Establishing Disaster and Climate Risk Information Platform for Resilient Public Investment in Bangladesh

National Resilience Programme (NRP)
(Programming Division Part)
Programming Division, Planning Commission
Government of the Peoples' Republic of Bangladesh

Funded by

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Submitted to:
National Resilience Programme (NRP)
Programming Division
Planning Commission

EXECUTIVE SUMMARY

The linkages between development and climate are by now commonly recognized. As well as with this recognition, the need to integrate or 'mainstream' Disaster Risk Reduction into development planning and decision-making processes which also has gradually emerged. To know about the climatic risks, proper data and information is required. Till now in our country, the risk related information is quite scattered and thus it is sometimes very difficult to get proper scenario of climatic risks. On the other hand Bangladesh is gradually integrating the global targets into its Five Year Plans by involving the government ministries, agencies NGOs and other private sectors as well. To continue the progress towards development the country need to pay attention in risk informed development as according to the World Bank, Bangladesh's geographical position renders it especially vulnerable to the adverse impacts of climate change. The 2014 Climate Change Vulnerability Index ranks Bangladesh as the number one economy at risk to climate change. Flood, cyclone and storm surge, tornado, drought, river bank erosion are common natural hazards in Bangladesh. These hazards strike Bangladesh in regular interval and damage properties/assets and infrastructures, influence societal and daily life of people. To maintain the balance between development and impact of disaster, proper planning and mechanism is essential. To keep the balance, the National Resilience Programme-Programming Division part will adopt a novel approach to establish tools and database for disaster and climate change related risks to generate a detail analysis in order to inform development projects, plans and programmes of relevant key sectors. As of this specific objectives the project will establish a digital risk information platform/interface adopting a data ecosystem approach connecting existing initiatives for digital Bangladesh.

The broad aim of this study is not limited to figure out the rationality of establishing DRIP but also illustrate the function of the platform. This study also analyze the global risk screening tools and some national level risk information platform and datasets as well. The study finds that, there are few Project Risk Screening/ Project Assessment tools exist in the country. None of them are free of cost for planner or decision makers. The risk screening tools are sometimes complicated to use and may take long time to assess. As a result this will be difficult to assess risk for a numerous number of DPP for planners.

Table of Contents

List of Tables

List of Figures

ACRONYMS

ACCNLDP	Adaptation to Climate Change into the National and Local Development Planning
ADB	Asian Development Bank
BARC	Bangladesh Agricultural Research Council (BARC)
BASIS	Bangladesh Association of Software and Information Services
BBS	Bangladesh Bureau of Statistics
BCC	Bangladesh Computer Council
BCCSAP	Bangladesh Climate Change Strategy and Action Plan
BGISP	Bangladesh GIS Portal
BWDB	Bangladesh Water Development Board
CCA	Climate Change Adaptation
CEGIS	Center for Environmental and Geographic Information Services
CRS	Climate Risk Screening
CRVA	Climate Risk and Vulnerability Assessment
CRVS	Climate Risk and Vulnerability Screening
DAE	Department of Agricultural Extension
DDM	Department of Disaster Management
DoE	Department of Environment
DPP	Development Project Proposal
DRIP	Digital Risk Information Platform
DSS	Decision-Support System
EEZ	Exclusive Economic Zone
FAO	Food and Agriculture Organization
GAR	Global Assessment Report
GDP	Gross Domestic Product
GED	General Economics Division
GFDRR	Global Facility for Disaster Reduction and Recovery
GIS	Geographic Information System
GSB	Geological Survey of Bangladesh
GUI	Graphical User Interface
HEVR	Hazard Exposure Vulnerability Risk
IFC	International Finance Corporation
IPCC	Intergovernmental Panel on Climate Change
IWM	Institute of Water Modelling
JICA	Japan International Cooperation Agency
LGED	Local Government Engineering Department
MASDAP	Malawi Spatial Data Portal
MoEF	Ministry of Environment and Forests
MRVAM	Multi-Hazard-Risk-and-Vulnerability-Assessment-Modelling
NCVA	Nationwide Climate Vulnerability Assessment
NEC	National Economic Council
NLDAS	Land Data Assimilation System
NPDM	National Plan for Disaster Management
NRP	National Resilience Programme

NSDI	National Spatial Data Infrastructure
NWRD	National Water Resources Database
ODI	Overseas Development Institute
OpenDRI	Open Data for Resilience Initiative
PCRAFI	Pacific Catastrophe Risk Assessment and Financing Initiative
RCP	Representative Concentration Pathway
SDG	Sustainable Development Goal
SoB	Survey of Bangladesh
SRDI	Soil Resource Development Institute
TA	Technical Assistance
UNDP	United Nations Development Programme
UNISDR	United Nations International Strategy for Disaster Reduction
UN-REDD	United Nations Programme on Reducing Emissions from Deforestation and Forest Degradation
UN-SPIDER	United Nations Platform for Space-based Information for Disaster Management and Emergency Response
USAID	United States Agency for International Development
WARPO	Water Resource and Planning Organization

CHAPTER 1: INTRODUCTION

Today Bangladesh stands at a vital crossroads in its development path. The country has achieved commendable success in economic and social indicators. Not only that it is about to lift itself from the list of least developed nations, it's recent progresses on a number of indicators have surpassed its neighboring developing nations in South Asia (Social Progress Imperative, 2014).

However, to keep its pace in achieving development goals, the country need to walk through a sustainable path that can be achieved over resilient public and private investment by ensuring risk informed development. As Bangladesh is one of the countries most vulnerable to climate change and for its geographic location, as well as one of the most disaster prone, investment (public & private) should be risk informed to make it resilient. Natural climatic hazards like flood, cyclone, river bank erosion and geo-physical hazards like earthquake , landslide have a high human cost in terms of casualties that affect the economy. On the other hand, these economic losses hurt public and private investment and subsequent infrastructure. In recent years, the increasing frequency and intensity of extreme weather and climate events (IPCC 2012), together with the concentration of social assets and inappropriate land use planning (UNISDR 2015a), have contributed to rising human and economic costs from natural disasters. Because no single stakeholder or institution can handle the problem of economic loss due to natural disaster alone, integrated safety nets with close partnerships among the public sector, the private sector, international financial institutions, and non-governmental organizations are called for (Linnerooth-Bayer and Mechler 2007). Unplanned development creates higher levels of disaster risk, which threatens efforts to eliminate poverty and boost shared prosperity. All development planning should therefore integrate appropriate disaster resilience measures (Thomas Tanner, Emma Lovell and Emily Wilkinson (ODI), and Francis Ghesquiere, Robert Reid, and Sumati Rajput – GFDRR, 2015). In this report of GFDRR (2015), the authors also mentioned seven key messages to ensure that disaster risk does not hamper the progress of achieving the sustainable development goals. Among the seven goals, first one is concentrated about the risk informed development. It said, to build a resilient future, it is critical that all development plans and investments are screened for disaster and climate risk and integrate appropriate resilience measures where risks exist. Investments in infrastructure will continue to increase with the rapid pace of urban growth and economic development. Through risk-sensitive planning and investment in disaster resilient infrastructure, societies can safeguard these key investments.

In this context, the National Resilience Programme (NRP) is designed to provide strategic support to public and private sector for building resilience in line with Sendai Framework for Disaster Risk Reduction and the SDGs in coordination with four key government agencies of Bangladesh. The Programming Division of Planning Commission, Bangladesh is one of the four key government agencies, is implementing NRP with an aim to facilitate gender responsive,

disability inclusive risk-informed public and private investment though mainstreaming disaster and climate change into public and private development planning process. The Programming Division part is establishing risk information platform and developing disaster impact assessment tool for disaster and climate change risk screening of Annual Development Programme.

The report is composed of seven chapters, including references and annex. The first chapter deals with the background of the research, its objectives and limitations.

The second chapter consists of conceptualization of risk information platform, definition of DRIP and its major components.

The third chapter is the literature review part. This chapter represents the reviewed reports for this study, available datasets in Bangladesh, Risk information platform and Climate Risk Screening Tools available in Bangladesh and global best practices as well.

The fourth chapter deals with way of data collection, serially description of methodology of the research and methodological framework.

The fifth chapter describes about analysis and findings. The zest of result has been given in key findings.

The sixth chapter gives description on the methodology of the DRIP development, the exposure, vulnerability and risk analysis module. It also illustrates the proposed structures of DRIP, its background engine and architecture, the output of DRIP, content of produced report by DRIP, how planners will use it and how it will relate the mainstreaming DRR thus risk informed public investment.

The seventh chapter is the conclusion of the study.

1.1 Objectives of the study

The objectives of this study are:

- To study the existing datasets of the country related to natural hazard/risk.
- Finding out the rationality of establishing the digital risk information platform.
- To prepare an outline of proposed digital risk information platform.

1.2 Limitations of the study

Only two interviews have been conducted. The platforms and screening tools studied in this research could not possible to examine in practical. In some cases, information on existing climatic datasets could not possible to collect through in person/telephonic interview so that we had to depend on web based secondary information.

CHAPTER 2: CONCEPTUALIZE RISK INFORMATION PLATFORM

Before conceptualize the risk information platform the concept of hazard, exposure, vulnerability and risk need to explain. In the following section the definition of these terms are given according to United Nations Office for Disaster Risk Reduction (UNDRR):

Hazard: A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption or environmental degradation.

Exposure: The situation of people, infrastructure, housing, production capacities and other tangible human assets located in hazard-prone areas.

Vulnerability: The conditions determined by physical, social, economic and environmental factors or processes which increase the susceptibility of an individual, a community, assets or systems to the impacts of hazards.

Risk: The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. 15 Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard. In this report, the term risk is used primarily to refer to the risks of climate-change impacts. (AR5, IPCC, 2014)

2.1 What is DRIP?

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.

It is a web based platform where natural hazard induced risk scoring data will be stored and displayed in map overlying with administrative boundaries. The risk score will vary depends on hazards and administrative boundary (district/upazila/union). The structure of the DRIP is discussed in detail in the respective chapter of this report.

The risk information which is originated from natural hazard data/information will be hosted on the Risk Data Hub will be built on the relation exposure- vulnerability- hazard. This approach offers a more complete insight for practitioners and policy makers dealing with disaster risk management. The hazard mapping within the DRIP will be considered return periods and scenarios (climate change, economic and socio-demographic scenarios). Consequently, the socio-economic and environmental exposure and potential impacts from extreme events are

structured on return periods and climate change scenarios RCP 4.5, and RCP 8.5).[1]

Primarily two sectors will have been covered:

- Agriculture
- Industry

2.2 Specific objectives for establishing DRIP

The specific objectives are:

- 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;
- Assisting the Planning Officials in different ministries with available risk information in different sectors.

