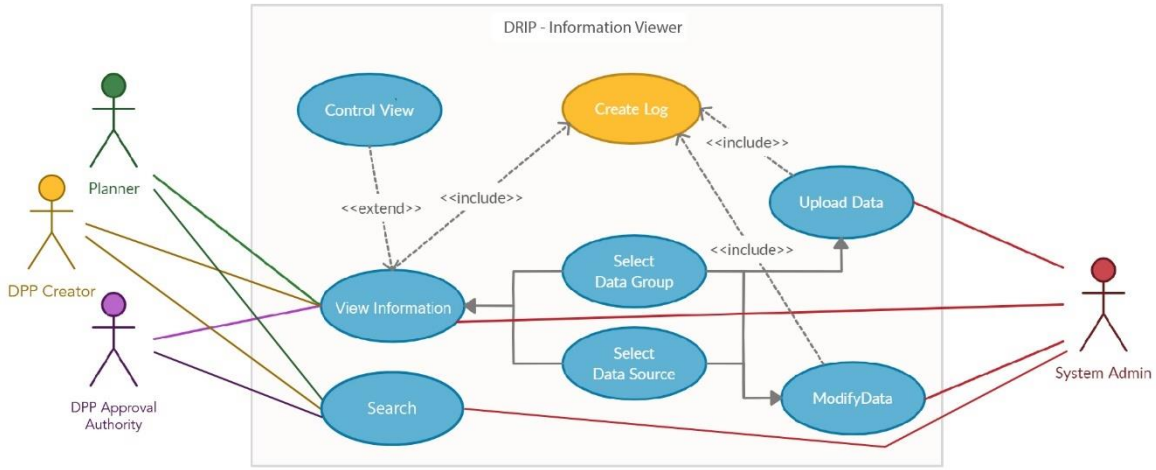


Figure 5.8: Use Case Diagram of DRIP – Information Viewer

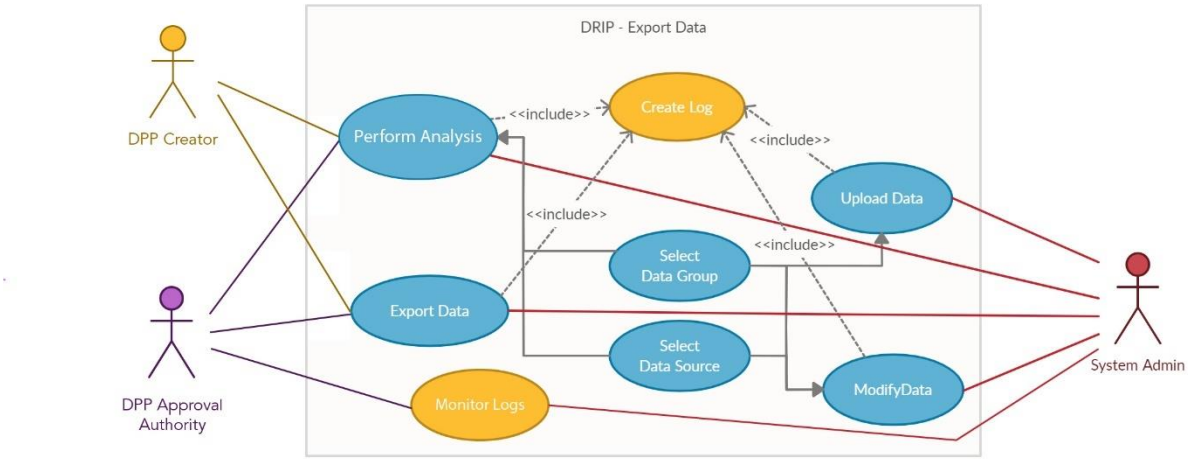


Figure 5.9: Use Case Diagram of DRIP – Export Data

5.7.2 Sequence Diagram

The sequence diagrams of DRIP system have been prepared to focus the interaction of objects that shows how they operate with one another and in what order. This diagram also represents the construct of a message sequence chart of DRIP system. In the diagram, the objects that will used in the DRIP system has been arranged in time sequence. Some of the sequence diagrams of DRIP System are given below.