[1] Representative concentration pathways (RCP) or emission scenarios are greenhouse gas concentration trajectories adopted by the Intergovernmental Panel on Climate Change (IPCC) to describe four possible climate futures, depending on how much greenhouse gases are emitted in the years to come. In RCP 4.5, emissions peak around 2040, then decline. In RCP 8.5, emissions continue to rise throughout the 21st century.

CHAPTER 3: LITERATURE REVIEW

Literature review is the main method in this study. In this chapter detail review and analyze of the selected:

- Study Reports
- National web based datasets which are directly or indirectly related to natural hazard and risk assessment.
- Similar risk information platform in national and global perspective

The purpose of this review is to understand how risk information platform is working in other countries, what are the content of the similar platform and finally finding out the justification of establishing Digital Risk Information Platform (DRIP).

The key findings from the review is described in the end section of this chapter. The detail review of each section mentioned above is described in the following sections:

3.1 Study Reports

Total 6 numbers of study reports have been reviewed in this research.

Dr. Hasse Goosen , Tanvir Hasan , Sanjib Kumar Saha , Dr. Nahid Rezwana , Md. Rejaur Rahman , Mohammad Assaduzzaman , Ashraful Kabir , Dr. Ghislain Dubois , Catharien Terwisscha van Scheltinga. "Nationwide Climate Vulnerability Assessment in Bangladesh". (2018): 11-12.
This study stated that, under the current climate conditions and due to its geographic location and topography, Bangladesh is exposed to a multitude of natural hazards such as floods, storm surges, droughts, riverbank erosion, etc. Impact of these hazards are threatening biodiversity, water resources, agriculture and settlements. A key question is, how to adjust development oriented planning to address issues triggered by climate change. There is a growing need for continuously updated and authentic information and data to enable the identification and monitoring of vulnerable areas and sectors in Bangladesh, and to design tailored adaptation strategies and measures. The elaboration of a Nationwide Climate Vulnerability Assessment (NCVA) is thus intended to provide the Government of Bangladesh with an evidence-based tool, prioritising adaptation funding and intervention within the country. This assessment was led by a team of international and national experts and was conducted through a systematic step by step approach applying participatory methods. The climate vulnerability was assessed for eight sectors at the Upazila level: Agriculture, Livestock, Fisheries, Navigation, Transport and Infrastructure, Water Resources, Biodiversity, Natural Disasters and Human Health. With this, the NCVA may serve as a tool to take on an integrated climate vulnerability perspective beyond the commonly regarded domains of flood risk and water management.

Integrating Climate and Disaster Risk into Development. The World Bank Group 1818 H Street, NW Washington, D.C. 20433, USA. (2018): 20-21.

The report reveals that, risk assessments serve multiple purposes for various stakeholders, ranging from urban risk assessments for disaster preparedness, to multi-country financial risk assessments, and to the design of financial transfer mechanisms. The World Bank has been supporting climate and disaster risk assessments through open geospatial data tools, and the establishment of the Understanding Risk Community of Practice (now with 2,850 members worldwide). The focus has been on promoting open data and information sharing between in-country agencies, the scientific community and decision makers in the field, and in supporting informed decision making for climate and disaster resilient development. As a consequence, access to risk information has improved for the more than 40 million people in 24 countries that have access to the Internet, and some 1,300 datasets related to natural hazard risks have been shared. In an effort to make as much of this risk data and analysis open and available as possible to potential users around the world, the World Bank has been implementing an Access to Information Program since 2010. Building on this, GFDRR established the Open Data for Resilience Initiative (OpenDRI), in partnership with governments, international organizations and civil society groups, to develop open systems for disaster risk and climate change information. OpenDRI also promotes innovative approaches to transparency and accountability, ensuring that a wide range of actors can participate in the challenge of building resilience. Complimenting this initiative is the CCKP, an online platform that draws together various international open sources of climate information.

S. Balbo et.el. A public platform for geospatial data sharing for disaster risk management. (2013): 189.

Several studies have been conducted in Africa to assist local governments in addressing the risk situation related to natural hazards. Geospatial data containing information on vulnerability, impacts, climate change, disaster risk reduction is usually part of the output of such studies and is valuable to national and international organizations to reduce the risks and mitigate the impacts of disasters. Nevertheless this data isn't efficiently widely distributed and often resides in remote storage solutions hardly reachable.

Spatial Data Infrastructures are technical solutions capable to solve this issue, by storing geospatial data and making them widely available through the internet. Among these solutions, GeoNode, an open source online platform for geospatial data sharing, has been developed in recent years. GeoNode is a platform for the management and publication of geospatial data. It brings together mature and stable open-source software projects under a consistent and easy-to-use interface allowing users, with little training, to quickly and easily share data and create interactive maps. GeoNode data management tools allow for integrated creation of data, metadata, and map visualizations. Each dataset in the system can be shared publicly or restricted to allow access to only specific users. Social features like user profiles and commenting and rating systems allow for the development of communities around each platform to facilitate the use, management, and quality control of the data the GeoNode instance contains (geonode.org).

This paper presents a case study scenario of setting up a Web platform based on GeoNode. It is a public platform called MASDAP and promoted by the Government of Malawi in order

to support development of the country and build resilience against natural disasters. A substantial amount of geospatial data has already been collected about hydrogeological risk, as well as several other-disasters related information. Moreover this platform will help to ensure that the data created by a number of past or ongoing projects is maintained and that this information remains accessible and useful. An Integrated Flood Risk Management Plan for a river basin has already been included in the platform and other data from future disaster risk management projects will be added as well.

Asian Development Bank (ADB). Natural hazard data a practical guide. (2017): 10

The report focused on the importance of hazard data in establishing a platform. The report said, in some cases, there may be many natural hazard datasets to choose from for project disaster risk screening and design purposes, and to inform the preparation of country partnership strategies. In others, new data may need to be developed. In general, consultants or firms with appropriate technical expertise should be able to provide technical guidance. It is important, however, for project officers to understand the basics of assessing available data to best guide and interact with technical experts. This section addresses some of the key issues for consideration in identifying and, where necessary, commissioning the preparation of appropriate natural hazard datasets.

International Finance Corporation (IFC), Note 10, World Bank Group. How new data tools can assess climate risks. (2016): 3

This study reveals a number of climate risk screening tools are emerging and many institutions, including the World Bank and IFC, are employing them to help understand climate risk in the investments they make.

The Climate and Disaster Risk Screening Tools developed by the World Bank provide a systematic, consistent, and transparent way of this data will require using downscaled projections of global climate models to local conditions.

To do that, these general climate projections are coupled with localized weather data that draw on information from the specific location of the business, including historical weather statistics from local weather stations. This process is easiest in regions where these models are in good agreement. In regions that lack such agreement, global and regional models can still provide better understanding of expected changes at a local level. The global and local data are then combined with a collection of highly localized climate models, resulting in tens of thousands of data points and probabilistic projections for the future. The statistical modeling projection built from these data points helps businesses understand climate risks in operations, the costs of those risks, and risk drivers. Additional tools draw on this information to analyze how climate risks interact with other business risks and how those risks evolve over time.

3.2 Disaster and Climate Risk Information in Bangladesh

Base data from multiple sources reveal information on issues like flood, storm surge, drought, earthquake, landslide, river erosion etc. Such data can be assimilated and analyzed. The analysis will help reveal the hidden patterns in data, find the correlation between data sets, and offer actionable insights. In Bangladesh different government and non-government organizations have their own datasets. Some data are open

accessible, some are not. Scale of the dataset also vary. The significance of these datasets is important as this dataset might be used for exposure and vulnerability assessment. For example, Bangladesh Bureau of Statistics (BBS) publish the census report which consist of upazila wise data of many of the sub-components of exposure. BARC and LGED have spatial datasets which can be used for exposure and vulnerability assessment for different climatic hazard.

The Ministry of Environment and Forests (MOEF) is the coordinating agency of the Central Government on all matters related to environment and sets the climate change strategy for the country. The government has developed Bangladesh Climate Change Strategy and Action Plan (BCCSAP) and National Adaptation Programme of Action (NAPA) in 2009 to respond to climate change induced development risks and National Plan for Disaster Management (NPDM) in 2010 to respond to disaster risks. These strategies are supported by the Perspective Plan of Bangladesh (2010-2021) and the Seventh Five Year Plan. Bangladesh ratified the Paris Agreement on September 21, 2016.

Earlier, MRVAM Atlas published the basic information on the 8 major hazards, such as Flood, Cyclone induced Storm Surge, Landslide, Drought, Earthquake, Tsunami, Technological & Health hazards in context of the country, and the exposure, vulnerability and risk with regard to population (Gender, Age, Ethnicity, Employment, Education, Disability, Poverty), housing
(Housing Types- Pucka, Semi-Pucka, Kutcha, Jhupri), livelihoods (Agriculture, Industries), critical facilities (Healthcare, Educational Institutions, First Responders- Fire and Police stations, Cyclone Shelters), and infrastructure (Road, Bridge, Railway, Air, Sea and River Ports, Power Stations).

The Atlas is presented in 3 Volumes, such as Volume I (Part I): Hydro-meteorological Hazard, Exposure/Risk Assessment (Flood and Storm Surge); Volume I (Part II): Hydro-meteorological Hazard, Exposure/Risk Assessment (Drought and Landslide); Volume II: Geological and Environmental Hazard, Exposure/Risk Assessment (Earthquake, Tsunami, Technological and Health), Volume III: Multi-Hazard Exposure and Risk Assessment (Flood, Storm Surge, Landslide, Drought, Earthquake and Tsunami).

It is now very interesting that the decision makers are aware of National Risk Atlas as a tool that must be applied during planning and programming for preparedness and response to disasters. Given that the disaster management is a cross cutting issue, the Atlas will serve to identify and prioritize hazard prone areas during planning and programming for development activities in various sectors, such as transport, health and education, other critical facilities, essential service, as well as in urban and rural land use planning and in the development of infrastructures.

The Action on Climate Change in South Asia is a regional TA project by the Asian Development Bank (ADB), implemented in six South Asian countries, namely, India, Bangladesh, Sri Lanka, Nepal, Bhutan and Maldives. The two main objectives of the project are – first, screening of investment projects against climate risks strengthened. The TA will support screening of ADB-assisted projects in selected South Asia DMCs for climate change risks, and provide early inputs into project planning, design, monitoring,

and reporting. Second, Building capacity of DMCs in developing and/or implementing climate change mitigation and adaptation strategies and action plans as well as disaster risk reduction and management.