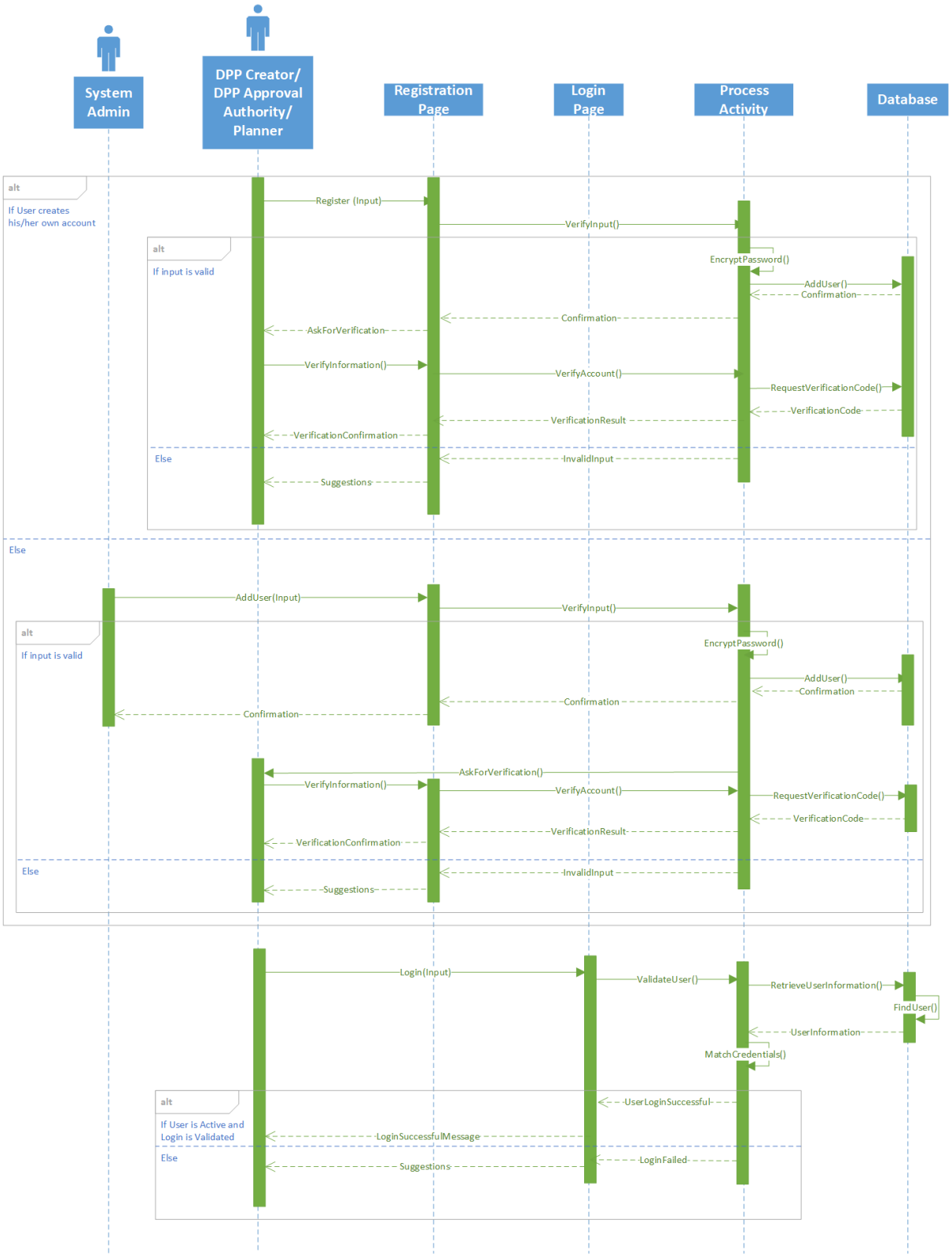


Figure 5.10: Sequence Diagram of DRIP – User Authentication

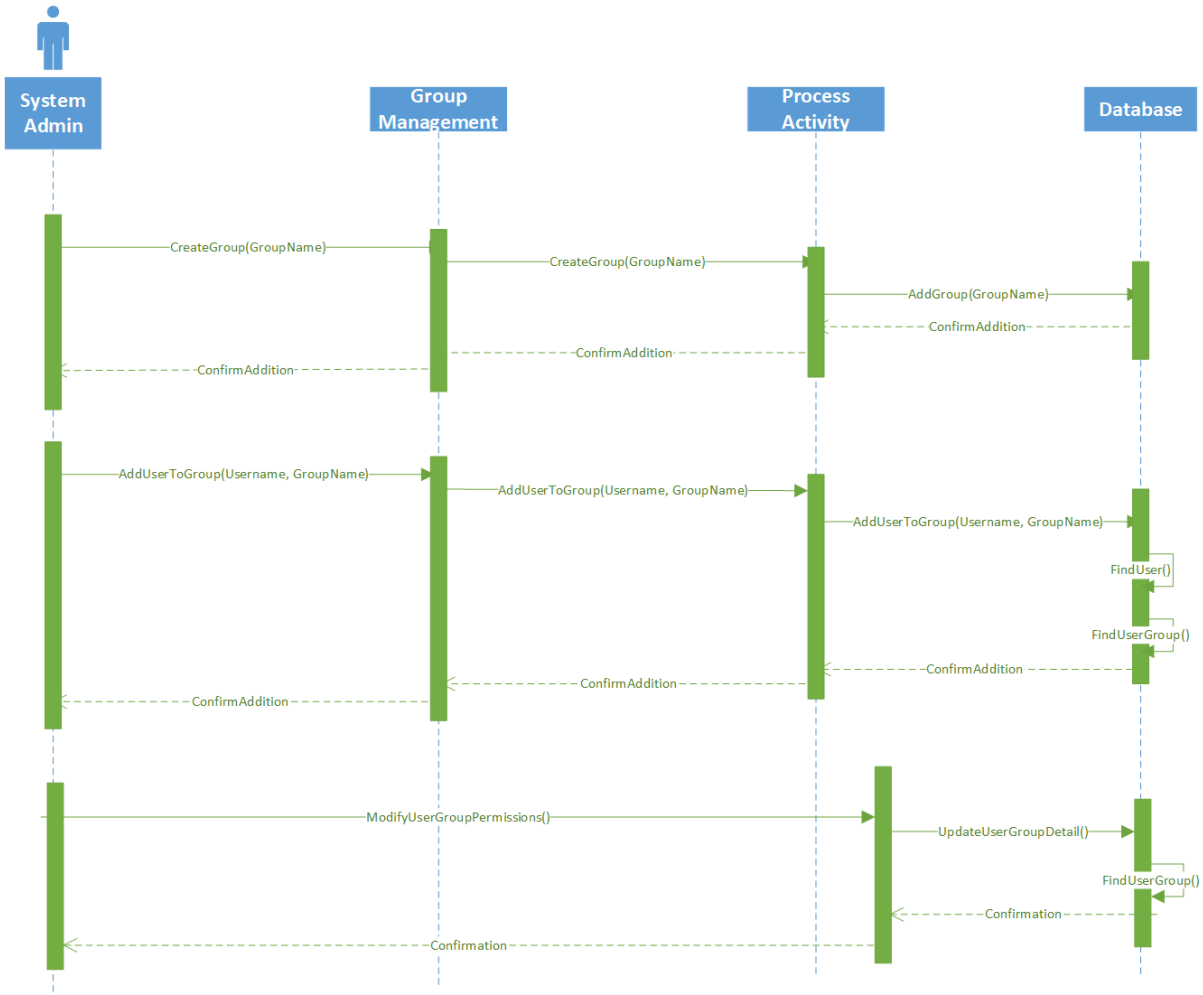


Figure 5.11: Sequence Diagram of DRIP – User Group Distribution – System Admin

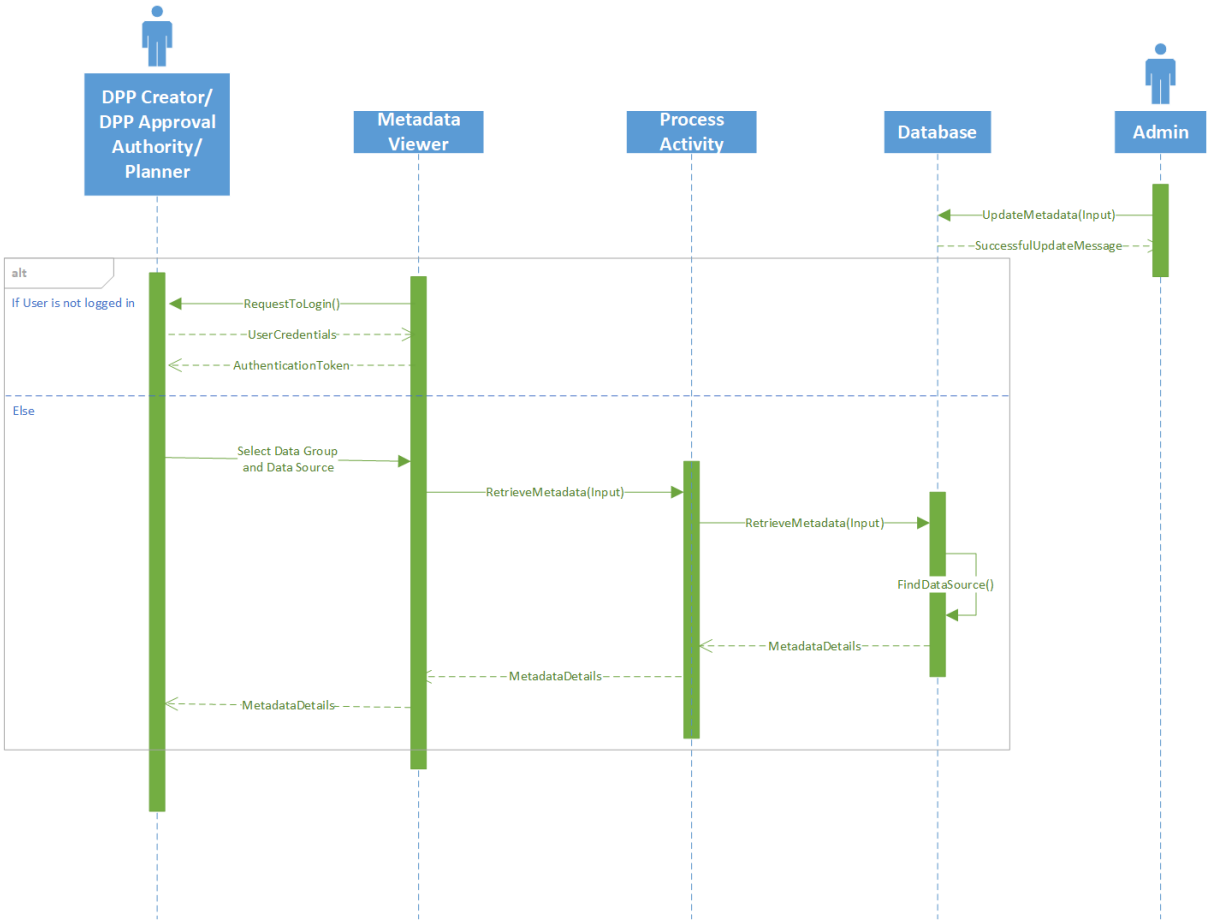