First task of the project was HEVR study, i.e. assessing Risk (R) of a development project considering its relevance to hazard (H), Exposure (E) and Vulnerability (V). An extensive collection of data for H, E and V components has been made from different sources including both Govt. agencies and autonomous bodies. It was a major challenging part of the study. Based on the H, E and V data set - an appropriate methodology has been developed for the Risk assessment and risk maps are prepared, spatially distributes over the country. The spatial scale of the study was district level and probably it was a limitation of the study. However, considering scarcity of many of the socio-economic data at further smaller scale, it sounds to be still a reasonable scale.

Apart from HEVR study, a very useful part of the study was to project climate change for Bangladesh under two RCP scenarios 4.5 and 8.5. GCM outputs were further downscaled up to 1 km grid for entire Bangladesh.

As After AR5 (2014), the definition of disaster risk management has been changed to a great extent, ADB work followed the IPCC fifth assessment report. Earlier DDM has followed the fourth AR of IPPC in MRVA Atlas.

3.3 Available web based datasets in Bangladesh

Bangladesh Bureau of Statistics (BBS) publish the census report which consist of upazila wise data of many of the sub-components of exposure. BARC and LGED have spatial datasets which can be used for exposure and vulnerability assessment for different climatic hazard up to upazila level. In this section of the report, datasets related to disaster and climatic risks from various organization is described. Each organization having what type of data, data accessibility and its implications in disaster impact assessment are focused in this part. A list of the datasets also given in annex-1.

3.3.1 GeoDASH

GeoDASH is being established by the World Bank in Bangladesh as part of the country's Open DRI to facilitate data sharing between government stakeholders, academia, and the public. GeoDASH is geo-spatial data storing and sharing initiative by Bangladesh Government. It is a web based platform for compiling, updating and sharing geospatial database which will allow facilitating the use, management, exchange and quality control of geospatial data sets in a collaborative manner. An open data sharing system will promote transparency, accountability, and will ensure a wide range of actors who are able to participate in the challenge of building resilience and managing disaster risk in Bangladesh.

GeoDASH is a GIS based archived data site which has both data upload and download facilities. Some hazard data is also available. The limitation is the data are not in organized form, rather are in scatter form. The dataset (Geospatial) has not any unique projection system.

3.3.2 Bangladesh GIS Portal (BGISP)

Different government and private organizations in Bangladesh are conducting GIS related

activities for their own or for national research and development project activities. But due to lack of coordination among the GIS related agencies, there are duplicate GIS efforts and wastage of time and money. Hence, the nation is deprived of expected development through GIS. That's why it is urgent to coordinate among the different ministries/divisions, agency and private organizations. If it is possible to gather all the GIS actors in a single platform, that can server the planners, researcher and development workers of the country in a better way. Bangladesh GIS Platform is created to serve this purpose. A government order has been issued to create the platform headed by Additional Secretary, Statistics and Informatics Division, Ministry of Planning on 30th June, 2016 incorporating 36 (Thirty Six) members from 34 (Thirty Four) organizations. BGISP is a geospatial archive, and in construction phase.

3.3.3 Bangladesh Open Data

In the context of Bangladesh, open government data is critical to ensure effective public services. There are large volume government and private sector data that can contribute in decision making for policy makers as well as for common citizen. Also, open data and open government data can support policy reform and ensure transparency and citizen participation.

Bangladesh open data give the accessibility of data of the following sectors: Finance, Education, Business, Agriculture, Environment, Health, Infrastructure, Technology, Transport, and Local-Government.

This site basically work as a connecting website having the datasets of the above mentioned factors. No climatic hazard/risk information is not directly available here.

3.3.4 The Bangladesh Forest Information System (BFIS)

BFIS was developed by the Bangladesh Forest Department (BFD) under the Ministry of Environment, Forest and Climate change with the technical assistance from the Food and Agriculture Organization of the United Nations (FAO) and funding from the UN-REDD programme and USAID.

It is mainly a descriptive web portal giving information regarding completed project and upcoming plans to conserve the forest/protected area. No spatial or tabular data is available in the website, however it gives information on some criteria of exposure of forest of Bangladesh. In the description item of the website they have mentioned for different tools for accessing, adding, and updating information but there are no screening tools available for it.

3.3.5 National Spatial Data Infrastructure (NSDI)

Geographical Information System (GIS) Unit of Survey of Bangladesh has started generating digital Topographic Database of entire Bangladesh from Photogrammetric products based on the recent aerial photographs and satellite imageries and verified by ground survey. Data from 18 different organizations will be available after the completion of the website construction.

NSDI is a GIS based archived data site. The website is still under construction and there is no provision to download data. So, we did not find any implications to assess climatic risk from it.

3.3.6 Bangladesh Agricultural Research Council (BARC)

BARC is executed a project entitled "Utilization of Agro-ecological zones Database and installation of GIS for Agricultural Development" initiated in 1996. BARC publishes lots of data related to agriculture for whole Bangladesh in their website. Anyone can download the data as shapefile or map format.

BARC has countrywide spatial database on the agricultural sector. There are many GIS layers including flood map, administrative boundary and so on, which are easily downloadable. Although most of the datasets are in national scale, the data could be used to disaster impact assessment. The disadvantage is, the dataset was last updated in the year 2000.

3.3.7 Bangladesh Bureau of Statistics (BBS)

Bangladesh Bureau of Statistics (BBS) is only the national Statistical institution responsible for collecting, compiling and disseminating statistical data of all the sectors of the Bangladesh economy to meet and provide the data-needs of the users and other stake holders like national level planners and other agencies of the Government.

BBS publishes some regular publication into their website. This publication has lot of information from census. The publications has some broad category: District Statistics, Small Area Atlas, Disaster Prone Area Atlas, Statistical Pocketbook, Statistical Yearbook, Yearbook of agricultural statistics. Anyone can download the publication in pdf format from the BBS website. BBS do not publish any tabular format data (excel, dbf) or GIS format data (shapefile) in its website. The district statistics and disaster prone area atlas can provide lot of data and information regarding socio-economic, hazard, disaster.

3.3.8 Flood Forecasting and Warning Center (FFWC)

Under Flood Forecasting and Warning Center (FFWC), it can create real time inundation level and short term forecast for a network of water gauge stations distributed all over the country. The data from BWDB is again not free of charge.

FFWC provides only the real time data on water level of each existing water level measuring station in tabular format. It also provides a map displaying water level status across the country. The data might be useful to generate flood intensity map of the country.

3.3.9 National Water Resources Database (NWRD)

Water Resources Planning Organization (WARPO) has developed National Water Resources Database (NWRD) to meet the demand of consistent and corrected data and information from the planners, researchers and managers working in water sector.

NWRD holds more than 400 data layers, out of which 125 layers are spatial data. 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.

NWRD data is being disseminated to large no. of users in universities, government & non-government agencies, national and international institutions and others. It can now 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 favoured formats. WARPO is updating and upgrading the database of all the existing NWRD and ICRD data layers and gathering new information.

Though NWRD is stated in their website to disseminate the data to large number of users in universities, government & non-government agencies, national and international institutions and others but there is no provision to download the data in the site. No procedure is given in the site how to get the data.

3.4 Global Risk Information Platforms and Screening Tools

Disaster and climatic change related risks are increasingly complex and interrelated. Different countries of the World establishes a Risk Platform. The platform will map and link various approaches to assessment, monitoring and management of development risk. It will link risk, vulnerability and capacity expertise into one global community of practice for all stakeholders from all relevant disciplines in order to inform and influence decisions, from humanitarian action, to risk reduction and through to the long-term goal of fully risk-informed development. Some platform have analyzed in this study. A summary table is also given in annex.

3.4.1 AWARE

Aware for Projects is an online tool that allows users to screen their investments for climate risk. The tool works across a wide range of project types and sectors and requires no climate change expertise to use. Simply locate the project anywhere on a world map and answering six simple questions on how climate may influence the success of any given project, and Aware for Projects will generate a detailed report to guide further discussions and assessments of climate risk. Some sample questions are given below:

1. What does this mean (Temperature) for the design of my project?
2. How could current high temperatures affect the project even without future climate change?
3. What does the science say could happen by the 2050s?

Three of the largest development banks in the world, European Investment Bank (EIB), Asian Development Bank (ADB) and Islamic Development Bank (IsDB), have embedded Aware for Projects into the early stages of their project climate risk management systems. Project officers use the tool to understand the potential climate risks to their projects and to identify those projects which may require more detailed climate risk assessments.

Figure 3. 1: AWARE screening tool

AWARE is not an open source tool. Acclimatise is a specialist advisory and digital application company that provides world-class expertise in climate change adaptation and resilience.

3.4.2 Climate and Disaster Risk Screening Tool: World Bank

Climate and Disaster Risk Screening represents a proactive approach to considering short- and long-term climate and disaster risks in project and national/sector planning processes. Screening is an initial, but essential, step to ensure these risks are assessed and managed to support mainstreaming of climate and disaster resilience into key development policies, programs, and projects. Considering climate change and disasters in today's plans and projects, can increase the long-term success of development efforts, while realizing other co-benefits today. An end-to-end sector specific guidance on how to use the screening tools can be found for the following sectors: Agriculture, Water, Energy, Health, Transportation, and National/Policy Level.

The tools link to climate projections, country adaptation profiles, and disaster risk data sources from the World Bank's Climate Change Knowledge Portal. The data, combined with the user's understanding of the subject matter and country context, generates a characterization of risks to help inform dialogue, consultation, and planning processes at the project and program level. These tools can be applied to a range of development sectors in support of a) national plans and strategies and b) project level investments. The greatest value of these tools is that they provide a self-paced, structured and systematic process for understanding climate and disaster risks to programs and investments.