Figure 5.12: Sequence Diagram of DRIP – Metadata Viewer

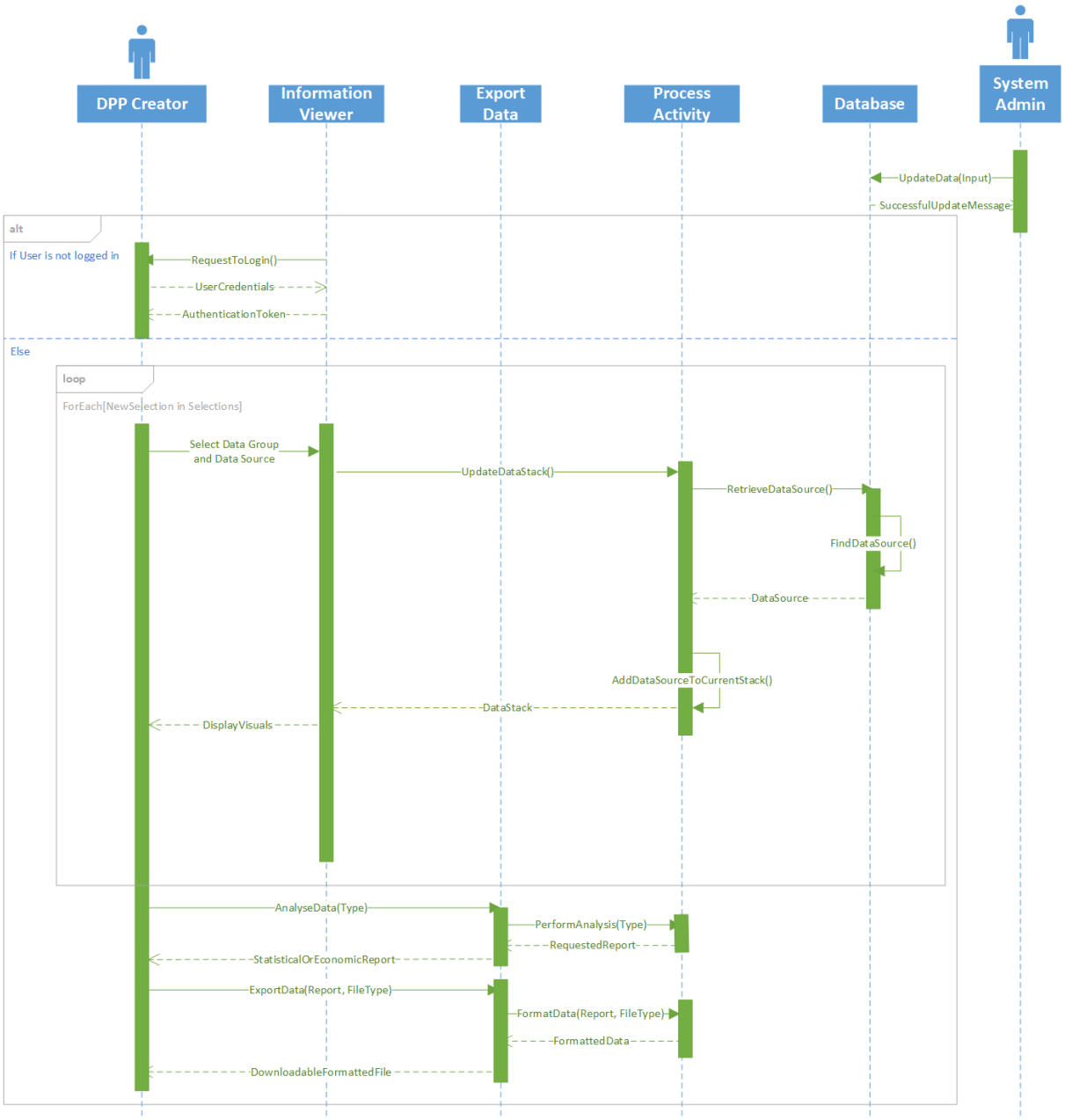


Figure 5.13: Sequence Diagram of DRIP – Information Viewer – DPP Creator

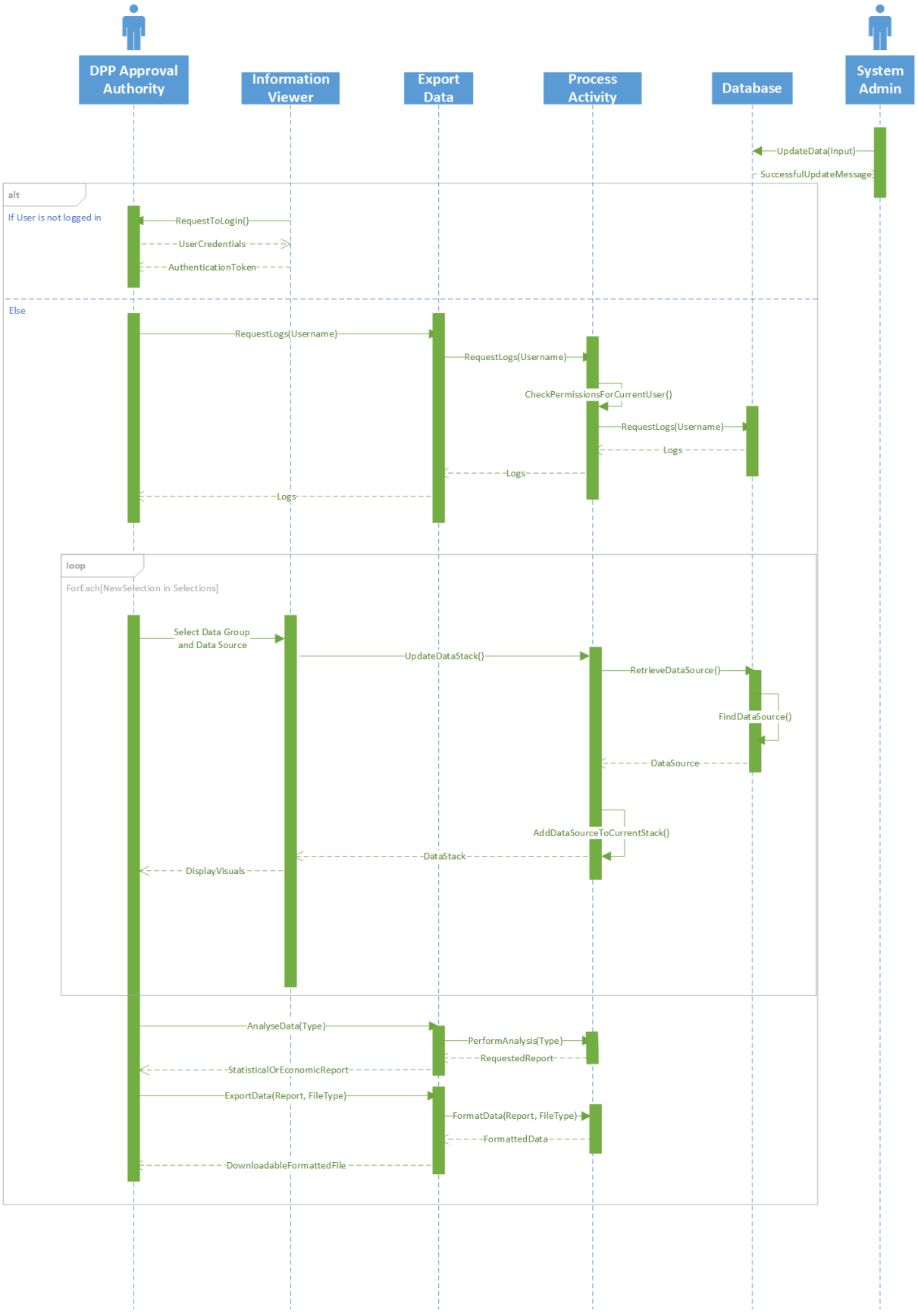


Figure 5.14: Sequence Diagram of DRIP – Information Viewer – DPP Approval Authority

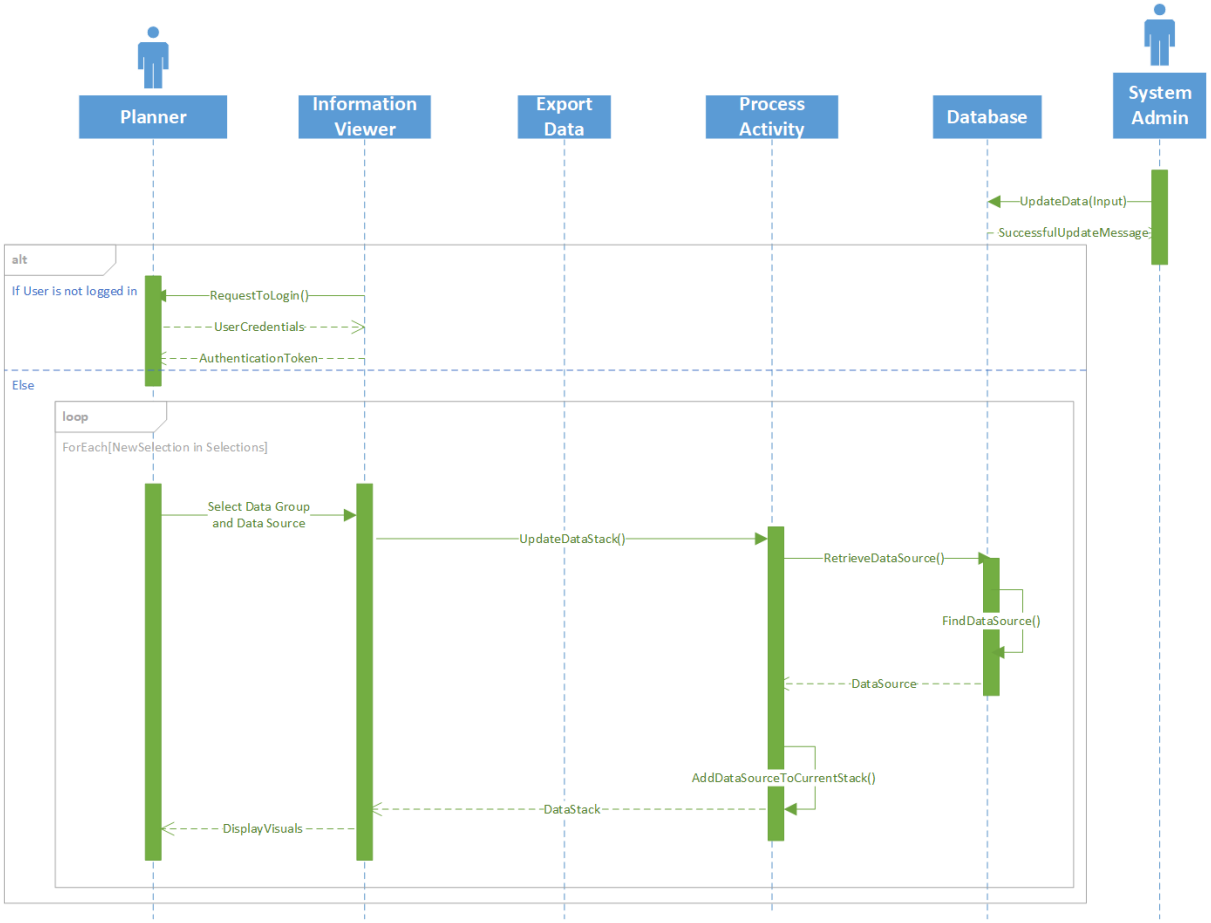


Figure 5.15: Sequence Diagram of DRIP– Information Viewer - Planner

5.7.3 Class Diagram

To model the static view of the DRIP system, the class diagram has been prepared which will be directly mapped with object-oriented languages like ASP.Net (C#).