3.4.3 Sri Lanka Risk Profile

Sri Lanka risk profile public platform for GIS Data to support development in Sri Lanka. This profile provides an overview of climate risk issues in Sri Lanka, including how climate change will potentially impact agriculture, water resources, human health, coastal zones, and infrastructure and industry. The web portal of risk profile is in fact an archive of risk related geo-spatial data of Sri Lanka. The datasets are categorized into 3 sections:

I. Hazard
II. Exposure
III. Baseline data

But this section of data still blank, it may be in up gradation process. However the following factors of hazard, exposure and baseline data will be archived in future:

Table 3. 1: Factors of 3 components of Sri Lanka Risk Profile

Component	Factors
Hazard	Flood, Tsunami, Elephant attack, Landslide, Cyclone, Epidemic, Man-made, Drought, NDVI, Other hazard
Exposure	Health, Transportation, Education, Population, Utilities, Emergency response, Structure, Places, Agriculture,
Baseline data	Administrative boundary, Elevation, Imagery, Climate, Landuse, Water

3.4.4 Malawi Spatial Data Platform

The Malawi Spatial Data Portal (MASDAP) was established in 2012 to address the issues of access to spatial data and to improve collaboration and use of the data by the Government of Malawi, the public and other key stakeholders. In order to set up, manage and maintain the technical platform and its data, a MASDAP working group was created comprising the key stakeholders involved in producing or using risk information. Originally, the working group was created around the Shire River Basin Management Program Technical Team and implementation agencies, the project it originally supported.[2]

3.4.5 Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI)

Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) is a joint initiative of Geoscience Division, SPC, World Bank, and the Asian Development Bank with the financial support of the Government of Japan, the Global Facility for Disaster Reduction and Recovery (GFDRR) and the ACP-EU Natural Disaster Risk Reduction Programme, and technical support from AIR Worldwide, New Zealand GNS Science, Geoscience Australia, Pacific Disaster Center (PDC), OpenGeo and GFDRR Labs.[3]

PCRAFI assembled, processed, developed, and organized the largest collection of geo-referenced data for hazard modeling in the region:

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

[2] Open data for Resilience Initiatives, The World Bank, 1818 H Street NW, pp 07-08

[3] http://pcrafi.spc.int/

3.4.6 Aqueduct Global Flood Analyzer

The Flood Analyzer was designed to identify the highest risk places in the world, and to plan accordingly to prevent disasters. The United Nations, World Bank, and similar organizations can use the tool to evaluate flood risks to development projects, helping them prioritize investments in various flood-protection measures. Re-insurance companies can quickly screen the globe to find flood hotspots that need additional financial-risk support. Organizations like Red Cross Red Crescent can evaluate how effective risk-reduction activities are against baseline conditions.

The features/modelling used in this site:

- Graphical and Map representations of current and future flood risks
- 3 different scenarios based on socio-political factors
- Global hydrological and hydraulic modelling
- Inundation modelling
- Impact modelling
- Estimation of "annual expected impacts"
- Future flood risk projections

In order to provide the best user experience the programmer/web developer of the site would need to consolidate the application into a single page. They implemented non-intrusive design characteristics to create a distinction between the graph and map.

3.4.7 The Global Integrated Drought Monitoring and Prediction System (GIDMaPS)

GIDMaPS integrates precipitation and soil moisture data from model simulations and remote sensing observations including the Modern-Era Retrospective analysis for Research and Applications (MERRA-Land), North American Land Data Assimilation System (NLDAS), Global Land Data Assimilation System (GLDAS) and the Global Drought Climate Data Record (GDCDR). GDCDR combines real-time Precipitation Estimation from Remotely Sensed Information using Artificial Neural Networks (PERSIANN) satellite data with long-term GPCP observations using a Bayesian algorithm. Table below summarizes the input data sets, their spatial resolutions, and providers.

3.4.8 Global Risk Data Platform: PREVIEW

PREVIEW site has the facility to generate some risk, hazard and exposure maps with background and contextual layers. Some past events like tropical cyclones, fire, floods, drought, and volcanic eruption is collected in the site as well. Following hazards has been considered:

I. Landslide
II. Cyclone wind
III. Flood hazard
IV. Peak ground acceleration
V. Storm Surge
VI. Tsunami
VII. Multi-hazard average annual loss

Data on following criteria can be used as background coverage:

I. Elevation
II. Open Street Map
III. Land Cover
IV. Population
V. GDP

3.5 Climate Risk Screening Tools for project: Global Practices

In this section, we take a detailed look at the global practice of climate risk screening tools and guidance. More specifically, a comparative overview is provided to form the basis for assessing the scope and objectives of these tools and guidance: What do they have in common? Where and how do they differ? What are their comparative strengths? What are the key challenges and opportunities? Table in annex-3 summarizes the key features of currently available climate risk screening tools, guidance, and portfolio screenings, listed in alphabetical order.

CHAPTER 4: MATERIALS AND METHODS

The study has been conducted through integrated approach of literature review, interview, case studies and findings from workshop. The study reports that has been reviewed is discussed in the previous chapter. The method is divided into two steps: 1. Desk Review, 2. Primary data collection.

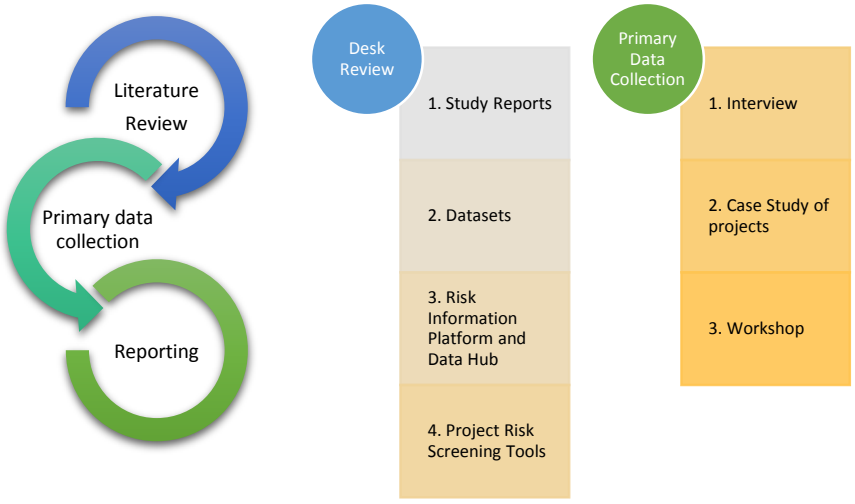

Figure 4. 1: Methodological Framework of the study

4.1 Desk Review

An integrative review usually has a different purpose, with the aim to assess, critique, and synthesize the literature on a research topic in a way that enables new theoretical frameworks and perspectives to emerge (Torraco, 2005). Following desk reviews have been conducted for this study.

4.1.1 Study Reports

The literature review includes an analysis of key research, policy, previously undertaken literature reviews and other relevant documentation primarily in the Bangladesh, but also in other countries where relevant. It covers the following three desk work categories:

- Hazard and Risk data used in several studies

- Methodology of Risk Assessment

- How it can serve the government in decision making

It has not been possible within this review to cover all categories under these three broad themes. However, the list of the reviewed study is given below:

i. Dr. Goosen H. Nationwide Climate Vulnerability Assessment in Bangladesh. (2018): 11-12.
ii. Integrating Climate and Disaster Risk into Development. The World Bank Group 1818 H Street, NW Washington, D.C. 20433, USA. (2018): 20-21.
iii. S. Balbo et.el. A public platform for geospatial data sharing for disaster risk management. (2013): 189.
iv. Asian Development Bank (ADB). Natural hazard data a practical guide. (2017): 10
v. International Finance Corporation (IFC), Note 10, World Bank Group. How new data tools can assess climate risks. (2016): 3

4.1.2 Risk Information Platform, Datasets and Project Risk Screening Tools

Existing risk information platform and archived data portal of Bangladesh which may carry significant value to assess climatic vulnerability/risk have been reviewed in this study. Some global risk information platform have also been studied. Some project risk screening tools are also exist globally, some of them are applicable for Bangladesh as well. Project risk assessment comes in different forms, such as dynamic risk assessment and qualitative and quantitative risk assessment. Project risk assessment is a crucial area of effective project management as it helps teams to prepare and plan for potential issues before they arise. In this study, we took a look at the project risk assessment model, a project risk assessment example and how project risk assessment software app can help the government to effectively and efficiently manage the risks of whatever projects are carrying out. List of Risk Information Platform, Data Hub and Project Risk Screening Tools have been discussed in Chapter 3.

4.2 Primary data collection

Primary data are collected through interview and case studies of some projects.

4.2.1 Interview

Interview was one of the key methods applied to perform the task. Some personal and telephonic interviews have been conducted. A total of 02 interview were conducted in this study. Questionnaire of the interview is attached in annex-5.

Table 4. 1: Interview of similar projects

Sl No.	Name of interviewee and position	Project	Type of Interview	Date of Interview
1	M. Mahmudur Rahman, Principal Advisor, GIZ	Adaptation to Climate Change into the National and Local Development Planning (ACCNLDP)	In Person	25 August 2019
2	Mirza Showkat Ali, Director (Climate change & International Convention (CC)), DoE	Nationwide Climate Vulnerability Assessment in Bangladesh	In Person	26 June 2019

4.2.2 Case Study

A regional TA project named "Action of Climate Change in South Asia" of Asian Development Bank (ADB) was implemented in 6 South Asian countries along with Bangladesh. The counterpart of GoB is programming division, planning commission.

This project is selected for case study as the project components and outputs would be the major data source of proposed DRIP.

The desired outcome of the Regional TA was the successful transition to a low-carbon and climate resilient development path in South Asia. It was hoped that there was increased investment towards institutional capacity

building of South Asia DMCs to mitigate and adapt to climate change.

Output 1: Screening of investment projects against climate risks strengthened. The TA will support screening of ADB-assisted projects in selected South Asia DMCs for climate change risks, and provide early inputs into project planning, design, monitoring, and reporting.

Output 2: Building capacity of DMCs in developing and/or implementing climate change mitigation and adaptation strategies and action plans as well as disaster risk reduction and management. As a part of this TA, the main objective of this project is climate risk screening (in some cases, detailed climate change risk and vulnerability assessments) and identification of adaptation measures in Bangladesh, which can be listed as:

(i) Design and establishment of a climate risk and vulnerability screening (CRVS) system and pilot-testing it for selected large

investment projects in the agriculture and water sectors that are proposed for inclusion in the ADP, and

(ii) Enhancing the human resource capacity of concerned government agencies/ departments/ministries in conducting climate risk and vulnerability screening at the project level.

The output under the entire study can be divided in the following major tasks:

Climate projection Maps

- Preparation of spatial data set for historical trend, baseline data and future projections of climatic parameters.
- Preparation of district level figures of the future climate change data downscaled by the Regional Climate Scientist.
- Sensitivity of each of the hydro-meteorological disasters to those climatic changes assesse

Hazard maps

- Nature based on appropriate secondary data sources.

Exposure Maps

- Physical and natural features, exposed to natural hazards and climatic changes are selected as *Exposure* unit and spatially distributed maps are prepared for them.