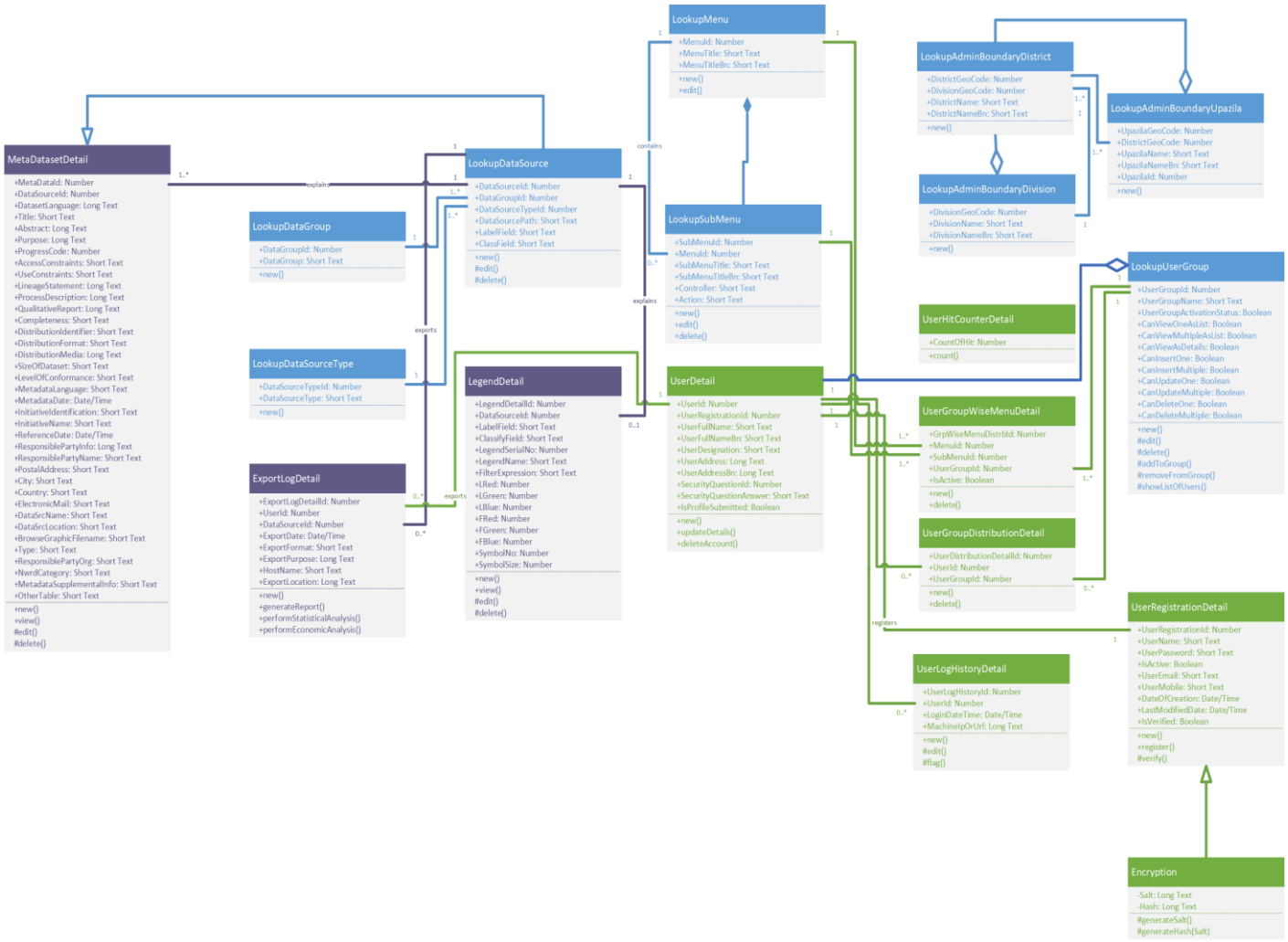


Figure 5.16: Class Diagram of DRIP

5.7.4 DRIP System Modules

During development, all of the features and functionalities of DRIP will be included in the system as different modules. All of the modules will be inter-related as per operational demand. The DRIP System will follow the standard service-oriented architecture to enhance the scope of integratibility and scalability with respect to existing features and functions.

There will be 4 (four) main modules in DRIP: Metadata Viewer, Information Viewer, Reporting Tool and Export/Import Tool. Brief description of each module is given in the following section.

Metadata Viewer

This tool will be designed and develop to display Metadata for each data layer. Metadata is "data about data". It is the background information which describes the content, quality, condition, and other appropriate characteristics of the data. Metadata enables intelligent and efficient access and management of data. It insures that potential data users can make an informed decision about whether data are appropriate for the intended use.

Customized metadata model will be developed on the basis of ISO standard and model developed for National Water Resources Database (NWRD). Table 5.1 shows the set of elements chosen for metadata model NWRD. The strategy was to conform to ISO level 1 extended with some level two elements.

Table 5.1: Metadata Components

Sl No	Name	Definition
1	Title	Name by which the dataset is known
2	Abstract	Brief narrative summery of the data set
3	Purpose	Summary of the intention with which the dataset was developed
4	Use constraints	Constraints applied to assure the protection of privacy or intellectual property, and any special restrictions or limitations on using the dataset.
5	Lineage statement	Additional lineage information
6	Qualitative narrative report	Descriptive quality information for the qualitative report type
7	Metadata date	Date that the metadata were created or last updated
8	Responsible party individual name	Person having primary responsibility for the intellectual content of the data
9	Responsible party organization name	Name of the organization associated with the dataset
10	Postal address	Address line for the address
11	City	City of the address
12	Postal code	Postal code of the address
13	Country	Country of the address
14	Electronic mail	Address of the electronic mailbox of the organization or the individual
15	Dataset extent coordinate	Geographic area domain of the dataset
16	Geographic extent name	Commonly used or well-known name of a place, area or region which describes a spatial domain of the dataset
17	Temporal extent date/time	Date and time of the content of the dataset
18	Category	Words or phrases summarizing a subject of the dataset
19	Keywords	Common used word(s) or phrases used to describe the subject of the dataset
20	Map projection	Name of the map projection
21	Feature type	Class of real world phenomena with common properties

The metadata viewer developed for National Water Resources Database (NWRD) is shown in Figure 5.17 as an example.

OverView	
Title	Population Census 2001
Abstract	An attribute data layer containing 508-Upazila/thana wise total population and other relevant information such as BBS area, number of male, female and number of rural, urban population according to 2001 census.
General	
Title	Population Census 2001
Quality	The data layer fully complies with the source population census book of 2001.
Completeness	The data layer covers all the thanas according to BBS census 2001.
History of the dataset	Thana wise population data were collected through population census conducted in 2001 and published in Population Census Book by Bangladesh Bureau of Statistics.
Purpose of production	Population census data are very much essential in different socio-economic studies, so the data layer has been included to NWRD for providing the researchers the basic population information.
Process description	NWRD has converted the published data in digital format and has organized them to prepare it as a NWRD data layer.
Type of dataset	Simple Table
Dataset language	English
Additional information source for the dataset	
Access	
Data source name	PopCensus1991
Data source location	BASEDATA\THANA\SHAPE\Thana508
Distribution file format	Dbase,Ms Excel,Ms Access,FoxPro,Text
Media of distribution	CD ROM, diskette (3.5 inch)
Organisation	Water Resources Planning Organisation
Address	House no.103, Road no.1, Banani, Dhaka-1213
Organisation e-mail address	dg@warpo.gov.bd
Use constraints	The data layer can be used for any purpose by maintaining the data dissemination protocol of WARPO with nominal price.
Access constraints	Outside users are not allowed to get direct access to this data layer. With due permission of DG, WARPO, one can have access to it.

Figure 5.17: Metadata Viewer of NWRD

Information Viewer

This module will be designed and developed to display information related to Hazard Intensity, Exposure, Risk, Vulnerability for a particular location. User can navigate different administrative boundaries like district or upazilla through map. Selection of location from dropdown list will also be available. In this case selected location will be zoomed in on map. Now clicking on the location on map will pop-up a window and display hazard, risk or vulnerability related information for that location. Possible Ideas of DRR or CCA measures, relevant design standard of measures, relevant government directives will also be displayed. Thus this module will help programming division in appraisal a project proposed for the selected location. It will also help other stakeholder in risk-informed planning. Different layers like river system, road network etc. can be superimposed administrative boundaries. Zoom in, zoom out, pan, super imposed and other standard facilities of spatial data viewer with advance search option will be incorporated into this tool. It will also provide facilities to view identity and attribute information of the data layer. Label and legend can also be shown on map. Google map will be used as background.

A tentative interface of this tool is shown in Figure 5.18.

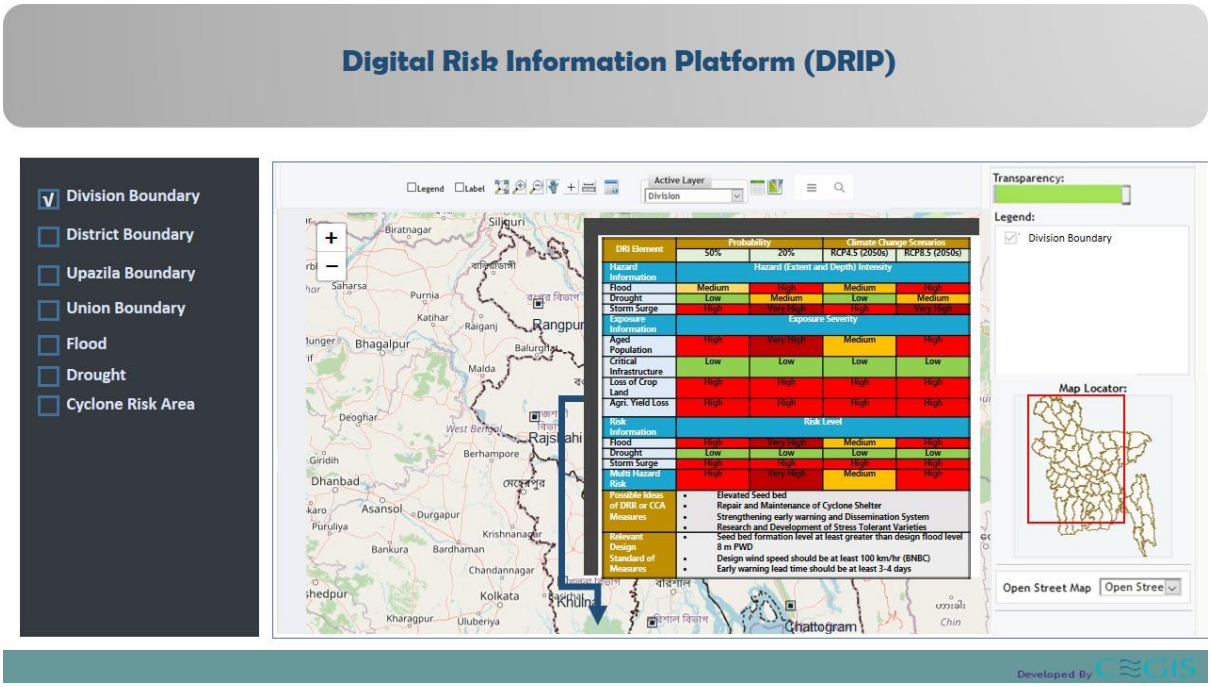


Figure 5.18: Tentative Information Viewer

Reporting Tool

This tool will help to generate different customized reports on hazard, risk or vulnerability for different location. An advance searching option will be provided to select searching criteria for generating the customized reports. It will generate a series of reports along with thematic map and chart to visualize the information from the database. The reports will be produced for different administrative units. The report will also provide facilities for selecting the output fields as well as generating report for different analysis. Output of this tool will be exported in PDF, excel etc. Reporting tool developed for GIS Application of BBS is shown in Figure 5.19.

Figure 5.19: Reporting Tool of GIS Application of BBS

Export/ Import Tool

A user-friendly generic export tool will be developed for easy exporting of data in PDF, XLs etc. format from database. The import tool allow user to import data from XLS/CSV into the system. This tool will be password protected, so that unauthorized user cannot download/upload valuable data from the database. This tool will also maintain a log file keeping one record for each export/import action. So, which user exports/imports which data can be monitored at any time. Figure 5.20 shows a snapshot of Export Tool of NWRD.

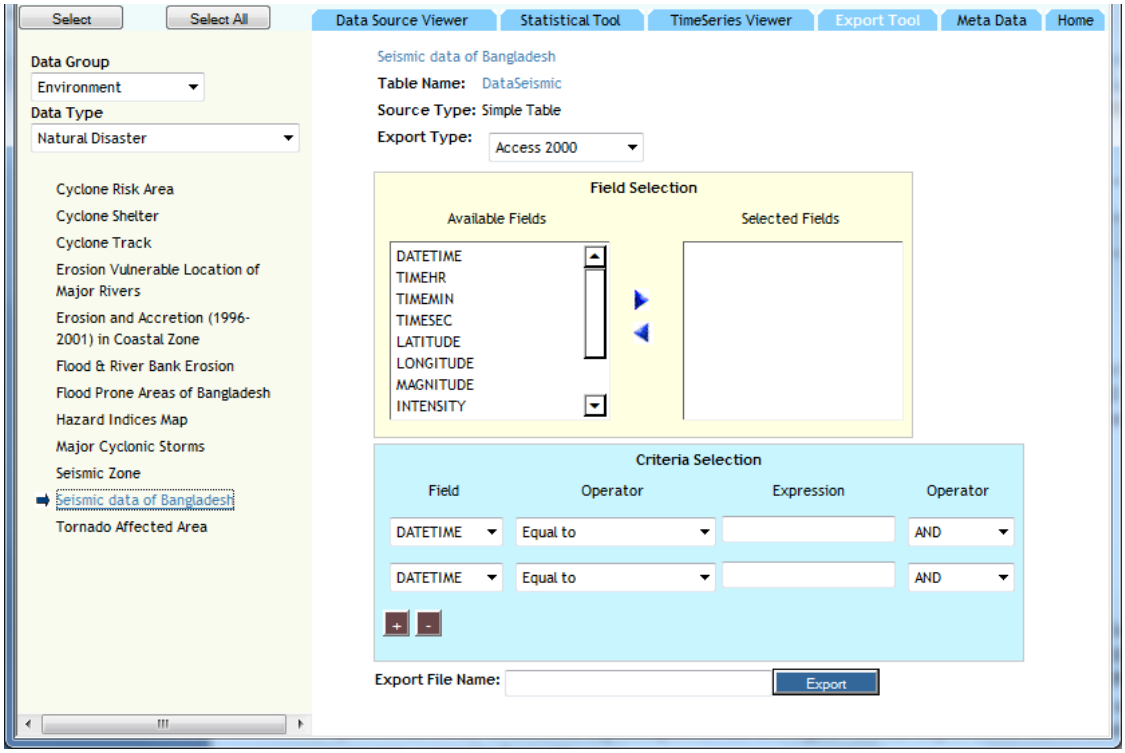


Figure 5.20: Export Tool of NWRD

5.8 Linking with Existing Initiatives

The DRIP system will be linked up with the existing digitalization initiatives such as the Planning Information System (PLIS) of Bangladesh Planning Commission, Aspire to Innovate project (a2i), the Digital ECNEC project, the Disaster Management and Information Centre of Department of Disaster Management, and the Ministry of Environment and Forests' online climate database, Bangladesh Delta Plan 2100 Project's knowledge portal, as well as Programming Division's Climate Risk Screening Tool & database. At first, CEGIS team will go through all the above mentioned digital initiatives with the help of Project Director/ Programming Division/ UNDP/ Other concerns. The team will identify the linking scopes based on the primary objectives, scopes and system features. After identification of linking scopes, the consultant team will share it to the Programming Division or other concerns. If the Web Service/RESTful API is available for accessing data from those existing systems and Project Director/ Programming Division/ UNDP/ Other concerns allows to link that data/feature with the DRIP system, CEGIS team will link those up accordingly.

5.9 Security and Access Control

Security and access control is a major issue in designing and developing web-based application software. The proposed systems will support application based, database level and operating system based authentication for control. Following are the steps of the control measures for possible exposed threats.

5.9.1 Application-level Security

For a web-based application, application level security is a major concern. This can be implemented, by introducing a firewall between the web server and the network. A firewall will

be used and configured for ensuring the network level security where some inbound and outbound rules will be applied to maintain specific program or port wise access rights. For intranet, application-level security will be implemented by developing a role-based user authentication system where a unique ID and password will be assigned to each user. The authentication system will ensure that every user must have to authenticate/validate this ID and password, in order to get access to the application. The CEGIS team will identify the required user groups and access roles for each user group with the help of Project Director/ Programming Division/ UNDP/ Other concerns. A user access log history will also be maintained with authentication system to track the user records/activities throughout the system. This security feature for which user will access which module, will be specified at database-level.