Vulnerability Maps

- Socio-economic factors that may amplify or retard the impact of a hazard are known as vulnerability. At the same time, adaptive capacity as physical structures and facilities to abate a hazard are grouped under adaptive capacity. GIS maps at district scale are prepared for all the components under these categories.

Multi-Hazard Risk Maps

- Review of existing methods for disaster risk assessment, i.e. HEVR methods.
- Formulation/customization of a suitable method appropriate for the Bangladesh context.

CRS and CRVA tool

- Conceptualization of the CRS tool and incorporation of the climate and disaster risks assessment outputs into CRS.
- Pilot testing: use of the HEVR assessment outputs to a specific real world project under the agriculture and water sectors to test its performance and applicability.
- Evaluate the tool from the experience of pilot testing, if required.

Risk Atlas and Database

- Risk Atlas: are prepared as compilation of HEVR maps and figures with explanatory text with all the information, datasets related to of natural disasters in the country in a book form in a systematic order, in collaboration with other TA consultants.
- Spatial presentation of all the components of risk assessment as natural hazard, exposure and vulnerability level with detail description of physical, social, ecological and economic conditions are compiled.

4.2.3 Workshop

A consultation workshop on Establishment of Risk Information Platform was held on 25 February 2019 at NEC Committee Room, Planning Commission, organized by NRP-Programming Division. Representatives from different agencies/organizations were present in the workshop: BBS, WARPO, CEGIS, SRDI, DAE, GSB, SoB.

The workshop is selected for review for this study because the objectives of the workshop is closely related to the rationality of establishing DRIP.

The main discussion areas of the workshop were:

- Explore/share the scope and opportunities of establishing a digital risk platform/interface through existing disaster and climate risk database, and digitised information;
- Identify disaster and climate risk data and information needs related to national and sectoral planning process (DPP preparation);
- Identify possible areas and mode of cooperation within government agencies (such as Planning Commission and other government agencies) for risk-informed public investment.

CHAPTER 5: ANALYSIS AND FINDINGS

The analysis part shows the detail exploration of the findings. In this section of the report, findings from the each section of literature review, findings from the case study, interview and workshop are described.

5.1 Study Reports

The reports are analyzed based on the following key factors:

- Objective of the research
- Climatic information used in the study
- Information related to risk information platform framework
- Major outputs

The following reports have been analyzed and the major findings from these reports are given in a table below:

Table 5. 1: Findings from study reports

Name of the study/Report	Findings
1. Dr. Goosen H. Nationwide Climate Vulnerability Assessment in Bangladesh. (2018): 11-12.	Hot spot zone wise current and future vulnerability assessment have been performed at upzalia level for all over the country.
2. MRVAM Atlas	A detailed assessment of HEVR for eight hazards (i.e. Floods, droughts, storm surges, earthquakes, landslides, tsunamis, technological and health)
3. Integrating Climate and Disaster Risk into Development. The World Bank Group 1818 H Street, NW Washington, D.C. 20433, USA. (2018): 20-21.	Technical information for DRIP outline
4. S. Balbo et.el. A public platform for geospatial data sharing for disaster risk management. (2013): 189.	
5. Asian Development Bank (ADB). Natural hazard data a practical guide. (2017): 10	
6. International Finance Corporation (IFC), Note 10, World Bank Group. How new data tools can assess climate risks. (2016): 3	

5.2 Web based datasets (Natural disaster & Climate related)

Total 9 datasets have been reviewed in this study based on the following criteria:

- Type of the portal (e.g. archive/analytical)
- Data download option
- Data accessibility/availability
- Implications of the data for climate risk assessment

It has been found that, some of the web portal is under maintenance/construction/beta stage. We found following 3 datasets having information related to Natural disaster & Climatic risk and having data capture or download option as well:

I. GeoDASH
II. Bangladesh Agricultural Research Council (BARC)
III. Bangladesh Bureau of Statistics (BBS)

5.3 Climate Risk Information Platform and Climate Risk Screening Tools

Some global risk information platform and risk screening tools have been reviewed based on the following factors:

- Aim of the platform
- Data archive facility
- Data download option
- Map display and analysis option
- Risk screening system

The objective of reviewing this platform is confined to find the similarity with the proposed DRIP and to construct an outline of DRIP.

5.4 Interview

Two interviews of two several projects have been conducted in this study. The findings are:

Adaptation to Climate Change into the National and Local Development Planning (ACCNLDP) project:

- There are 2 main aspects the PLIS: 1) Appraisal of DPP or TAPP 2) National Level Planning
- In ACCNLDP project, data have collected mainly from different organizations specially LGED, Roads and Highways Department, UDD, and City Corporation.
- A web based tool is developed, it is a decision making tool based on existing infrastructure.
- Climate related data might be included on the 2nd phase of the project

Nationwide Climate Vulnerability Assessment in Bangladesh (NCVA) project:

- Hot spot zone wise current and future vulnerability assessment have been performed at upzalia level for all over the country.

5.5 Case study

The project named “Action on Climate Change in South Asia” is selected for case study as the project components and outputs would be the major data source of proposed DRIP. The major outputs of the project is given below:

- Climate projection Maps: 385 numbers of climate projection maps have been produced for all over the country at district level. Two factors: Temperature & Rainfall for RCP 4.5 & 8.5

- Hazard maps for or 10 different hazards: Flood, Flash flood, Cyclone, Storm Surge, River erosion, Salinity, Drought (Kharif), Drought (Pre-kharif), Earthquake and Landslide.
- Exposure Maps
- Vulnerability Maps
- Multi-Hazard Risk Maps
- Risk Atlas and GIS database

5.6 Workshop

The workshop is selected for review for this study because the objectives of the workshop is closely related to the rationality of establishing DRIP. Major decision taken in workshop are:

- A common platform need to establish to store geo-spatial data
- Take the best practices from neighboring countries to establish a common platform for geospatial data
- Formation of Technical Committee to develop Standard Operating Procedures (SoP)

5.7 Overall findings

Summarizing the findings from each methodological tools, we can reveal the findings below:

I. Most of the web based datasets are just storing data from various source. The file type are not similar and scattered. Regarding Geo-database or Shapefile, no specific projection system is followed. Cluster wise data storing is not seen.

II. There are few Project Risk Screening/ Project Assessment tools can be used in the country. None of them are free of cost for planner or decision makers. The risk screening tools are sometimes complicated to use and may take long time to assess. As a result this will be difficult to assess risk for a numerous number of DPP for planners.

III. Integration of climatic hazard data from different Project/ organization/agency into a single platform is not established yet.

IV. A common platform need to establish to assess the impact of climatic risk in development project all over the country

CHAPTER 6: ESTABLISHING DIGITAL RISK INFORMATION PLATFORM (DRIP)

6.1 Structure of DRIP

GIS software has enabled users to view spatial data in its proper format. As a result, the interpretation of spatial data has become easy and increasingly simple to understand. Unfortunately, everyone does not have access to GIS, nor would able to spend the time necessary to use it efficiently. Web GIS becomes a cheap and easy way of disseminating geospatial data and processing tools. Internet technology has made its way to accumulate spatial data of many government organizations as well as non-government agencies. The ability to get risk information through internet made spatial data providers to explore the internet resources for disseminating spatial information.

6.1.1 Transferred of Geo-spatial data

Except attribute data, a decisive question for using GIS in the Internet is the data format (vector or raster), which would be used to transfer data to Programming Division, Planning Commission. For data transmission to the client/programming division, map will be converted in to no space raster or a suitable vector format. When raster data will be transferred, a standard Web browser without extension can be used, since Web browser displays GIF and JPEG. That means the data on the server has to be converted to a raster format. The data volume due to the known image size and the original data on the server is safe as only an image will be sent to the client. The disadvantage of using raster data is the lack of comfort of handling and regarding cartographic aspects, like font problem. Moving over an object with mouse cannot highlight single objects. In addition, a server contact is necessary per each request from the client.

Because of low vector data volume, it transmits faster than raster. Vector data handled by a standard Web browser with extended functionality (e.g. using plug-ins). The user gets a more functionality with vector data. For example, single objects can be selected directly or highlighted. One more advantage of using vector data is the possibility of local processing; it is not necessary to contact the server per executed browser action. The amount of vector data sent over Web could be three to four times less than the amount of raster data needed for equivalent resolution resulting in faster response time and greater productivity (Nayak, 2000). Disadvantages of vector data are manufacturer dependence, as well as, changing data volume; the amount of data varies with the selected area. To avoid data redundancy in client side, dynamic generalization must be provided. Distributing vector data may also endanger copyright rules. The choice of transferring data form (vector or raster) varies with applications and the existing infrastructures. Software products, which offer optional transferring of vector or raster data, may provide advantages. They may allow a pre-selection with raster data, and afterwards, loading of the actual vector data with the possibility of subsequently local process (Leukert & Reinhardt, 2000).

6.1.2 Data Analysis and Background Engine

The proposed DRIP might have a complex background engine for analysis. Internet Map Server (IMS) applications allow GIS database custodians to easily make their spatial data accessible through a web browser interface to end-users.

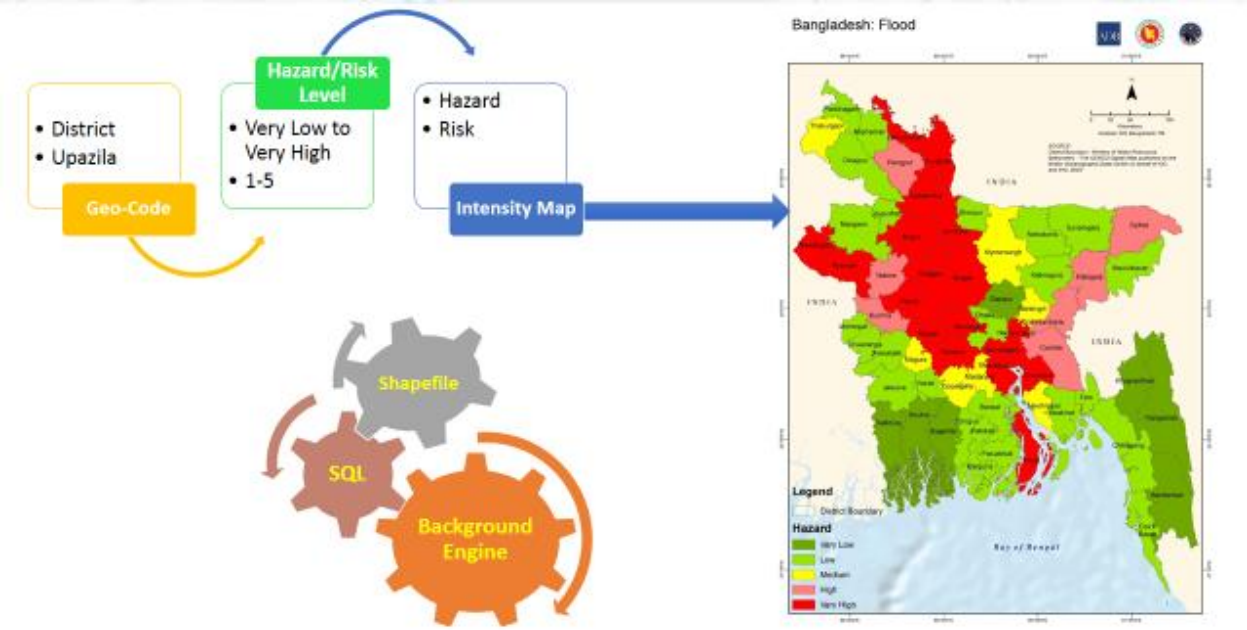

Figure 6. 1 : How DRIP will work

The collected base information and geo-spatial data regarding hazard, exposure, vulnerability and risk assessment will be archived and there will be provision to analyze these data to get a result. There are several technology levels to publish map data on the Web, ranging from sites that simply publish static web maps to more sophisticated sites which support dynamic maps, interactively customized maps and multiple computer platforms and operating systems.

6.1.3 Architecture of proposed DRIP

From an information management standpoint, the architecture (structure) of proposed digital risk information platform can be split into three main components, each contributing to its core functionality:

- **A user-interface / client:** allows the user to interact and use GIS tools through a graphical user interface (GUI).
- **An application engine / server:** the collection of tools available for the user to manipulate and analyze GIS data
- **A database:** the data stored as files or web services and the associated database management software

This three-tier architecture of GIS systems allows for a number of operational implementations,

differentiated by the location of the main components and services (Longley et al., 2010):

- Desktop: all software components are installed and run from a single machine (usually a desktop computer).
- Client-server: functionality is split between the client (computer running the user-interface), with some functionality/services and the data typically being hosted on a remote computer (server).
- Centralized desktop: a GIS desktop application with limited processing capability is installed on the client side; tools and data are hosted on a server; common with departmental implementations.
- Centralized server: enterprise GIS and web-based GIS belong to this category; simple interfaces (e.g. web browser) allow control of the user interface (typically hosted on a remote server), while tools and databases are hosted on dedicated servers, often linked within large networks.

Developments in GIS infrastructure have brought about a diversification of software components tailored for specific configurations. Today, “traditional” desktop GIS still serve an important segment of the GIS user base, while centralized desktop GIS remain common in enterprise implementations. Web-based GIS is registering rapid growth, due to the unique combination of ease-of-access and opportunities for collaborative/shared work presented by cloud computing. The existing database can either be linked directly to the proposed site or typically collected for upload.

However, this is a proposed architecture. The assigned consulting firm can change the architecture in consultation with programming division.

6.1.4 User interface and accessibility

This can be done by interviewing potential users or working with a subject matter expert to identify who the users will be. Identify facts about potential users, their behaviors, and their goals. What do they want from the proposed platform, and why do they want it? Their personas will be used to justify the relevance of design decisions as well as tools and functionality as the project moves forward. The accessibility might not be open and limited to related government officials.

6.2 Vulnerability and Risk Assessment

The Risk Data Hub supports the identification, implementation and evaluation of prevention and preparedness actions for DRR. The data will be typically collected from various secondary sources. In the context of extreme events and to support risk management decision-making, information on socio-economic, environmental and land use are presented as potential impact. Being designed to consolidate risk management, the Risk Data Hub creates a basis for analysis approaches that relates physical characteristics of the hazard to their various potential impacts. In this way, linking hazard characteristics with their effects on society, economy, environment and land use, at large, it establishes a data source that can be used for disaster risk management. It may also provide the necessary link to evaluate which hazard metrics can predict impacts the data hosted on the Risk Information Platform is divided in four modules: Exposure Analysis, Vulnerability Analysis, Risk Analysis and

Historical Events. The user can select within these modules the domain of analysis represented by sector-structured exposure (e.g. population, agriculture, infrastructure etc.) and their attributes (the metrics of the domains, e.g. agricultural metrics).

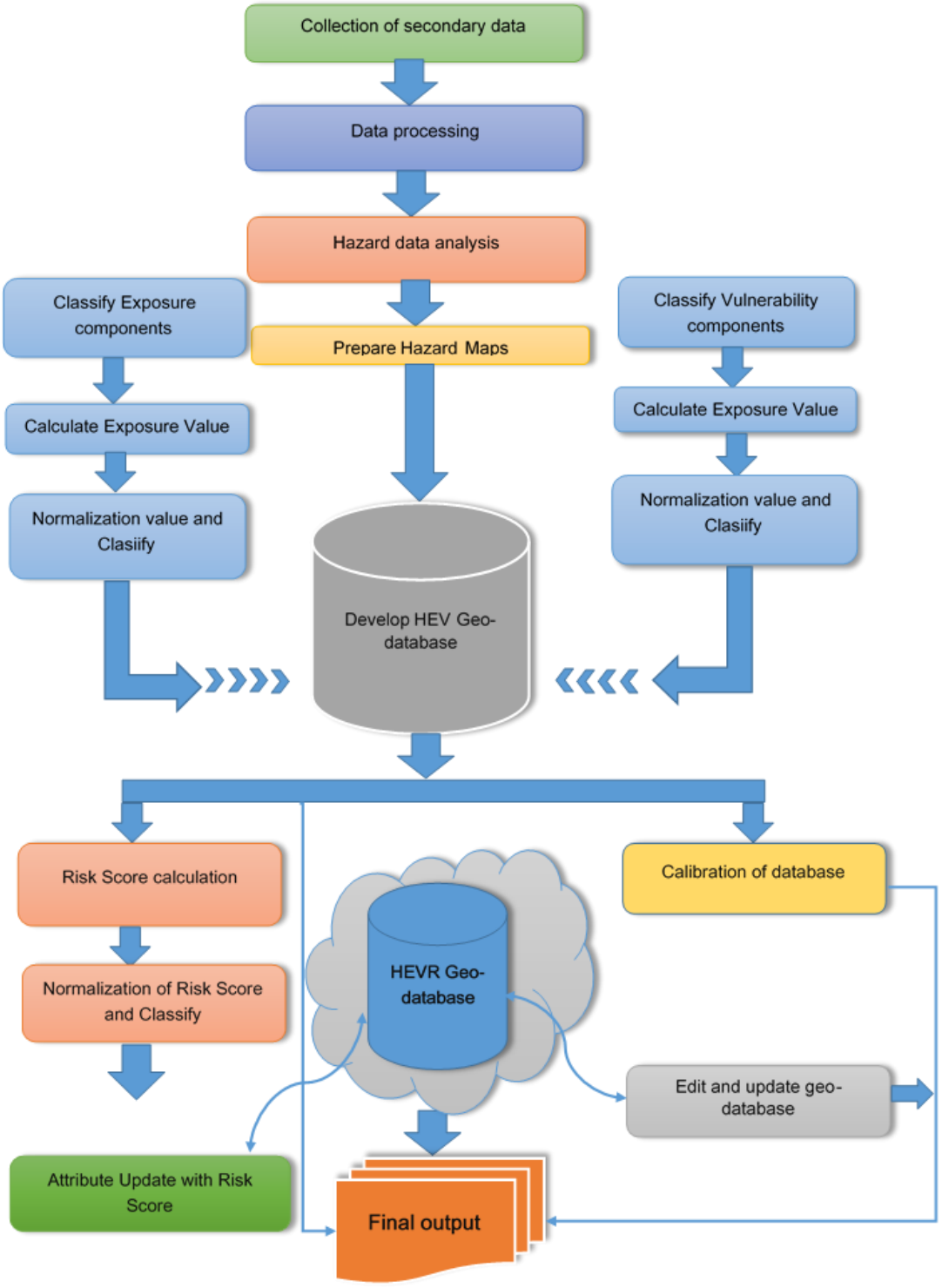

Figure 6. 2: Methodological flow chart for establishing DRIP

6.2.1 The Exposure Analysis module

The exposure Analysis module will be based on the identification of the impact areas by means of exposure analysis. Links to various exposure layers (population and built-up gridded data, Open Street Map layers etc.) and hazard layer from various sources are made available for the user to discover and compare. Across geographical scales (countries or local administrative units) and across-hazards spatial data analysis is enabled.
Major exposure units or elements-at-risk might be considered initially are population, settlement and agriculture. For a particular hazard, it is expected that these elements will be affected mostly.

a. Agriculture
b. Settlement
c. Road
d. Population

Depending on the availability of the data, number of sub components of both exposure and vulnerability may vary. The sub components mentioned in this report, were used in ADB project with programming division. However, the spatial data for the above components will be collected from different secondary sources. Based on the upper and lower limit of the data range, normalization will be done and divided the range into five levels as Very low, Low, Medium, High, Very High.

The fundamental assumption here is that the higher the density of exposure units in an administrative unit, the higher the possibility of disaster risk. Depending on the type of hazard, however, these exposure units will be affected in varying degrees. Appropriate weights are thus assigned to each of the exposure units for different hazards.

6.2.2 The Vulnerability Analysis module

Physical and socio-economic settings that may further aggravate or damp out the impact of a hazard, is defined as vulnerability. Another term related to vulnerability is the adaptive capacity or adaptability. Lack of adaptive capacity is also a form of vulnerability. The combined impact of these two terms are grouped under V, i.e. vulnerability. For proposed digital risk information platform, vulnerability will be divided under two parts (Table 3.1) as;

- Vulnerability -Socio-economic factors: These include disability, education rate, gender and income.
- Adaptive capacity - Physical structures: to abate hazard impact or adaptive capacity factors: These are the facilities like flood shelter, embankment and medical facilities.

The major vulnerability sub components are:

a. Education
b. Gender
c. Livelihood
d. Disability

Based on the upper and lower limit of the data range, normalization will be done and divided the range into five levels as Very low, Low, Medium, High, Very High. The order of the scale will be selected based on the expected consequence of the vulnerability components, as for example, the lower the education rate, the higher the vulnerability, Similarly, the higher the no. of population per flood shelter, the lesser the adaptive capacity or higher vulnerability, etc.

Vulnerability together is then defined as, V= (Socio-economic vulnerability / Adaptive capacity – physical)
Obtained values will be again normalized to the five scales. Depending on the type of hazard, however, these vulnerability units will be affected in varying degrees. Appropriate weights will be thus assigned to each of the exposure units for different hazards.