5.9.2 Database-level Security

To implement database-level security and to protect data from unauthorized access, the database will not be accessible directly from external network (non-government network). Strict security policies will be established for archived data to prevent unauthorised access and data loss. RDBMS will be used with security controls to ensure aggregation (value of disclosed data) and inference (confidentiality). Four user groups can be created and different levels of access rights can be assigned to each group. Each user will be assigned to a particular user group. The four levels of security access that could be implemented for this project are as follows:

The four levels of security access that could be implemented for this project are as follows:

- Level 1: This level will be assigned to the stakeholders who will prepare DPP. They will view data and it is background information, analyze disaster risk related information in the system for preparing risk informed DPP.
- Level 2: This level will be assigned to approval authority who will approve the DPP. They will also be able to view data and it's background information, analyze disaster risk related information, reports in the system for providing approval of DPP.
- Level 3: This level will be assigned to higher officials of planning division/NRP-PD who will view and search the information important for planning level decision making.
- Level 4: This level will be assigned to System Administrator. The system administrator will create user, assign rights, process data requests, update spatial data and generate customized reports.

5.9.3 Operating System-level Security

Operating system-level security means the limitation of physical access to a machine and would require an additional login in order to gain access. In the application server the windows operating system will be used. So, windows security features will be implemented in it. However, in the database server, the Linux operating system will be used. That is why, the UNIX based security measures will be applied for it.

The operating system will restrict unauthorized users from logging on or opening the computer and database itself, securing database to deleting or adding any data from unauthorized users. Operating system–level security will be implemented by assigning a user ID and password to each user. Each user will be then assigned to a particular user group. . Remote access will be

stopped/ disabled from the operating system of the web server, application server and database server.

5.10 Software Test Plan

After developing the software, different levels testing need to be performed to ensure software quality. In this project the following tests will be performed.

5.10.1 White Box Testing

The developers of the DRIP system who knows the internal logic of the application's code will apply the white box testing method. They will test against the implementation and will discover any fault of omission, indicating that part of the implementation is faulty. Hence, if any module of the software were faulty it would be identified by this test. Programmers/developers will set up some test cases for this testing and apply to the application software. The following steps will be followed during the white box testing:

- Understand the source code
- Create test cases
- Execute

The white box testing method will include some functional testing for DRIP like Unit Testing to validate that a particular module of source code is working properly, Testing for Memory Leaks etc. which will ensure the usability of the system.

5.10.2 Black Box Testing

The black box testing method will be applied to the DRIP system in order to ensure that the software will produce desired output for specific inputs. This test will discover faults of omission, indicating that part of the software specification has not been fulfilled. The black box testing method is generally applicable to the Integration Testing, System Testing and User Acceptance Testing where some test cases will be generated and the testers will apply these cases to the application software. The following steps will be followed during the black box testing of DRIP system:

- Initially, the testers with the help of the development team will examine the requirements and specifications of the system.
- The Tester will choose some valid inputs (positive test scenario) to check whether system under test (SUT) processes them correctly. In addition, some invalid inputs (negative test scenario) will be chosen to verify that the SUT is able to detect them.
- The Tester will determine expected outputs for all those inputs.
- The Software tester will construct test cases with the selected inputs.
- Then the test cases will be executed.
- After that, they will compare the actual outputs with the expected outputs.
- If they can identify defects, they will inform and submit it to the development team to fix accordingly. After fixing the issues by the development team, the testers will start re-testing.

5.10.3 User Acceptance Testing

User Acceptance Testing (UAT) is a process for obtaining confirmation by the owner or client of the object under test, through trial or review, that the modification or addition meets mutually agreed-upon requirements. In software development, UAT is one of the final stages of a project and will often occur before a client or customer accepts a new system. After developing the overall system and performing the system test, the responsible official of Programming Division and UNDP will be invited to test the system. A detail UAT plan will be provided describing the engagement of stakeholders linked on different testing stages in the DRIP outline report. The following tasks will be accomplished during the user acceptance testing:

I. Analysis of Business Requirements

The requirements of DRIP will be reviewed and analysed by a group of experts from the consultant team. They will thoroughly check and study the following documents:

- Project Charter
- Business Use Cases
- Process Flow Diagrams
- Business Requirements Document(BRD)
- System Requirements Specification(SRS)

II. Creation of UAT Test Plan

A UAT test plan will be created which will outline the strategy that will be used to verify and ensure the DRIP meets its business requirements. The UAT test plan of DRIP will include the objectives, test items, features to be tested, features not to be tested, approach, pass/fail criteria, suspension criteria, test deliverables, testing tasks, environmental needs, responsibilities, staffing and training needs, schedule, risks and contingencies, approvals, etc. A summarized view of the UAT plan considering the entry and exit criteria for UAT, test scenarios and test cases approach and timelines of testing is given below:

Test Team	Entry Criteria	Exit Criteria	Test Scenario	Test Case	Timeline
Team 1 & 2	1. Must have knowledge about the requirement of DRIP system 2. Must be trained up properly	1. Minimum 95% Pass Rate 2. Must have to function as expected 3. No critical defects found	Will be identified with respect to high-level business process	1. Will be created with clear test steps. 2. Test Cases will sufficiently cover the UAT scenarios 3. Business use cases will be the input for creating the test cases of DRIP.	Start: after 1 week of Development End: within 10 days
Team 3 & 4	Do	Do	Do	Do	Start: after 2 weeks of Development

					End: within 10 days

III. Preparation of Test Data (Production like Data)

It will be advised to use live data for UAT of DRIP system. Data should be scrambled for privacy and security reasons. All of the Testers must have to be familiar with the database flow.

IV. Running and Recording the Test Cases

The testing team will execute the test cases and if they find any bug, they will record it in a report. The report will contain the Test Results and Defect Log. The Testing team will also re-test those bugs once the developer team fixes it. For most of the cases, a Test Management tool will be used for execution.

V. Confirmation of Business Objectives & Sign Off

Business Analysts or UAT Testers will send a sign off mail after completing the UAT testing. After sign-off, the product will go for production.

VI. Exit Criteria for UAT

Before moving in to production or live operation of DRIP, following points must be ensured:

- No critical defects open
- Business process works satisfactorily
- UAT Sign off meeting with all stakeholders

Table 5.2: Testing Schedule

Activity	Estimated Completion Time (Days)
Formation of Test Team	1
Identify Requirements	1
Review Use Cases	1
Prepare Test Cases	2
Get Test Script Approval	1
Set Test Environment	1
Test Script Execution	2
UAT Sign-Off	1
Total	**10**

5.10.4 Pilot Testing

A Pilot testing will be performed for the DRIP system where a group of users will use the software in totality before the final launch or deployment of the software. This testing will verify a component of the system or the entire system under a real time operating condition. The purpose of the pilot testing will be to evaluate the feasibility, time, cost, risk and performance of DRIP before roll out.