6.2.3 The Risk Assessment module

Risk identification is the process of finding, recognizing and describing risks. It is a screening exercise and serves as a preliminary step for subsequent risk analysis. Risk analysis is the process of comprehending the nature of risk and determining the corresponding level of risk. Risk evaluation is the process of comparing the results of risk analysis based on criteria, to determine whether the risk and/ or its magnitude is acceptable or tolerable (EC 2010).

Initially, it was perceived that risk is the product of probability of occurrence and hazard impacts. But the impacts are dependent on preparedness (e.g. cyclone shelter centre) and preventive/ mitigation measures, because these reduce hazard-specific vulnerabilities of a community. Thus, exposure to a hazard in certain locations affect communities collectively. As expressed below:

$$R = \int(H,E,V)$$

Where, R = Risk

H = Hazard
E = Exposure
V = Vulnerability.
A straight forward approach to adopt is R = H x E x V.

Under this formula, the value of H, E and V for a particular administrative boundary (for example: district) has been multiplied. The total score will be then normalized to five categories as Very low, Low, Medium, High and Very High. The highest possible value here will be 5*5*5 = 125. The lowest possible value is 1*1*1 = 1. In between 1 and 125, five divisions will be made accordingly. Based on a particular hazard, weights is given to the sub-elements of the E and V components.

Earlier ADB project with programming division have used the formula below:

In this approach Risk has been defined as the product of Hazard and Impact. i.e

Risk = hazard x Impact
Impact = (0.7 E + 0.3 V)

So, R = H x (0.7E + 0.3 V)

Through some visual observation of risk maps, this approach showed a better picture of Risk along the country. However, this can be considered as an arbitrary or empirical approach, without any solid theoretical background.

6.3 Output from DRIP and report generation

In the previous sections, we have explored the rationale for DRIP, outlined the main components of DRIP to operationalize risk informed public investment thus development, and indicated the various relevant levels and associated entry points to consider in the mainstreaming process. We have also illustrated and discussed how key hazards induced risks, climate change adaptation and mainstreaming concepts are defined and used in relevant literature – as well as in practice – and how they relate to development. These sections have addressed what will be the major outcomes of

establishing DRIP, and where it fits into the resilient public investment process. Primarily, agricultural and industrial sector risk platform will be developed.

Building resilience to climate and geophysical hazards is a vital step in the fight against poverty and for sustainable development. Screening for risks from these hazards improves the likelihood and longevity of a project's success. The project level Climate and Disaster Risks Screening Tool provides early stage due diligence on climate and disaster risks at the concept stage of project development. The DRIP will use an exposure - sensitivity - adaptive capacity framework to consider and characterize risks from climate and geophysical hazards, based on key components of a project and its broader development context. This report summarizes the results of the screening process for Bangladesh. In its continuity, the specific outputs of the DRIP are:

I. A project area risk screening report will be generated which will give an impression of climatic risk and vulnerabilities of project site.
II. Identify potential impacts and risks from climate and geophysical hazards.
III. DRIP will provide the concept of risk level elevated from climatic hazards that will help the decision makers to facilitate risk informed planning.
IV. It will assist the planners to include the mitigation measures regarding climatic risks while DPP formulation of a project.
V. Recognize the need for further detailed assessment.
VI. It is expected that, loss and damages of development infrastructures will be reduced gradually for considering climatic risks from the beginning of project designing and planning phase.

6.3.1 Content of produced report

The report will summarizes the key challenges faced when attempting to assess climatic risks. The Climate and Disaster Risk Screening Tool provides high-level screening to help consider short- and long-term climate and disaster risks at an early stage of project design. The DRIP will apply an Exposure–Impact–Adaptive capacity framework to characterize risks. Potential risks are identified by connecting information on climate and geophysical hazards with users' subject matter expertise of project components (both physical and climatic) and understanding of the broader sector and development context.

The generated report will not provide a detailed risk analysis. Rather, it is intended to help inform the need for further consultations, dialogue with local and other experts and analytical work at the project location to strengthen resilience measures in the course of project design. Content of the risk screening report of DRIP is attached in annex-4.

6.3.2 How development planners will use it?

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. [4] Thus, 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.

In Bangladesh, when rivers enter the mature stage (as in the case with the three mighty rivers, ganges, brahmaputra and meghna) they become sluggish and meander or braid. These oscillations cause massive riverbank erosion. Every year, many infrastructures are affected by erosion and also destroys standing crops, farmland and homestead land. It is estimated that about 5% of the total floodplain of the country is directly affected by erosion. Some researchers have reported that bank erosion is taking place in about 94 out of 489 upazilas of the country. A few other researchers have identified 56 upazilas with incidence of erosion. At present, bank erosion and flood hazards in nearly 100 upazilas have become almost a regular feature. Of these, 35 are severely affected. [5]

Figure 6. 3: Hospital collapse due to river erosion

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 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.

6.3.3 How DRIP will facilitate for mainstreaming DRR into development process and thus resilient investment?

With the increasing frequency of disastrous events, their effects on development are becoming increasingly evident. Thus, Mainstreaming risk reduction into the development process is one of the priority initiatives of DRIP. The proposed DRIP will link DRR into development planning process focusing on the point below:

1. Increase understanding of the hazard and climate change context: An understanding of past trends, present experiences and future projections of hazard occurrence, climate variability and the range of effects of climate change on the area and population concerned should underpin any decisions or actions to build disaster and climate resilience. It should include mapping at different scales, to allow for regional and local hazards and effects of climate change. The risk analysis process itself should increase understanding among all stakeholders, both as a result of its participatory nature, and through sharing of the results.

[4] 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.
[5] M Aminul Islam, Environment Land Use and Natural Hazards in Bangladesh, University of Dhaka, 1995; Muhammad Zahir Mamun and ATM Nurul Amin, Densification, The University Press Limited, Dhaka, 1999; Environment and GIS Support Project for Water Sector Planning (EGIS), Riverine Chars in Bangladesh, The University Press Limited, 2000.

2. Increase understanding of exposure, vulnerability and capacity: An assessment of the vulnerabilities and capacities of the population, systems and resources should be the foundation for decisions on the location, target populations (including understanding differential vulnerability),
objectives and approach of measures to build disaster and climate resilience. It should include analysis of the projected effects of climate change as well as of those currently observed. The assessment should also increase understanding among all stakeholders of the causes of exposure, vulnerability and capacity, both as a result of a participatory process, and through sharing of the results.

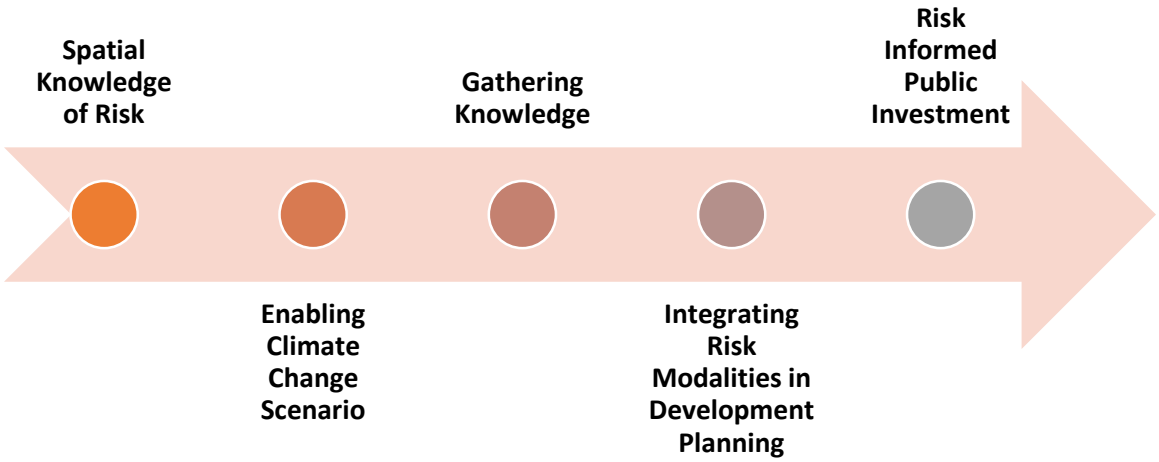

Figure 6. 4: DRIP for Risk Informed Development Planning

3. Promote systemic engagement and change: As there are multiple causes and drivers of vulnerability and exposure to hazards and the effects of climate change, strategies to build disaster and climate resilience should engage all sectors of society and government. The goal of multi-sectoral and multi-stakeholder engagement should be to make building disaster and climate resilience central to development planning. The commitment of all actors to this goal should be reflected in their respective policies, plans and budgets.

4. Draw on and build diverse sources of knowledge: Analysis of disaster and climate change risk should seek to complement local and traditional knowledge with the results of scientific research in order to continue to co-generate new knowledge. Measures to build disaster and climate resilience should promote

replication of effective practices, encourage autonomous innovation and introduce, where appropriate, external technology to help address new or magnified challenges. Strategies and programs should be monitored and evaluated to

ensure that learning is captured and made available to others.

CHAPTER 7: CONCLUSION

This report set out to provide a comparative overview and analysis of key climate screening tools and datasets exists in the country and globally, and to illustrate how climate risk screening supports the process of mainstreaming DRR thus public investment. We have additionally explored the necessity of establishing a common ground of sharing risk data to support risk informed planning. The concept of DRIP are used and defined in relevant literature, while clarifying how they relate to development. One of the essential aspects is to further develop a common understanding of climatic risk is about, how it can be operationalized. A final observation is that, In Bangladesh the existing datasets regarding hazards/disasters are quite fragmented. Although some platform and check tool exists, these cannot properly address the risk issues for development indicators. As climate risk screening efforts are largely useful to support risk informed planning and investment, an easy and common ground for the planners and decision makers is highly required.

The Digital Risk Information Platform (DRIP) proposes the identification of impact areas from spatial coincidence of the hazard with the exposure layers. The scope is to anticipate the areas expected to suffer significant impact from hazards. By integrating hazard data and mapping areas of potential impact, we provide means that serve as a starting point for prioritized local case studies on impacts to natural hazards, as well as the basis for the development of mitigation strategies. The DRIP will help Develop Planers and implementation agencies in advance identification of climatic risks of future investment of Bangladesh.

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ANNEXES

Annex-1: Available datasets (Natural disaster and climate related) in Bangladesh

Datasets	Year of establishment	Organization	Status	Data Accessibility/Availability	Data Type/ Format
GeoDASH [https://geodash.gov.bd/]	2015	Government of Bangladesh	Active	Access to all but request need to send to get download permission.	GIS
Bangladesh GIS Portal (BGISP) [http://www.gis.gov.bd/bn/index.php]	2019	Bangladesh Bureau of Statistics (BBS)	Active (Beta version)	Access to all but request need to send to get download permission.	GIS
Bangladesh Open data [http://data.gov.bd]		Government of Bangladesh	Active (Beta version)	Open access	Tabular/CSV
Bangladesh Forest Information System (BFIS) [http://bfis.bforest.gov.bd/bfis/]		Department of Forest	Active	Open access but need to send request to download the data layers.	Information
National Spatial Data Infrastructure (NSDI) [https://nsdi.gov.bd/]	2016	Survey of Bangladesh (SoB)	Active (Beta version)	Open access but need to send request to download the data layers.	GIS
Bangladesh Agricultural Research Council (BARC) [http://maps.barcapps.gov.bd/index.php?t=shape_file]		Bangladesh Agricultural Research Council	Active	Open access	GIS
Bangladesh Bureau of Statistics (BBS) [http://www.bbs.gov.bd/site/page/2888a55d-d686-4736-bad0-54b70462afda/-]		Bangladesh Bureau of Statistics	Active	Open access	Documents

National Water Resource Database (NWRD) [http://www.warpo.gov.bd/site/files/923d3fb9-77b6-463a-a5f7-4fe28d2d3ecf/-]		Water Resources and Planning organization (WARPO)	Data catalogue is Published but none of the dataset is published yet.	Only data list is accessible to all but data is not available in the website.	GIS
Flood Forecasting and Warning Center (FFWC) [http://www.ffwc.gov.bd/?id=riv]		Bangladesh Water Development Board (BWDB)	Active	Open access	Map viewer, Tabular

Annex-2: Global Risk Information Platform

SL No.	Name	Year of Establishment	Institutions / Country	Aim of platform	Data Archive	Data Download Option	Map Display	Map Manipulate /Generate Option	Project Screening System
1	Sri Lanka: Risk Info http://www.riskinfo.lk/	2011	Sri Lanka	To provide an overview of climate risk issues in Sri Lanka	Yes	No	Yes	No	No
2	Malawi Spatial Data Platform http://www.masdap.mw/	2012	Malawi	Using risk information to the key stakeholders	Yes	No	Yes	No	No
3	Pacific Catastrophe Risk Assessment and Financing Initiative (PCRAFI) http://pcrafi.spc.int/	2017	ADB, World Bank, GFDRR	To provide the Pacific Island Countries (PICs) with disaster risk modeling and assessment tools.	Yes	No		No	No
4	Aqueduct Global Flood Analyzer http://floods.wri.org/#/		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	No

5	The Global Integrated Drought Monitoring and Prediction System (GIDMaPS) http://drought.eng.uci.edu/		University of California	To provide near real-time drought information	No	No	Yes	Yes	No
6	Global Risk Data Platform: PREVIEW https://preview.grid.unep.ch/	1999	UNISDR	Visualization of data on natural hazards, exposure (both human and economic) and risk all over the world.	Yes	Yes	Yes	Yes	No

Annex-3: Comparative Overview of Available Climate Risk Screening Tools

Title of tool/ guidance	Organization / institution	Target Audience	Approach	Summary	Level	Costing exercise included	Practical application	Link/References
Assessment and Design for Adaptation to climate change – A Prototype Tool (ADAPT)	World Bank (WB)	Policy makers, Development project planners and managers	Softwareba sed approach integrating climate databases and expert assessment s	Carries out risk analysis at the planning and design stage, through a five level flag classification and proposes options to minimize risks + guides project designers to appropriate resources. The focus thus far is on agriculture, irrigation and bio-diversity.	Project	No	Agriculture and Natural Resource Management in South Asia and Sub-Saharan Africa. Tool available for Africa and India	http://sdwebx.worldbank.org/climateportal/
Adaptation Wizard	UK Climate Impacts Programme (UKCIP)	Planners and managers, UK	User-friendly info- and structuring computerb ased 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	Organiz ation	Yes	UK	www.ukcip.org.uk/index.php?option=com_content&task=view&id=147&Itemid=297

				countries.				
Climate Risk Impacts on Sectors and Programmes (CRISP)	Department for International Development (DFID)	Policy makers, project/ programme managers	Sector-based climate risk assessment methodology	Structuring framework developed for the portfolio screening of DFID activities in Kenya. Assesses climate impacts at the sector level.	Programme & sector	Yes	Kenya	http://www.dewpoint.org.uk/Article.Aspx?ArticleID=901
The Communitybased Risk Screening tool - Adaptation and Livelihoods (CRiSTAL)	SDC, IISD, World Conservation Unit (IUCN), Stockholm Environment Institute (SEI) and Intercooperation	Development project planners and managers	Participatory and vulnerabilitybased approach , step-by-step, computerbased 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/
Disaster Risk Reduction Tools	ProVention Consortium	Policy makers, project planners/	Disaster risk reduction (DRR) approach	Provides guidance on different DRR mainstreaming tools	Various	Yes, guidance note	N/A	http://www.proventionconsortium.org/?pageid=32&projectid=1
NAPAssess	Stockholm Environment Institute (SEI)	Stakeholders to the National Adaptation Programme of Action (NAPA) process and	Participatory, bottomup and consensusbased approach drawing on multi-criteria analysis for the	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	National/ sector	No	Sudan	http://www.sei-us.org/napassess/

		development practitioners	assessment and prioritizing of adaptation initiatives.	the context of climate screening				
Opportunities and Risks from Climate Change and Disasters (ORCHID)	Institute of Development Studies (IDS) and Department for International Development (DFID)	Development project planners / managers	Portfolio risk assessment method based on pilot studies	Basic framework including a 4-step generic approach to portfolio screening for climate risks.	Project	Yes	India, Bangladesh and China	http://www.ids.ac.uk/go/research-teams/vulnerability-team/research-themes/climate-change/projects/orchid
Screening Matrix	Danida	Development project planners/ managers	Pre-screening of activities	Simple climate change screening matrix, which establishes sector programme support sensitivity	Programme & Sector	No	Kenya, Cambodia, Bhutan, and Nepal	http://www.danidadevforum.um.dk/en/menu/Topics/ClimateChange/ClimateAndDevelopment/ToolsAndReferences/ClimateChangeScreeningNote/

Annex-4: Project Climate Risk Assessment Report

Introduction

This report summaries results from a climate risk screening exercise. The project information and location(s) are detailed in the next session of the report.

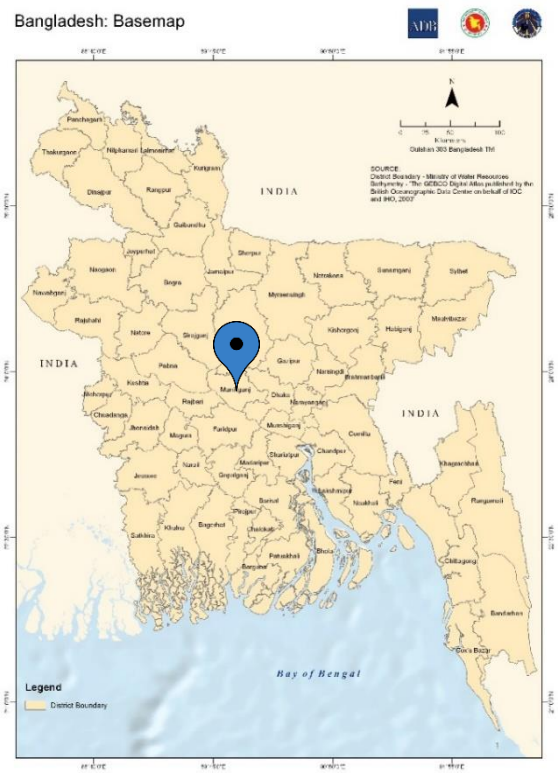
The screening is based on the DRIP dataset, compiled from the several project/study on current climate and related hazards together with projected changes for the future where available. These information are combined with the project's sensitivities to climate variables, returning information on the current and potential future risks that could influence its design and planning.

Project Information

Project Name	Name of the project
Sector	Agriculture/Industry
Description	Working area of the project

Project Location

Sirajganj



Project Risk Scoring

Below you will find the specific hazard wise and overall risk level for the project together with a chart presenting the level of risk associated with each individual risk topic analysed in DRIP. Projects with a final "High Risk" and "Very High Risk" rating are always recommended for further more detailed climate risk analyses. The chart provides an overview of which individual risks are most significant. This should be used in conjunction with the final rating to determine whether the project as a whole, or its individual components, should be assessed in further detail.

In the further sections of this report parameters of project screening and existing risk scenario of project location is provided. Information is given on existing and possible future climate conditions and associated hazards.

Risk for Individual Hazard

Total 11 hazards has been considered. Below you will find the scoring:

Hazard	Risk Level					Score
	Very Low	Low	Medium	High	Very High	
Flood					✓	5
Flash Flood						0
Erosion				✓		4
Cyclone		✓				2
Storm Surge						0
Drought (Kharif)			✓			3
Drought (Pre Kharif)		✓				2
Sea-Level Rise						0
Salinity						0
Earthquake		✓				2
Landslide						0

Our data suggest that the project is located in a region which has experienced recurring major flood and river erosion events in the recent past. Following factors need to note for this project location:

- Proximity to the coast and inland watercourses
- Highest Flood Level

- Condition of Embankment
- Urban drainage infrastructure
- River Erosion for several return period

Considering climatic risk in the project area, DRIP is suggesting the following links to recent case studies, relevant data portals and other technical resources for further investigation:

Hazard	Organization/Agency	Topic	Link
Flood	BWDB	Flood Forecasting	http://www.ffwc.gov.bd/
Flood	Global Flood Analyzer	Flood Scenario	http://floods.wri.org/#/
River Erosion	DDM	River Erosion-Return Period	http://www.ddm.gov.bd/site/page/c2d881ae-fcfd-45bd-9f03-81b33d080aab/Multi-Hazard-Risk-and-Vulnerability-Assessment-Modeling-and-Mapping--

Critical Questions for Mitigation Measures

As a starting point you may wish to consider the following questions:

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?

Annex-5: Questionnaire for Interview

1. Data used in the project:

a. Types of data

b. Quality of data

c. Sources of data

d. Format of data

2. How data will be used to produce maps?

3. What information will be in the map?

4. How the project outcome will be applied in planning purposes?

5. How planning professionals will use the PLIS?

6. Is there any use of climate related data/component in the study?