5.11 Deployment Plan

The database will be installed, created and configured at the server of NRP-PD. All checked and tested information will be transferred from the test database to the production (central) database. The web applications will be installed and configured into the central web server. Considering the scenario, web application's work volumes and network infrastructure, the following hardware, OS, internet bandwidth and essential accessories may be required for hosting the web application:

- Dell Server R740, 128GB RAM with scalable Processors, 6x2TB SAS HDD, Raid 5, 10 and 50 supported Controller with Licensed Software-2 units
- OS: Windows Server 2016
- 42U Dell Server rack with KVM and 1U console monitor
- 10KVA Online UPS for Servers (at least 2 hours' backup support)
- External Data Backup Device, like any USB robust storage/ DLT Tape drive with Tape-2 units
- Internet bandwidth for regular use needs 50 Mbps full duplex min. and for exceptional use up to 80Mbps full duplex min. with 5 real IP
- Internet connection from two (02) ISP will be required for redundancy and failover support (BTCL and others)
- Cisco/Juniper Firewall Router – 1 unit
- Cisco Router 4000 series or higher - 1 unit
- Server Farm Switch- 1 unit
- Gigabit/10 Gigabit Network Managed switch-1 unit
- CISCO SFP or Gigabit media converter
- For 24/7/365 running- Data center environment will be required (proper Air condition system, HVAC, Power Generator backup, IPS backup and Fire Protection)

5.12 Backup and Recovery

As data can be lost or database can be corrupted due to hardware failure or software crash, the system will provide facilities to take regular backup of the database. The database server will run on Archive log mode. This mode will help to recover data from the last backup. In order to reduce backup space and time, a multilevel incremental backup procedure will be used.

An incremental level x backup will copy all changed blocks since previous incremental level y backup where x>=y, y>=0 and x>=0.

6. Implementation and Sustainability Strategy

6.1 Sustainability Strategy

A team can be formed selecting IT professionals from Programming Division and/or Planning Division for on the job training who will maintain the system. CEGIS will undertake knowledge transfer to the team/stakeholders during the design and development phases of the platform. Again, CEGIS will provide a one-year maintenance support as part of contractual deliverable to ensure that the platform and system is working properly. In this maintenance period, CEGIS will further train up the team or the key stakeholders, which will cover the following topics:

1) Use and Maintenance of the Platform
2) Upload data to the platform and database administration
3) Maintain and update the platform after implementation
4) Users and Role Management
5) Manage Data Layers
6) Backup database and the application

Other than this, If needed, a one/two years maintenance contract can be made with CEGIS after completion of the project period to further maintenance, guiding and enhancing the skills of the in-house team.

The sustainability issues will be discussed with Programming Division and UNDP through stakeholder analysis and CEGIS will make a plan for sustainability of the platform including preparing strategy for post project operations, forming team and training them for post project operation. In addition, the following policies and plans will be developed to ensure the sustainability:

a. A maintenance policy
b. A training plan and Training of Trainers (TOT) manual for end-user training
c. A costed plan for maintenance of the platform
d. A policy guideline (*Nitimala*) for best uses of the platform

6.1.1 Data Sharing Protocol

A framework of communication infrastructure needs be introduced to connect DRIP with other national level databases outside and to share data and information among departments. In order to develop this framework to serves vaious departments. A guideline will be developed and disseminated among the prime data providing agencies. In this guideline, DRIP has proposed to form an inter-agency network committee and offered to develop a framework for communication infrastructure.

6.1.2 Data Update Protocol

A Database Management Guideline will be prepared describing database, metadatabase, data definition tables, data type (temporal, attribute and spatial), hierarchical structure of spatial data, views and stored procedures of DRIP. This guideline helps to manage and update the database. This guideline will be updated to include maintenance and operation of DRIP

web portal, data collection and processing, data Layer preparation, data quality checking, data storage and archiving, data categorization, database development and management, principle of data sharing and dissemination, data Backup, data purging, maintaining standard in all aspects, roles and responsibilities of respective entities and other activities necessary for the best performance and efficiency of DRIP. A data collection guideline will be developed which will contain plan for data collection, review of sectoral data collection responsibilities and upgrade method of data collection. This guideline will help to update data quality methodologies to maintain the quality of data in all steps including data collection, processing, quality checking, storing and dissemination.

6.1.3 Technology Transfer and Roll Out

Transfer of knowledge and technology is an important issue required for smooth operation and management of the project. The objective of technology transfer could be achieved through selecting suitable training programs and involving implementing professionals. Both in-class training and on-the-job training will be provided to the government officials.

Two user group will be created for in-class training program: 1) End-Users and 2) Super Users. Two in-class training programs will be arranged for the relevant officials

1. Training on use of DRIP for End-Users
2. TOT on use of DRIP for Super Users

The training schedule and number of participants will be finalized after discussing with Project Director, NRP-PD and UNDP officials. However, a tentative training schedule is given in Table 6.1.

Table 6.1: Tentative Training Schedule for UNDP

Subject of Training	User Group	Number of Officials	Duration of Training
Training on use of DRIP	End-Users	25	2 days
TOT on use of DRIP	Super Users	20	2 days

A team of client part will work with the project team. On the job training will be provided to the client team during the development of web enabled GIS based Application Tools, installing and configuring the database and web server, trouble shooting and fixing different problems, taking backup and tuning of database within the project warranty and maintenance period.

6.1.4 Maintenance

CEGIS will provide maintenance and support services for a year since activation of DRIP to ensure platform and system is working properly. A report providing information on the resolution of requests, errors, queries and concerns stated by users will be prepared and submitted at the end of this period. This report will include sustainability plan including data update guideline and maintenance policy for the platform. During this maintenance period, the consultant will perform the following tasks:

- Application bugs will be fixed and minor changes as per user requirement will be incorporated into the application systems;
- Fix any software related problem within 2 days;

- Help database administrator to administer the database;
- Maintain back-up and recovery of data; and
- Assist the client to maintain and enhance the system through transfer of knowledge as required.

6.1.5 Risk Factor Management

Several issues can be raised in this project. Some example of issues that can be raised and probable actions that can be taken is given in following table.

Issues	Action
Data not available in time	Team Leader will inform the issue to the Project Director. He/she will take necessary action to make data available in time.
One or more team member (e.g. GIS Programmer/Analyst) is unavailable during project period	Team Leader will take necessary action according to rules and regulation.
Natural Calamity (flood, cyclone, earth quake, epidemic etc.)	Team Leader will inform Project Director for the time extension of the project.
Political disturbance	Team Leader will inform Project Director for the time extension of the project.
System crash during development	Recovery from backup.
Delay of payment	Team Leader will inform the issue to the Project Director for necessary action.
Unavailable of fund	The project may be temporary postponed with due consultation with executive authority.

6.1.6 Policy Note for Enhancing Data Sharing

The data collection and management process of DRIP needs an institutional shape which is often oriented toward project needs. Large quantities of data are scattered among many different organizations. This duplication of work, gaps between the data collected and user needs, inconsistent data format and wastage of system outrage. Legally there is no barrier to the collection of processed data, unless it is restricted. Restricted data can only be supplied to the users with clearance from the relevant agencies. Before releasing data to the users, the agencies require government approval issued by the head of the relevant sections requesting information about the purpose of the data collection, extent of area, time or frequency and media requirement. The database is maintained and updated by Planning Commission. Updating at a limited scale is done by DRIP itself. Advanced and complex processes of data generation and updating through GIS data are usually followed under different projects of Planning Commission. To make the database sustainable, regular updating and upgrading of the DRIP is necessary. Making a protocol to linkage with the individual agencies that are the primary source of data through creating focal points in each agency..